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Gannett Fleming

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIATION AND REDEVELOPMENT DIVISION
SUPERFUND SECTION
CONSTITUTION HALL
525 WEST ALLEGAN
2ND FLOOR, SOUTH
LANSING, MICHIGAN 48933

QUALITY ASSURANCE PROJECT PLAN FOR THE ADDITIONAL INVESTIGATIONS AND CORRECTIVE ACTIONS SAMPLING OF THE SOUTH BRANCH OF THE SHIAWASSEE RIVER HOWELL, MICHIGAN

PROJECT #40229.000

OCTOBER 2006

Office Location:
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APPENDICES

APPENDIX A

LABORATORY CERTIFICATION

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

September 6, 2005

Mr. Norman C. Hoffa
Eno River Labs, LLC
2445 South Alston Avenue
Durham, NC 27713

Laboratory ID: 9916

Dear Mr. Hoffa:

SUBJECT: Reciprocal Certification

The information supplied to this office by the State of North Carolina and your laboratory has been reviewed. Based on the North Carolina certification of Eno River Labs, LLC the Michigan Department of Environmental Quality will accept the results generated by your facility for compliance monitoring under the Safe Drinking Water Act, 1976 PA 399, as amended. The results that will be accepted are for the following contaminants and certification levels:

Organic Chemistry
Full Certification:

2,3,7,8-TCDD (Dioxin)(via EPA Method 1613)

Our acceptance of results and certification of Eno River Labs, LLC is contingent on your continued certification by the State of North Carolina. Additionally, your certification is contingent on the submission of acceptable performance evaluation sample results from a state-approved supplier on a running 12-month basis throughout the certification period and the results of any on-site inspections conducted by the State of North Carolina or its agents. Our certification of your facility will expire on July 31, 2006.

If you have questions regarding this information, please contact me, at 517-335-8812.

Sincerely,

George L. Krisztian
Laboratory Certification Officer
Systems Management Unit
Laboratory Services Section
Environmental Science and Services Division

gk/rnb

cc: North Carolina Department of Health and Human Service

APPENDIX B

GANNETT FLEMING RESUMES

YEARS EXPERIENCE WITH FIRM: 12

YEARS EXPERIENCE WITH OTHER FIRMS: 10

EDUCATION:

B.S., Biology/Chemistry, Bowling Green State University, 1981
Graduate Studies in Geology, Bowling Green State University, 1981-1983
40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, National Response Team, U.S. EPA, 1982
8-Hour OSHA HAZWOPER Refresher Training, Calcaterra & Associates, 2006

PROFESSIONAL REGISTRATION(S):

P.G.: Indiana - No. 1699 (1991)
Kentucky - No. 1632 (1994)
Certified Professional Geologist: American Institute of Professional Geologists - No. CPG-08674 (1990)
Certified Underground Storage Tank Professional: Michigan - No. 137 (1994)
Certified Professional: Ohio - No. CP129 (2002)
Standard First Aid Certification: American Red Cross (2005)
Adult CPR/AED Certification: American Red Cross (2005)

CURRENT RESPONSIBILITIES:

Vice President and Regional Office Manager/Senior Project Manager responsible for directing operations and business development activities for environmental, geotechnical, and transportation projects throughout Michigan. Experienced in facility compliance, hazardous waste management, and permitting. Responsible for managing on-site activities during Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) and Resource Conservation and Recovery Act (RCRA) remedial actions. Management experience includes hazardous waste site investigation and remediation projects. Retained by industrial clients to provide emergency response support services; health and safety program development; and oversight in connection with derailments, spills, and other incidents. Also monitors compliance with environmental permit requirements. Has provided project management and technical oversight for more than 100 Michigan Act 307/201 sites and authored one of the first delisting packages accepted by the Michigan Department of Natural Resources.

SUMMARY OF EXPERIENCE:

Contract Management, Various Locations, MI, *Michigan Department of Environmental Quality.* Contract Expediter/Project Manager responsible for the management of several multiyear, multimillion dollar contracts to provided professional environmental and engineering services for the characterization, cleanup, and closure of environmentally contaminated sites located through out the state of Michigan, including the performance of feasibility analyses concerning the cleanup of these sites. All professional labor hours were provided by our firm with specialty services, such as environmental drilling, analytical laboratory analyses, and surveying, provided by subcontractors. Project assignments have involved, but are not limited to, initial site assessments, remedial investigations, feasibility studies, remedial designs, remedial action oversight, and litigation support. Project management responsibilities have included the

oversight of investigations and cleanup activities at federally owned military bases in Michigan. In total, over 100 different sites/assignments have been awarded under these contracts. Types of sites have included abandoned industrial facilities, landfills with buried hazardous waste, underground storage tank sites. state-owned maintenance and park facilities, and contaminated residential areas (impacted aquifers).

McCoy Creek Industrial Park Site, Buchanan, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the performance of a remedial investigation and the design/oversight of a free-product abatement system and its operations at an historic industrial park. Because there was interest in revitalizing this area, information collected during the investigation was used to prepare a baseline environmental assessment to support proposed future-use scenarios. In addition to the investigation activities completed, provided support/oversight for cleanup activities. This included remnant carbide lagoon closures and adjacent stream restoration. Plans for the construction of a new industrial park are underway.

Soil and Groundwater Remediation, Niles, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for providing technical oversight services for the design, construction, and operations of an innovative air sparging/soil vapor extraction (SVE) system for the remediation of soil and groundwater contaminated with petroleum hydrocarbons and chlorinated solvents. The design combined sparging and SVE technologies using innovative piping configurations in the remediation well design. The project scope included the preparation of a site-specific sampling plan and system specifications. Performed construction oversight, system start-up, and system monitoring. System operations and maintenance are ongoing, including quarterly performance sampling and monitoring.

Multistate Due Diligence Assessments and Underground Storage Tank (UST) Removals, Various Locations, U.S., *SuperValu, Inc.* Project Manager for projects involving Phase I and II environmental site assessments (ESAs), preliminary asbestos surveys, UST removals and investigations, leaking UST remediation, and site investigations and closures under state voluntary remediation programs for this grocery wholesale, distribution, and retail supermarket chain. Assisted the client with seeking reimbursement under state UST programs and provided professional consulting services on multisite due diligence portfolios. Most Phase I ESAs are completed and final reports are submitted to the client within three weeks of project authorization.

Piquette Avenue Demolition Project, Detroit, MI, *Weston Solutions of Michigan, Inc.* Project Manager for the completion of an environmental assessment, including an asbestos survey for demolition; the preparation of biddable specifications; and contractor oversight/management during the removal of hazardous substances from the site and the demolition of a vacant on-site building as part of the City's redevelopment plan. Previously, the building had been used by a dry cleaner, a finishing company, and a construction company, as well as for lithographing operations. The environmental assessment included the identification, inventory, and evaluation of potentially hazardous substances on the site. This assessment included suspect asbestos-containing materials; polychlorinated biphenyl (PCB)-containing materials, such as transformers and fluorescent light ballasts; aboveground storage tanks; underground storage tanks; recyclable fluorescent and sodium/mercury vapor lamps; recyclable mercury switches and thermostats; chemicals in drums and miscellaneous containers; grit/grease traps; oil/water separator systems, and drainage sumps. Prepared a biddable specifications package for contractor bid solicitation, as well as a final summary report following building demolition and debris disposal.

Federal Facilities Oversight, Various Locations, MI, *Michigan Department of Environmental Quality (MDEQ).* Contract Administrator responsible for providing technical oversight for the MDEQ at U.S. Department of Defense facilities involved in the Base Realignment and Closure (BRAC) program. Reviewed work plans, remedial investigation/feasibility study reports, leaking underground storage tank reports, remedial action plans, and corrective action plans. Assisted with site scoring and public information meetings. Attended technical committee meetings for installation activities.

Battery Recycling Facility, Toledo, OH, *Potentially Responsible Party Committee.* Project Manager for a potentially responsible party-funded removal action at a CERCLA site. Negotiated an administrative order by consent with the U.S. EPA for this former battery recycling facility. Prepared the work plan, a health and safety plan, and a removal action report. Supervised an extent-of-contamination study, waste removal, and building decontamination.

Redevelopment Project, Columbus, OH, *CSX Transportation, Inc.* Project Manager for a Phase I environmental assessment of a 131-acre parcel of undeveloped land adjacent to a major switchyard owned by the railroad in Columbus. This property had been owned and operated from 1947 to 1974 by a steel castings company that had dumped more than 250,000 cubic yards of foundry wastes and buried drums during those years. As a result, the property was contaminated with foundry wastes containing metals and semivolatile organic compounds (SVOCs). The site was subsequently enrolled in the Ohio Environmental Protection Agency's Voluntary Action Program. Drums were removed concurrently with an extensive remedial investigation so that the property could be returned to use or sold for development.

Plating Waste Recycler, Kalamazoo, MI, *Potentially Responsible Party Committee.* Project Manager for a predesign investigation, a remedial design, and a remedial action for Operable Unit I at a Superfund site. Also completed the preparation of the Operable Unit II (groundwater) feasibility study and began the design of monitoring systems.

Coal Transloading Facility, Sandusky, OH, *Norfolk Southern Corporation.* Project Manager for the segregation, characterization, and proper disposal of petroleum-impacted soil/coal at a coal transfer station/railroad yard in Sandusky. During the installation of a dust suppression system, approximately 4,000 tons of contaminated soil/coal were stockpiled pending nonhazardous disposal. Supervised the segregation and sampling of impacted soil/coal and confirmed that nonimpacted earthen materials (coal) were not regulated by the Ohio Environmental Protection Agency. As a result, approximately $75,000 in disposal costs were avoided through appropriate management of the waste.

EXPERIENCE OTHER THAN GANNETT FLEMING:

Chemical Processing Facility, Grand Ledge, MI, *U.S. EPA.* On-Scene Coordinator responsible for the preparation of an engineering evaluation/cost analysis (EE/CA) concerning facility processes and the costs of a full-scale demonstration of an alternative waste treatment technology. Developed comparative cost studies for in situ vitrification. Conducted public meetings and managed public relations activities.

Mercury Remediation, Lincoln Park, MI, *U.S. EPA.* On-Scene Coordinator for a CERCLA action for mercury decontamination and a remedial action at a private residence. Installed a negative-pressure air treatment system and supervised continuous air monitoring for mercury vapor.

Industrial Landfill, Uniontown, OH, *U.S. EPA.* Project Manager responsible for sampling flue gas, interpreting data, and modeling air to determine ambient air quality conditions at a suspected hazardous waste landfill to evaluate risks to nearby residents. Duties also included overseeing the installation of a landfill gas collection system.

Polychlorinated Biphenyl (PCB) Lagoon Closures, Freemont, OH, *U.S. EPA.* On-Scene Coordinator supervising CERCLA activities for the closure of PCB-contaminated lagoons, including dewatering, solidification, and stabilization. Directed cost recovery negotiations with a potentially responsible party group.

PROFESSIONAL AFFILIATIONS:

American Institute of Professional Geologists
Engineering Society of Detroit
National Brownfield Association
Michigan Chamber of Commerce

Eric M. Hammerly — Resume

YEARS EXPERIENCE WITH FIRM: 1

YEARS EXPERIENCE WITH OTHER FIRMS: 4

EDUCATION:

B.A., Geology, Miami University, 2001
Dupont Site Contractor Safety Training 2005
Canadian National Railroad Site Contractor Safety Training, 2005
40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, UND Environmental Training Institute, 2003
8-Hour OSHA HAZWOPER Refresher Training, Earth Tech, 2006

PROFESSIONAL REGISTRATION(S):

Standard First Aid Certification: American Red Cross (2005)
Adult CPR/AED Certification: American Red Cross (2005)
National Groundwater Association
American Institute of Professional Geologists

CURRENT RESPONSIBILITIES:

Staff Geologist responsible for performing a variety of compliance, remediation, and due diligence tasks for private industrial and public sector clients. This work includes groundwater, soil and air sampling, as well as operation and maintenance of on-site remediation systems. This work specifically includes Michigan Act 451 Parts 201 and 213; Resource Conservation and Recovery Act (RCRA); Environmental Response, Compensation, and Liability Act (CERCLA); and Superfund Amendments and Reauthorization Act (SARA) Title III regulations.

SUMMARY OF EXPERIENCE:

Environmental Investigation for a Meat Processor, Confidential Location, Southern MI, *Confidential Client.* Staff Geologist responsible for conducting ground water sampling as part of an on-going groundwater investigation.

Shiawassee River Sediment Survey, South Branch of the Shiawassee River, Howell, MI, *Michigan Department of Environmental Quality.* Staff Geologist responsible for collecting samples for a sediment study along a 40-mile stretch of the Shiawassee River.

EXPERIENCE PRIOR TO GANNETT FLEMING:
Earth Tech Inc., Livonia, MI

Construction Oversight, Toledo North Assembly Plant, Toledo, OH, *Daimler Chrysler.* Geologist responsible for performing periodic oversight of professional service contractors during the removal of approximately 2,000,000 cubic yards of previously tested soil at this 50-acre site. Activities included the oversight of soil removal operations, continuous monitoring of potential visual soil contamination, the removal and separation of construction and natural debris before soil transport, and verification of design specification of the final soil storage location.

Operation, Maintenance and Sampling, Rose Township Superfund Site, MI, Michigan *Department of Environmental Quality.* Geologist responsible for performing various tasks including installation, sampling and redevelopment of monitoring wells; soil logging and field sampling/screening of soils during a Geoprobe exploratory sampling event; operation and maintenance of an on-site 500 gal-per-min air stripper system employed to remove vinyl chloride plume from local groundwater; and sampling of off-site residential drinking wells.

Compliance Sampling, Omimex Energy Inc. Various Locations, MI, *Michigan Department of Environmental Quality.* Geologist responsible for performing periodic groundwater sampling at numerous oil and gas processing facilities, as well as performing monitoring well installation, abandonment and verification sampling.

Site Remediation and Restoration, Gasoline Tanker Spill/Explosion, Kenan Advantage Group Fostoria, OH, *Ohio Environmental Protection Agency.* Geologist responsible for the remediation and restoration of a gasoline contaminated site due to the release of 4,400 gallons of gasoline on to a residential property. Duties included the delineation of the extent of contamination, oversight and verification of soil excavation and removal activities, and oversight of land restoration including backfill, final grading, and tree planting. Also responsible for the installation, development, and periodic sampling of monitoring and extraction wells to remove free product from groundwater, vertical aquifer sampling during well installation, and weekly vacuum extraction events on previously installed extraction wells.

Operation and Maintenance and Construction Oversight, Former North Cove Landfill and Toledo Jeep, Toledo, OH, Daimler Chrysler. Geologist responsible for performing periodic oversight of a professional service contractor during soil removal operations, the installation and repair of site fences, and restoration activities including drainage grading, grass seeding and tree planting. Duties also included operation and maintenance and verification sampling of and on-site pump and treat system and groundwater sampling of sentinel monitoring wells.

Remedial Oversight, Alpena Combat Readiness Training Center, Alpena, MI, *Michigan Air National Guard.* Geologist responsible for performing monitoring well installation, soil logging, well development, and groundwater sampling.

Underground Storage Tank (UST) Investigation and Remediation, Butte, MT, Geologist responsible for conducting a field investigation in the vicinity of three former USTs within a parking structure. The investigation consisted of collecting soil samples through the use of a Geoprobe® equipped with Laser-Induced Fluorescence to delineate the vertical and horizontal impacts to soils and the assessment of the corresponding analytical data. Responsibilities also included the operational maintenance on a previously installed air-sparging remediation system.

Remediation System Operation, Maintenance, and Environmental Testing, Former UST Sites, Hazen, Minot, and Bismarck, ND, *North Dakota Department of Health.* Geologist responsible for performing operational maintenance on multiple groundwater pump-and-treat systems, including extensive sampling of groundwater, system effluent, influent and treated-air. Also responsible for the installation of new remediation systems and troubleshooting activities involved with maintaining the new systems.

Energy and Environmental Research Investigations, EERC, Grand Forks, ND, *Various Private and Federal Clients* Geologist involved in the historical research, industry coordination, proposal writing and data complication for several large-scale projects including coal-bed methane feasibility and environmental impact studies, carbon dioxide flood enhanced oil recovery operations.

Martha L. Hannah, E.I.T. Resume

YEARS EXPERIENCE WITH FIRM: 1

YEARS EXPERIENCE WITH OTHER FIRMS: 1

EDUCATION:

B.S., Civil/Environmental Engineering, University of Michigan, 2003
40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, Michigan Hazardous Materials Training Center, 2005
8-Hour OSHA HAZWOPER Refresher Training, Calcaterra & Associates, 2006

PROFESSIONAL REGISTRATION(S):

E.I.T.: Michigan (2003)
Standard First Aid Certification: American Red Cross (2005)
Adult CPR/AED Certification: American Red Cross (2006)

CURRENT RESPONSIBILITIES:

Environmental Professional responsible for performing a variety of compliance, remediation, and due diligence tasks for industrial and municipal customers. These tasks include performing various field activities, which range from site investigations through site remediation, to make certain of compliance with current federal and state regulations.

SUMMARY OF EXPERIENCE:

EXPERIENCE PRIOR TO GANNETT FLEMING:

Limno-Tech, Ann Arbor, MI

Willamette River Watershed Management Assessment, Portland, OR, *Portland Bureau of Environmental Services.* Environmental Intern responsible for reviewing documents, analyzing data, and presenting findings and recommendations to the client in the form of a report. The project involved reviewing available publications concerning the watershed, summarizing the pertinent information found, and making recommendations for the future management of the watershed. The project also featured reviewing the client's application of best management practices, studying combined sewer overflows emptying into the watershed, and verifying compliance with applicable regulations.

Brian R. Kardos, P.E. Resume

YEARS EXPERIENCE WITH FIRM: 3

YEARS EXPERIENCE WITH OTHER FIRMS: 3

EDUCATION:

B.S., Civil Engineering, University of Cincinnati, 1999
Lead Inspector/Risk Assessor Training, University of Cincinnati, 2000
40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, 2003
8-Hour OSHA HAZWOPER Refresher Training, Calcaterra & Associates, 2006

PROFESSIONAL REGISTRATION(S):

P.E.: Michigan - No. 6201053112 (2006)
Asbestos Hazard Evaluation Specialist: Ohio - No. ES33795 (2000)
Asbestos Inspector: Michigan - No. A30819 (2003)
Asbestos Management Planner: Michigan - No. A30819 (2003)
Standard First Aid Certification: American Red Cross (2005)
Adult CPR/AED Certification: American Red Cross (2005)

CURRENT RESPONSIBILITIES:

Environmental Professional responsible for performing a variety of compliance, remediation, and due diligence tasks for industrial and municipal customers. Experienced in evaluating site conditions through site investigations and emergency response actions and confirming compliance with federal and state regulations. This work specifically includes Michigan Act 451 Parts 201 and 213; Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and Superfund Amendments and Reauthorization Act (SARA) Title III regulations.

SUMMARY OF EXPERIENCE:

Remedial Investigation and Acute Risk Abatement, Alamo, MI, *Michigan Department of Environmental Quality.* Environmental Professional for a state-funded assessment and remediation effort involving both petroleum and halocarbon contaminants in soil and groundwater. The ongoing assessment efforts include documenting the extent and potential sources of the halocarbon contamination and removing free-phase gasoline from the site of a former rural general store.

Rural Brownfield Site Assessments, Berrien County, MI, *Michigan Department of Environmental Quality.* Environmental Professional for two projects funded through U.S. EPA grants designated to finance environmental assessments at rural properties with underground storage tank-related environmental concerns. Our firm is conducting Phase I and Phase II environmental site assessments at each site to evaluate risks associated with past uses of these tax-reverted properties, with the goal of facilitating their reuse.

Environmental Investigation for a Meat Processor, Confidential Location, Southern MI, *Confidential Client.* Environmental Professional for an environmental investigation associated with a $35 million facility expansion. The client discovered free product (diesel fuel) on groundwater during excavation activities for the planned expansion. Construction tasks included significant dewatering activities for the purpose of installing wet wells and utilities. Our firm determined the source of the free

product by completing test pit activities and subsequently installed soil test borings and groundwater monitoring wells to partially define the horizontal and vertical extent of the impact. Our firm also installed and operated a water treatment system designed to meet the terms of a National Pollutant Discharge Elimination System permit obtained for the dewatering efforts. Ongoing efforts include completing the soil and groundwater investigation to define the complete extent of impacts and preparing due care and/or closure documentation now that construction activities are complete.

Former Patterson's Service Station, Bay City, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Environmental Professional responsible for overseeing remedial investigation activities at a former gasoline station. Project activities included overseeing the excavation, removal, and disposal of grossly contaminated soil; supervising site restoration; and monitoring adherence to construction specifications.

Bridge Survey, Mahoning County, OH, *Ohio Department of Transportation/Palmer Engineering.* Field Technician responsible for collecting concrete samples from four bridges over I-11 to test for the presence of asbestos. Activities also included performing on-site evaluations of bridge materials, interpreting the results of laboratory tests, and preparing a report.

Rural Brownfield Site Assessments, Arenac, Tuscola, and Saginaw Counties, MI, *Michigan Department of Environmental Quality.* Environmental Professional for five projects funded through U.S. EPA grants designated to finance environmental assessments at rural properties with underground storage tank-related environmental concerns. Activities for each site include conducting Phase I and Phase II environmental site assessments, drafting construction specifications and field sampling plans, and providing project coordination and scheduling services for on-site activities and personnel.

River Street Brownfield Project, Buchanan, MI, *Michigan Department of Environmental Quality (MDEQ).* Environmental Professional responsible for providing construction oversight services for remedial activities conducted by the responsible party's contractors. Activities include monitoring adherence to construction specifications and MDEQ directives.

Remedial Oversight, Carl's Retreading, Grawn, MI, *Michigan Department of Environmental Quality.* Environmental Professional responsible for performing periodic oversight of a professional service contractor during the removal of approximately 150,000 cubic yards of soil impacted with pyrolitic oil at this 4.4-acre site. Remedial activities were required as the result of an uncontrolled fire at the facility. Duties included overseeing test pitting and soil removal operations, continuous air monitoring, and verification sampling.

Corrective Action Plan (CAP), Fort Wayne, IN, *Armour Swift-Eckrich.* Environmental Professional responsible for compiling a CAP for the implementation of a remediation system to remove soil and groundwater contaminants.

Phase I Environmental Site Assessments (ESAs), Various Locations, U.S., *SuperValu, Inc.* Environmental Professional responsible for the completion of Phase I ESAs at various commercial, residential, and industrial sites throughout the United States to support property transactions. Current responsibilities include coordinating Phase I ESA activities, completing site reconnaissance activities, producing a final report for each site for the client, and making recommendations to the client for evaluating possible soil and groundwater impacts.

Railroad Yard, Saginaw, MI, *CSX Transportation, Inc.* Environmental Professional responsible for various investigations at the site ranging from subsurface soil investigations to site reconnaissance. Also responsible for reporting requirements to the Michigan Department of Environmental Quality for completed assessment activities.

McLeicer Oil Site Closure, Kalamazoo, MI, *Michigan Department of Environmental Quality.* Field Technician responsible for coordinating with the professional services consultant concerning building demolition activities and underground and aboveground storage tank removal activities.

Shiawassee River Sediment Survey, South Branch of the Shiawassee River, Howell, MI, *Michigan Department of Environmental Quality.* Environmental Professional responsible for collecting samples for a sediment study along a 40-mile stretch of the Shiawassee River.

Underground Storage Tank (UST) Investigation - Motor Pool, Lansing, MI, *Michigan Department of Management and Budget.* Environmental Professional responsible for conducting a field investigation in the vicinity of three former USTs within a parking structure. The investigation consisted of coordinating the efforts of several contractors to obtain soil samples through the use of a Geoprobe® to delineate the vertical and horizontal impacts to soils and assessing the corresponding analytical data to complete the design of a remediation system for the eventual closure of the site.

Remediation System Maintenance and Pilot Test, Wyoming, MI, *CSX Transportation (CSXT), Inc.* Environmental Professional responsible for performing operational maintenance on a two-acre groundwater pump-and-treat system for the CXST railroad yard in Wyoming, Michigan. Also responsible for the design and installation of a new remediation system and troubleshooting activities involved with maintaining the new system.

EXPERIENCE PRIOR TO GANNETT FLEMING:

Law Engineering/MACTEC, Newport, KY

Asbestos Survey/Phase I Environmental Site Assessment (ESA), Virginia Beach, VA, *Circuit City.* Environmental Professional responsible for conducting an asbestos survey and a Phase I ESA on an large asphalt plant and the surrounding buildings.

Lead Inspections, Cincinnati, OH, *Cincinnati Public Schools.* Environmental Professional responsible for conducting lead-based paint inspections on five Cincinnati public schools for proposed window replacement activities.

Asbestos Inspection, Lebanon, OH, *Walgreen's.* Environmental Professional responsible for conducting an asbestos survey on a restaurant as part of a possible property transaction.

Asbestos Clearance Monitoring, New York, NY, *Bank of New York.* Environmental Professional participating in asbestos clearance monitoring and the inspection of buildings around the World Trade Center disaster site.

Lead Inspections/Risk Assessments, Various Locations, OH and NY, *U.S. Department of Housing and Urban Development (HUD).* Environmental Professional participating in a large lead-based paint inspection/risk assessment project encompassing HUD housing across the United States.

Lead Inspections, Various Locations, U.S., *AIMCO.* Environmental Professional participating in a large lead-based paint inspection project encompassing more than 700 apartment complexes throughout

the United States. Inspected sites in the states of Ohio (12 sites, 400 units tested), Kentucky (7 sites, 215 units tested), Virginia (2 sites, 70 units tested), Indiana (13 sites, 467 units tested), and Massachusetts (2 sites, 54 units tested).

Lead Inspection/Risk Assessment, Elyria, OH, *AMI.* Environmental Professional responsible for conducting a lead inspection/risk assessment on a 121-unit apartment complex. Twenty-six units were required to be tested.

Assisted-Care Facilities, Caledonia, OH, *JPI.* Environmental Professional responsible for conducting Phase I environmental site assessments on two assisted-care facilities that were being considered for possible acquisition.

Property Acquisition, Hebron, KY, *Kenton County Airport Board.* Environmental Professional responsible for conducting Phase I environmental site assessments on two properties being acquired by the Airport Board.

Printing Facilities, Washington and Cedar Rapids, IA, *Norwood Promotional.* Environmental Professional responsible for conducting an environmental compliance audit and developing an operating plan encompassing air, water, waste, and SARA Title III requirements.

Multi-Residential Property Transaction, Cincinnati, OH, *JPI.* Environmental Professional responsible for conducting a Phase I environmental site assessment and a lead-in-water study on a multi-residential facility for a proposed property transaction.

Remedial Action Plan, Marysville, OH, *Allied Systems, Ltd.* Environmental Professional responsible for assisting in the development of a remedial action plan for a trucking facility and overseeing the installation of the equipment and procedures designed in the plan.

Mobile Home Site, West Lafayette, IN, *JPI.* Environmental Professional responsible for conducting a Phase II environmental site assessment of a mobile home site for a proposed property transaction.

Property Acquisition, Cincinnati, OH, *Ferguson, Inc.* Environmental Professional responsible for conducting a Phase I environmental site assessment of a site for its possible acquisition and development by a nationwide plumbing supplier.

Proposed Commercial Lumber Facility, Dayton, OH, *Erb Lumber.* Environmental Professional responsible for conducting a Phase II environmental site assessment on a former concrete-producing facility for a proposed property transaction by a commercial lumber company. This involved doing the initial field work, as well as reoccurring water sampling activities, to assess the extent of contamination to the surrounding soils and groundwater.

Multi-Residential Housing, Columbus, OH, *JPI.* Environmental Professional responsible for conducting a Phase II environmental site assessment, a waste characterization profile, and an asbestos survey for a facility that was being acquired for multi-residential housing.

Former Fire Department, Alexandria, KY, *Archdiocese of Covington.* Environmental Professional responsible for conducting a Phase I environmental site assessment, a lead-based paint screening, a radon survey, and an asbestos survey for a facility that was being acquired by a neighboring high school.

Automobile Repair Facility, Northwood, OH, *Capstone Environmental.* Environmental Professional responsible for preparing a report on previous field activities involving a Phase II environmental site assessment, a geophysical survey, and hydraulic lift removal work.

Underground Storage Tank (UST) Removal, Mason, OH, *Goodyear.* Environmental Professional responsible for assisting in closure activities involving two large USTs, including overseeing and performing closure sampling.

Paul Brown Stadium, Cincinnati, OH, *Metromont Prestressed Concrete.* Technician responsible for testing precast concrete beams within the stadium to make certain they performed correctly under their proposed loading.

PROFESSIONAL AFFILIATIONS:

Engineering Society of Detroit

Mohamed Zakkar, P.E., C.P. Resume

YEARS EXPERIENCE WITH FIRM: 4

YEARS EXPERIENCE WITH OTHER FIRMS: 14

EDUCATION:

B.S., Civil Engineering, University of Damascus (Syria), 1984
M.S., Civil/Structural Engineering, University of Detroit, 1992
M.S., Civil/Environmental Engineering, Wayne State University, 1993
40-Hour OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training, 1994
8-Hour OSHA HAZWOPER Refresher Training, Calcaterra & Associates, 2006

PROFESSIONAL REGISTRATION(S):

P.E.: Michigan - No. 6201039731 (1994)
Certified Underground Storage Tank Professional (C.P.): Michigan - No. 787 (1998)
Standard First Aid Certification: American Red Cross (2005)
Adult CPR/AED Certification: American Red Cross (2005)

CURRENT RESPONSIBILITIES:

Senior Project Manager for projects involving contamination assessments; remedial investigations; the design, installation, and operation of soil and groundwater remediation systems; feasibility studies; underground storage tank (UST) removals; site closures; the preparation of specifications and work plans; and building demolition. Experienced in performing environmental site assessments (ESAs) and property condition assessments (PCAs) for real estate transactions.

SUMMARY OF EXPERIENCE:

Michigan Rural Brownfield Assessment Project, Saginaw, Tuscola, and Arenac Counties, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manger responsible for the completion of Phase I and Phase II ESAs at five sites located in three counties. Project activities have included preparing bid specifications and overseeing the demolition of buildings; the removal and disposal of underground/aboveground storage tanks and hazardous and nonhazardous and wastes; the excavation, removal, and disposal of contaminated soil; and the backfilling and restoration of sites.

Former Patterson's Service, Bay City, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation activities at a former gasoline station. Project activities included the preparation of bid specifications; the excavation, removal, and disposal of grossly contaminated soil; and site restoration.

Shiawassee River, Howell, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division, Superfund Section.* Project Manager responsible for the management and coordination of sampling activities for river sediment and floodplains potentially impacted with discharged polychlorinated biphenyls (PCBs). Forty miles of the river were evaluated during the investigation activities.

Carl's Retreading, Grawn, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the management and coordination of an emergency response action to mitigate the risks associated with the release of pyrolitic oil from a tire fire at the site. Project tasks consisted of the removal and disposal of intact tires, burnt tires, ash, debris, and contaminated soil; a site investigation to determine the impact of the pyrolitic oil on the groundwater; the preparation of bid specifications for the removal activities; and the management of removal activities and the project closeout.

McLeieer Oil, Battle Creek, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the management and coordination of project tasks, including a predemolition site assessment, the preparation of bid specifications, the removal of underground and aboveground storage tanks, the demolition of buildings, the excavation of contaminated soil, and remedial investigation work.

Zeilinger Site, Ithaca, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the management and coordination of project activities, including a predemolition site assessment, the preparation of bid specifications, the removal of underground and aboveground storage tanks, the removal and disposal of hazardous soil and foundry sand, the demolition of buildings, and site closure.

Belgravia Site, South Haven, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the management and coordination of remediation activities at a former plating facility, which had discharged chlorinated wastes into the ground. Tasks have involved air monitoring and sampling at the residential properties adjacent to the site. Project activities also included reviewing and evaluating designs for a vapor barrier and a soil vapor extraction system to protect residential condominiums at the site; installing and operating an interim free-product recovery system; and designing, installing, and operating an interceptor trench to prevent the migration of contaminated shallow groundwater to adjacent properties.

Marcy's Cleaners Site, Howell, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for the management and coordination of a project involving a release of chlorinated solvents from a dry cleaning facility. Project activities included investigating potential contaminant source areas, assessing the vertical and horizontal extent of both on- and off-site contaminants, and performing an interim response to stop contaminated groundwater from entering sewer lines and prevent any applicable indoor risks to area homes and businesses.

Ralph's Marathon, Evart, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation and acute risk abatement activities at a former gasoline station.

Asa Smith Property, Highland, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation and acute risk abatement activities at a former gasoline station.

Camp Pellston, Pellston, MI, *Michigan Department of Management and Budget.* Project Manager responsible for coordinating remedial investigation activities; preparing specifications for the removal of contaminated soil; and overseeing the removal of the contaminated soil removal, site closure, and monitoring well abandonment.

Lynn's Auto, Sault Ste. Marie, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation, acute risk abatement, and UST removal activities at a former gasoline station.

Vienna Road Alleyway, Clio, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation and free-product abatement activities at this site and implementing corrective actions to mitigate acute risks.

Wellston Hardware, Wellston, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation and acute risk abatement activities at an active gasoline station.

Barbier Oil Bulk Petroleum Plant, East Tawas, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Project Manager responsible for coordinating remedial investigation activities and the abatement of free product at a former bulk petroleum plant. Project activities include preparing specifications for building demolition and managing building demolition activities and the excavation and removal of grossly contaminated soil.

South Macomb Disposal Authority, Macomb Township, Macomb County, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division, Superfund Section.* Project Manager responsible for coordinating the oversight of the construction of a leachate collection and treatment system and monitoring the groundwater impacted by the landfill.

Jackson Drop Forge Site, Jackson, MI, *Weston Solutions of Michigan, Inc.* Project Manager responsible for managing and coordinating the demolition of a former metal forging facility, which consisted of 21 industrial buildings situated on 5.5 acres. Project activities included the performance of an environmental assessment, the preparation of bid specifications, the demolition of the buildings, site restoration, drinking water well abandonment, and remedial investigations.

EXPERIENCE PRIOR TO GANNETT FLEMING:

DLZ Michigan, Inc., Lansing, MI

Detroit Multisite Building Demolition Project, Detroit, MI, *Michigan Department of Environmental Quality (MDEQ), Remediation and Redevelopment Division.* Site Manager responsible for assisting with project coordination and management activities for the demolition of 43 properties. These activities included the preparation of requests for proposals; participation in prebid meetings; the review of site assessment reports; demolition oversight work; and the coordination of efforts with professional service contractors, the City of Detroit, and MDEQ.

Former Statler Hilton Hotel, Detroit, MI, *Michigan Department of Environmental Quality (MDEQ), Remediation and Redevelopment Division.* Site Engineer responsible for assisting with project coordination and management activities. These activities included the preparation of a request for proposal; participation in prebid meetings; and the coordination of efforts with professional service contractors, the City of Detroit, and MDEQ for the performance of a limited remedial investigation, a risk assessment, and risk abatement at a 15-story abandoned building.

Sears Redevelopment Site, Demolition of Existing Structures and Parking Lot, Highland Park, MI, *Tetra Tech NUS, Inc.* Site Engineer responsible for conducting and coordinating a limited site assessment of the property and participating in the development of bid specifications to demolish a parking lot and four buildings at the site.

Mike's BP Service Station, Ecorse, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Site Manager responsible for coordinating project activities with the professional service contractor, including a site investigation, free-product abatement, the design of soil and groundwater remediation systems, and the implementation of site remediation.

River Rouge Animal Shelter, River Rouge, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Site Manager responsible for coordinating project activities with the professional service contractor, including a site investigation and the removal and disposal of USTs at the site.

Spartan Chemical Company Superfund Project, Wyoming, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Site Engineer responsible for assisting with the design, developing specifications, and preparing shop drawings for a soil vapor extraction system to remediate volatile organic and chlorinated compounds in soil.

Fenske Landfill, Grand Rapids, MI, *Michigan Department of Environmental Quality, Waste Management Division.* Site Engineer responsible for characterizing leachate for its off-site disposal.

Lawton Street Project, Detroit, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Site Engineer responsible for preparing a feasibility study for the remediation of contaminated soil at the site.

General Oil, Northville, MI, *Michigan Department of Environmental Quality, Remediation and Redevelopment Division.* Site Engineer responsible for preparing a feasibility study concerning the abatement of two free-product plumes at the site and participating in the performance of a free-product recovery pilot test. The feasibility study addressed the use of various innovative remediation technologies.

Professional Service Industries, Inc., Detroit, MI

Site Remediation and Closure, Livonia, MI, *Stevens Design.* Project Manager responsible for managing the operations and maintenance of a soil vapor extraction system in combination with an air sparging system to remove hydrocarbon contaminants from impacted groundwater, overseeing remedial system performance by field monitoring and groundwater sampling, and preparing a site closure report after reaching cleanup criteria.

Site Investigation, Detroit, MI, *Wayne State University.* Project Manager responsible for supervising the field testing of suspected contaminated soils encountered during renovation and construction activities at the Old Main building. Field testing consisted of the chemical analysis of suspected soil samples using an immunoassay technique to detect the presence of hydrocarbon contaminants.

Contamination Assessment, Auburn Hills, MI, *Wal-Mart.* Project Manager responsible for performing a contamination assessment, including soil sampling and the analysis of suspected contaminated soils encountered during construction activities to detect the presence of polychlorinated biphenyls (PCBs), metals, and hydrocarbon contaminants.

Operations and Maintenance of Remediation Systems, Jackson, MI, *Foote Hospital.* Project Manager responsible for supervising the operations and maintenance of a soil vapor extraction system in combination with an air sparging system to remove hydrocarbon contaminants from soil and groundwater.

Soil Washing System, Jackson, MI, *Bio Center Company.* Project Manager responsible for supervising the construction of a soil washing system to remove lead contamination from soil and installing the required system equipment.

UST Removals, Farmington, MI, *Michigan National Bank.* Project Manager responsible for supervising the removal of USTs and preparing closure reports.

ESA and PCA Reports, Troy, MI, *Paine Webber.* Project Manager responsible for preparing Phase I ESA and PCA reports on three multistory office buildings.

ESA and PCA Reports, Various Locations, MI, *Associated Estates Realty Corporation.* Project Manager responsible for preparing PCA reports and Phase I ESA reports on various apartment complexes in Holland, Farmington Hills, and Grand Rapids.

Industrial Park, Detroit, MI, *MIG Financial Company.* Project Manager responsible for preparing a PCA report on a 70.9-acre industrial park containing three million square feet of buildings.

PCA and ESA Reports, Various Locations, MI, *Bernard Financial Group.* Project Manager responsible for preparing PCA reports and Phase I ESA reports on various types of industrial, commercial, and residential properties located throughout Michigan.

PCA Report, Santa Rosa, CA, *Boston Capital Mortgage Company.* Project Manager responsible for preparing a PCA report on a 70-year-old historical building in Santa Rosa.

PCA Report, Chicago, IL, *L. J. Melody & Company.* Project Manager responsible for preparing a PCA report on a 28-story, Class A office building in downtown Chicago.

PCA Reports, Various Locations, MI, *McNeal Real Estate Management, Inc.* Project Manager responsible for preparing PCA reports on apartment complexes in Belleville and Bay City.

PCA Report, Chicago, IL, *Amtrak.* Project Manager responsible for performing a PCA on an eight-story office building at Union Station, which was constructed in 1913.

Facility Audits, Detroit, MI, *Archdiocese of Detroit.* Project Manager responsible for performing facility audits and building and environmental assessments in 15 parishes for churches, schools, convents, and other facilities constructed in the middle of the nineteenth century and the beginning of the twentieth century.

Advanced Engineering & Development, Inc., Northville, MI

Project Engineer responsible for designing overhead cranes and performing related tasks.

Yalbugha Center, Damascus, Syria

Project Manager responsible for civil engineering and construction work.

PROFESSIONAL AFFILIATIONS:

American Society of Civil Engineers

FOREIGN LANGUAGE PROFICIENCY:

Arabic (verbal and written)
French (verbal and written)

APPENDIX C

MDEQ-RRD OPERATIONAL MEMORANDUM NO. 1 AND NO. 2

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

JENNIFER M. GRANHOLM
GOVERNOR

STEVEN E. CHESTER
DIRECTOR

December 10, 2004

TO: Interested Parties

FROM: Andrew W. Hogarth, Remediation and Redevelopment Division

SUBJECT: RRD Operational Memorandum No. 1
Part 201 Cleanup Criteria
Part 213 Risk-based Screening Levels

The Remediation and Redevelopment Division (RRD) of the Michigan Department of Environmental Quality (MDEQ) is issuing the attached RRD Operational Memorandum No. 1. This Operational Memorandum provides general information about the criteria tables and the criteria for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) and Part 213, Leaking Underground Storage Tanks, of the NREPA. The MDEQ has developed interim cleanup criteria developed for acetate, dicamba, methane, metribuzin, and sodium azide, and is allowing a 45 day public comment period on these criteria. The following information is intended to assist in understanding the process followed for criteria changes within this Operational Memorandum. The criteria tables of this Operational Memorandum (Attachment 1) have been revised in accordance with rule provisions that allow criteria to be added and revised in the following categories:

Changes in the Target Detection Limits

Criteria with the footnote (M) promulgated with the Part 201 Administrative Rules represent situations where the calculated risk-based criterion was below the designated analytical target detection limit. In accordance with provisions of R 299.5103(l) "target detection limits" (TDL) is defined as the detection limit for a hazardous substance in a given environmental medium that is specified by the MDEQ on a list that it publishes not more than once a year. The TDL for a given hazardous substance is greater than or equal to the method detection limit for that hazardous substance. In establishing a TDL, the department must consider:

- The low level capabilities of methods published by governmental agencies
- Reported method detection limits published by state laboratories.
- Reported method detection limits published by commercial laboratories
- The need to be able to measure a hazardous substance at concentrations at or below cleanup criteria.

The TDLs previously designated by the MDEQ in Operational Memoranda were reviewed considering these factors, and proposed revisions were provided to the Michigan Environmental Laboratory Association for comment. Revised TDLs were included in the TDLs published with RRD Operational Memorandum No. 2. The effective date of the revised TDLs has been extended to February 1, 2005, to allow adequate implementation time for laboratories and monitoring plans. The criteria tables reflect the revised TDLs as indicated in Attachment 2 of this Operational Memorandum. Criteria revisions based on revised TDLs will also become effective February 1, 2005.

Changes in Drinking Water Criteria

If a new state drinking water standard is established or a state drinking water standard is changed the drinking water standard developed under the Michigan Safe Drinking Water Act, Section 5 of 1976 PA 399, becomes the generic residential cleanup criterion (R 299.5706a(12), R 299.5744, Section 20120a(5) and 21304a(4) of the NREPA). The criteria tables reflect changes in the state drinking water standards as indicated in Attachment 2 of this Operational Memorandum. These criteria are effective immediately.

Changes in Criteria Previously Designated as "ID" or "NA"

Criteria promulgated with the Part 201 Administrative Rules that were designated with a footnote "ID" or "NA", represent situations where insufficient data was available to calculate risk-based criterion. In accordance with provisions of R 299.5706a(11) if the MDEQ obtains sufficient information to support the calculation of a cleanup criterion the MDEQ must use best available information to calculate a criterion for the hazardous substance. The MDEQ has calculated water quality standards pursuant to R 323.1057 of Part 31 of the NREPA for hazardous substances previously designated as "ID" or "NA". These water quality standards become groundwater surface water interface (GSI) criteria pursuant to R 299.5716(6), and Section 20120(15) of the NREPA. The new GSI criteria are effective immediately. The soil criteria tables also include an interim Soil Volatilization to Indoor Air criterion for methane. This criterion was developed specifically to address acute physical hazards, specifically explosivity (R 299.5728(1)(d)). The MDEQ is allowing a 45 day public comment period on this methane criterion. A final criterion will be published following the comment period.

Hazardous Substances Not Previously Listed in the Criteria Tables

For a substance not previously listed in the cleanup criteria tables the MDEQ may determine that it is a hazardous substance and develop generic criteria using best available information about the toxicological and physical chemical properties of the substance (R 299.5706a(10)). There are four new hazardous substances for which interim criteria have been developed. They are: acetate; dicamba; metribuzin; and sodium azide. The MDEQ is allowing a 45 day public comment period on these criterion. Final criteria will be published following the comment period. A brief summary of the toxicological bases for the interim criteria follows.

Acetate: The drinking water criteria were derived using a chronic reference dose (RfD) of 5.7E-1 mg/kg-day (MDEQ/ERD, 1992). A no-observed-adverse-effect-level (NOAEL) of 1.0 g/kg/day was identified for calcium magnesium acetate in male and female rats dosed by gavage (Chevron Environmental Health Center, 1987). The GSI criterion is based on the water quality standard calculated pursuant to R 323.1057 as provided by R 299.5716(6).

Key reference: Chevron Environmental Health Center. 1987. Twenty-eight day oral toxicity study in rats with Ortho Ice-B-Gon Deicer. J.R. Cushman, Study Director. Richmond, CA.

Dicamba: A chronic RfD of 3.0E-2 mg/kg/day was obtained from the U.S. EPA Integrated Risk Information System (IRIS) file dated July, 1992. This reference dose serves as the basis for the criteria. See IRIS for details.

Metribuzin: The criteria are based on a chronic RfD of 2.5E-2 mg/kg/day from IRIS (January 1995). See IRIS for details.

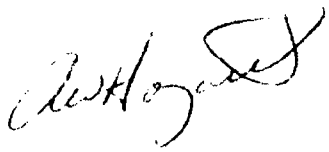
Sodium azide: An RfD of 1.2E-2 mg/kg/day was derived July 2003 by RRD toxicologists. The key study is a two-year gavage study in rats. Low dose animals exhibited decreased body

weights and necrosis of the cerebrum. The RfD is based on lowest observed adverse effect level (LOAEL).

Key reference: National Toxicology Program. 1991. Toxicology and Carcinogenesis Studies of Sodium Azide. September 1991. NTP TR 389. U.S. Department of Health and Human Services.

Comments on the interim criteria for methane, acetate, dicamba, metribuzin, and sodium azide should be postmarked no later than January 24, 2005, and should be sent to the attention of Ms. Christine Flaga, Chief, Toxicology Unit, Remediation and Redevelopment Division, Michigan Department of Environmental Quality, P.O. Box 30426, Lansing, Michigan, 48909 (Mail Code: 76115).

Attachments



Remediation and Redevelopment Division

Michigan Department of Environmental Quality

December 10, 2004

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: PART 201 CLEANUP CRITERIA
PART 213 RISK-BASED SCREENING LEVELS

Key definitions for terms used in this document:

NREPA:	**The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended**
Part 201:	**Part 201, Environmental Remediation, of NREPA**
Part 213:	**Part 213, Leaking Underground Storage Tanks, of NREPA**
MDEQ:	**Michigan Department of Environmental Quality**
RRD:	**Remediation and Redevelopment Division**
U.S. EPA:	**United States Environmental Protection Agency**
CAP/RAP:	**"Corrective action plan" pursuant to provisions of Part 213 of NREPA and "remedial action plan" pursuant to provisions of Part 201 of NREPA**
Criteria or criterion:	**Includes the cleanup criteria for Part 201 of NREPA and the Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)**
Facility:	**Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA**
Response actions:	**Includes "response activities" as defined by Part 201 of NREPA and "corrective action" as defined by Part 213 of NREPA**
TSD:	**Technical Support Document**

This operational memorandum has been prepared to facilitate implementation of Part 201 and Part 213 of NREPA. The RRD Operational Memorandum No. 1 supersedes all previous MDEQ operational memoranda pertaining to Part 201 and Part 213 criteria. The attached tables (Attachment 1) identify the generic cleanup criteria for groundwater and soil developed pursuant to Sections 20120a and 21304a of NREPA, according to relevant statutory provisions and the methods and equations presented in the respective attached TSDs. The criteria in Attachment 1 reflect some new and revised criteria developed in accordance with R 299.5706a and are based on new and revised target detection limits which were developed in accordance with R 299.5103(l). The revisions to criteria which are associated with revised target detection limits (TDLs) are effective February 1, 2005. Other new and revised criteria developed in accordance with R 299.5706a are, by operation of rule and law, effective immediately.

This operational memorandum provides general information about the criteria tables and the criteria. It also provides direction for the implementation of the criteria for site investigation and response actions under Part 201 and Part 213 of NREPA. Details about methodology and implementation of the criteria are provided in the respective TSDs. The TSDs are also

applicable to Part 213. This operational memorandum must be used in coordination with other MDEQ operational memoranda regarding implementation of Part 201 and Part 213.

The Part 201 Administrative Rules took effect on December 21, 2002, and include the criteria. Existing cleanup criteria cannot be modified unless the rules are repromulgated. However, for substances currently not listed in the cleanup criteria tables, the MDEQ can determine if the substance is hazardous using the best available information and use that information to develop cleanup criteria (R 299.5706a(10)). For substances currently listed in the cleanup criteria tables and designated "ID" or "NA" for certain pathways, the MDEQ can use the best available information to generate cleanup criteria for those pathways (R 299.5706a(11)). If a new state drinking water standard is established or an existing state standard is changed, the drinking water standard will become the generic drinking water criterion (R 299.5706a(12)). These new criteria will take effect when published and announced by the MDEQ (R 299.5706a(13)). Any questions regarding substances for which criteria are not included in the criteria tables can be directed to the MDEQ-RRD Toxicology Unit.

GENERAL INFORMATION ABOUT THE CRITERIA TABLES

Hazardous substances in the attached criteria tables are listed alphabetically. The criteria are presented in three tables entitled: Table 1. Groundwater: Residential and Industrial-Commercial; Table 2. Soil: Residential and Commercial I; and Table 3. Soil: Industrial and Commercial II, III, and IV. A footnote is designated by a letter in parentheses and is explained in the footnotes section that follows the criteria tables. Chemical Abstract Service numbers are provided to assist with identification of the correct hazardous substance. Table 4 of Attachment 1 presents the toxicological and chemical-physical data used to generate the criteria.

Each column of criteria has a numbered heading that is associated with two guide sheets; one for statistics and one for cleanup criteria. These guide sheets are part of the Part 201 criteria and statistics training material prepared for staff. The criteria guide sheets contain implementation information for the various criteria, and the statistical guide sheets provide direction on the use of statistics. The criteria guide sheets are contained in the Training Material for Part 201 Cleanup Criteria and the statistical guide sheets are contained in the MDEQ Sampling Strategies and Statistics Training Materials. These are both located on the MDEQ web site (http://www.michigan.gov/deq select "Land," "Land Cleanup," "Site Investigation and Cleanup"). The criteria tables within the criteria training material provide the hazardous substances listed according to analytical group.

The attached criteria tables present some of the criteria within a bolded box; these boxed values represent the lowest generic residential soil or groundwater criterion for a given hazardous substance. Values in bold boxes are presented for those hazardous substances having either a full set of criteria or a partial set where professional judgment can be made that the lowest presented criterion is protective of pathways lacking criteria. Therefore, groundwater or soil concentrations equal to or less than the value in the bolded box comply with generic criteria for all pathways although some of these pathways may not be relevant. For example, the drinking water criteria are not applicable at locations where it is documented that groundwater is not in an aquifer and not in contact with an aquifer. However, if the drinking water criterion is in a bolded box and groundwater concentrations do not exceed this value, it may be concluded that groundwater complies with the criteria for all other groundwater pathways. The values in bolded boxes are most useful for determining whether a location is a facility.

The lowest criterion is not bolded for hazardous substances lacking groundwater surface water interface (GSI) criteria. With respect to hazardous substances lacking GSI criteria, it may not

be possible to reach definitive conclusions regarding status as a facility or compliance with cleanup criteria until a GSI criterion is generated.

For all criteria and pathways, a person proposing or implementing response activities where a criterion for a relevant pathway is not available must supply the data necessary for the MDEQ to generate a criterion. An exception may be made where the MDEQ can determine that measured concentrations are protective (R 299.5706(3)).

GENERAL INFORMATION ABOUT THE CRITERIA

The criteria, flammability and explosivity screening levels (FESLs), and acute inhalation screening levels (AISLs) are presented in the tables. The screening levels are, however, considered to be protective for the concerns they address. If a concentration of a hazardous substance is higher than the FESL or the AISL, then the person proposing or implementing response activities shall document whether additional response activity is required to protect against those acute hazards (R 299.5706a(1)). Further details about these screening levels are presented in the FESL/AISL TSD (RRD Operational Memorandum No. 1, Attachment 10).

The criteria were developed using available chemical-specific toxicological and chemical-physical data, exposure data, or other data. Chemical-specific data used to develop the criteria and screening levels are presented in R 299.5752.

The criteria are presented in two significant figures. Some chemical-physical data are presented in more than two significant figures to retain mathematical precision. Cleanup criteria from the attached table should be compared to analytical data presented in two significant figures. Any statistical manipulation of the data should be done using the reported (unrounded) data with rounding occurring as the last step.

Analytical target detection limits (TDLs) and available analytical methods that are capable of achieving the TDLs have been designated by the MDEQ pursuant to R 299.5103(l) and are provided in RRD Operational Memorandum No. 2, Attachment 1. If the TDL is greater than the risk-based cleanup criterion for a hazardous substance in a given environmental medium, the TDL is used in place of the risk-based value as the cleanup criterion. In such cases, TDLs are presented in the criteria tables and footnoted where appropriate; risk-based criteria are presented along with the TDLs. A background concentration may be substituted for the generic cleanup criterion when the cleanup criterion is less than background (R 299.5707, R 299.5706a(5)(b)). Background soil may be represented by the statewide default background level, regional background developed using the Waste and Hazardous Materials Division (WHMD) Michigan Background Soil Survey April 1991, or facility-specific background developed by the party proposing response activities. Background levels have not been substituted for criteria in the tables since these three options exist. However, the background footnote is presented for substances where background may be substituted. Statewide default values are shown for those substances for which they have been derived. See column 10 of the soil criteria tables. Background for groundwater must be determined on a facility-specific basis if proposed as a default cleanup criterion. Additional guidance regarding establishing facility-specific background concentrations is available in the RRD Operational Memorandum No. 4.

If a generic criterion is greater than the respective soil saturation concentration (C_{sat}), the person proposing or implementing response activity must document whether additional response activity is required to control free-phase liquids or protect against related hazards (R 299.5706a(2)(a)). In the criteria tables, the C_{sat} value is included when the calculated risk-

based soil criterion is greater than C_{sat} and footnoted as such in the tables. R 299.5718(2) states that when the health-based criterion is greater than the C_{sat} concentration, the C_{sat} concentration becomes the criterion for that pathway unless a facility-specific C_{sat} concentration is generated. Concentrations greater than C_{sat} are acceptable cleanup criteria for the footnoted pathways where a site-specific demonstration indicates that free-phase material containing a hazardous substance is not present (R 299.5750(C)). Calculated values which exceed C_{sat} are not presented in the tables but may be obtained by contacting the MDEQ-RRD Toxicology Unit.

A groundwater criterion that exceeds the hazardous substance specific water solubility value defaults to the water solubility value (R 299.5708(2) and R 299.5750(S)) and is footnoted as such in the tables.

NEW INFORMATION ABOUT THE CRITERIA

Lead concentrations in both the fine (less than 250 microns) and coarse soil fractions are necessary to evaluate the risks from exposure to lead in soil. For comparison to the soil direct contact criteria and the particulate soil inhalation criteria for lead, the concentration of lead in the fine fraction must be determined. For all other soil criteria, the total concentration of lead in soil must be determined. Refer to the RRD Operational Memorandum No. 2, Attachment 1, Footnote 13 and Attachment 5, Page 3 for additional details on lead analyses.

IMPLEMENTATION OF THE CRITERIA

The following information describes the process that should be followed for identifying the relevant pathways and applicable criteria for response actions under Part 201 and Part 213 of NREPA.

Selecting Final Cleanup Criteria

The following process should be used in determining the final cleanup criterion for a given hazardous substance in soil and/or groundwater.

1. Identify the relevant pathways.

   Sections 20120a and 21304a require that the MDEQ utilize only reasonable and relevant exposure pathways in determining cleanup criteria. Each set of generic criteria correspond to a specific exposure pathway. R 299.5103(h) defines relevant pathway as an exposure pathway that is reasonable and relevant because there is a reasonable potential for human or non-human exposure to a hazardous substance to occur. An exposure pathway is the course a chemical takes from a source to an exposed organism. The components of an exposure pathway are a source or release of a hazardous substance, an exposure point, an exposure route, and, if the exposure point is not the source or point of release, a transport medium. It represents a mechanism by which an individual or population is exposed to chemicals at or originating from a facility. A pathway is relevant when exposure can occur even if exposure controls are or will be relied upon to prevent exposure and even if concentrations are less than applicable criteria. For example, ingestion of contaminated drinking water is a relevant pathway even in the presence of institutional controls or use restrictions. A pathway may not be

relevant due to natural physical characteristics that preclude the pathway from occurring. For example, the absence of a hydraulic connection to surface water in the vicinity of the facility and no indirect discharge to a surface water via a storm drainage system eliminates the potential for surface water to be impacted by the groundwater venting to surface water pathway (R 299.5716(1)).

R 299.5532(7) states that a Part 201 RAP shall evaluate all of the pathways, risks, and conditions listed in the rule to identify those that are relevant for the facility. Further information about the relevance of a pathway is presented in the rules for each exposure pathway. Part 213 CAPs must similarly evaluate the potential exposure pathways and identify those that are relevant. The evaluation must be based on the same exposure assumptions used for the development of the criteria that are contained within these rules.

2. Identify all the applicable criteria.

R 299.5101(c) defines an applicable criterion as a cleanup criterion for a relevant pathway. A criterion is not applicable if the exposure pathway is not relevant at a particular facility or if the exposure it addresses is reliably restricted by a restrictive covenant or institutional control or other allowed mechanism. Whenever a pathway is relevant, the associated criteria are applicable unless exposure can be reliably controlled by land or resource use restrictions or institutional controls.

Cleanup criteria may be applicable to waste material if the generic assumptions for the criteria are representative of the waste material. If the criteria are not applicable to the waste material, a site-specific evaluation must be conducted.

3. Select the lowest applicable generic groundwater and soil criterion.

The lowest applicable criterion determines the need for response action unless a higher criterion can be justified by providing reliable exposure controls for the controlling pathway. In addition, special characteristics of the facility and/or contamination may require a greater degree of response action (e.g., hazardous substances are present which are documented to have interactive toxicological effects) (R 299.5728, R 299.5734(2)(3), and R 299.532(9)). In lieu of using generic criteria, less restrictive facility-specific generic or site-specific cleanup criteria may be proposed. If facility- or site-specific criteria are to be used in lieu of generic criteria, it is the responsibility of the person proposing the plan to adequately document the basis for the limited or site-specific cleanup criteria in any RAP (R 299.5732) or CAP.

Types of Remedial Actions Under Part 201

Section 20120a(1) of NREPA allows for the development of cleanup criteria and remedial actions in the following land use categories:

a) generic and limited residential
b) generic and limited commercial
c) generic and limited industrial
d) generic and limited recreational (Generic recreational criteria have not been developed by the MDEQ. Recreational criteria are handled on a site-specific basis.)

Generic Remedial Actions: Generic remedial actions are based on generic cleanup criteria for all relevant pathways for the facility in question. Generic residential remedial actions allow for the property to be used without any type of restriction. Generic industrial and commercial remedial actions require an assurance that the land use will continue to be consistent with the generic land use category. A Notice of Approved Environmental Remediation (NAER) for the property consistent with provisions of Section 20120b(2) filed with the Register of Deeds forms an acceptable assurance regarding land use for generic commercial and industrial remedial actions. RAPs must include a statement confirming that the expected activity patterns at the facility are consistent with the exposure assumptions used to calculate the applicable generic criteria. The RAP must also include documentation of the current zoning of the property and any legal nonconforming uses that are relevant to the RAP.

Facility-Specific Generic Remedial Actions: Facility-specific generic remedial actions are generic remedial actions, however, one or more of the generic criteria have been modified based upon characteristics of the property that are not expected to change, such as soil characteristics. Those criteria which incorporate soil parameters (soil volatilization to indoor air inhalation criteria (SVIIC), groundwater volatilization to indoor air inhalation criteria (GVIIC), generic volatile soil inhalation criteria for ambient air, generic particulate soil inhalation criteria for ambient air, generic soil saturation concentrations (C_{sat}), and generic soil-water partitioning values) can be adjusted to incorporate facility-specific soil parameters and still allow the facility to satisfy the generic categorical criteria under Section 20120a(1)(a) to (e) of NREPA. Facility-specific measurements of the following parameters may be substituted individually for the generic assumptions and still allow the facility to satisfy the categorical criteria in Section 20120a(1)(a) to (e) of NREPA (R 299.5714(4), R 299.5724(4), and R 299.5726(7)):

a) dry soil bulk density
b) fraction of organic carbon in soil
c) soil vapor permeability
d) temperature adjustment factor for Henry's Law Constant
e) source-building foundation separation distance (GVIIC only)
f) vertical thickness of the capillary fringe (GVIIC only)
g) vertical thickness of soil contamination (SVIIC only)
h) emission due to wind (Ew) (soil inhalation criteria (SIC) only)
i) dispersion factor (Q/C) (SIC only)

Adjustments to the source-building foundation separation distance and vertical thickness of the capillary fringe must be made in consideration of seasonal variation and meteorological conditions. Consult the appropriate TSD for details. Facility-specific generic industrial-commercial RAPs do not require any limitations or restrictions except a NAER.

Site-Specific Remedial Actions: Site-specific remedial actions may be acceptable under Part 201 Section 20120(a)(2). A site-specific remedial action utilizes cleanup criteria that are based on site-specific assumptions which are substituted for the default assumptions specified in the rules for the various cleanup criteria. However, the equations presented in the pertinent rule must be used to calculate the site-specific criteria (R 299.5706a(9)). Site-specific criteria are also developed for exposure pathways and scenarios for which generic methodology has not been developed. The following pathways are approached on a site-specific basis:

a) recreational exposures/land uses
b) sediments (R 299.5730)

c) surface water column (R 299.5730)

Use controls must be in place to assure that activities or characteristics of the facility continue unchanged into the future such that unacceptable exposures will not occur. In this respect, a site-specific closure is a type of limited remedial action. A RAP relying on site-specific cleanup criteria must include documentation of the current zoning of the property and any legal nonconforming uses that are relevant to the RAP. Except for response actions which meet generic residential criteria, site-specific response actions also apply to property that is not zoned. The site-specific RAP for property not zoned must include documentation of the reasonably foreseeable future use of the property and natural resources in question (R 299.5532(8)(b)). Because Section 20120a(6) constrains application of generic or limited categorical cleanup designations to cases where the category is consistent with zoning, a facility that is not zoned cannot be addressed under Section 20120a(1). For property not zoned, any remedial action that does not meet generic residential criteria is considered a site-specific remedial action under Section 20120a(2) of NREPA. In these cases, the generic criteria that correspond to the land use may still be used to assess the adequacy of the remedial action. The person proposing the plan must document the land use and include a statement in the RAP confirming that exposures associated with that land use at the facility do not exceed the exposures used to develop the generic criteria proposed to be applied. If a site-specific remedial action for unzoned property relies on generic cleanup criteria appropriate to the land use, land use restrictions in a form similar to a NAER (rather than a restrictive covenant) may be appropriate and, generally, other RAP elements of Section 20120b(3) may not be needed.

Limited Remedial Actions: A limited remedial action under Section 20120(a)(1)(e) through (h) is necessary whenever a use restriction is required, which is beyond those required to assure activities are consistent with the land use category being applied. The need for use restrictions is established by comparison of facility conditions to generic assumptions used in the generic criteria equations (in contrast to site-specific closures described above). A limited RAP requires a land use or natural resource use restriction or an institutional control such that unacceptable exposures to media exceeding acceptable cleanup criteria cannot occur, along with the other RAP elements of Section 20120b(3). The necessary restrictions must be provided in a restrictive covenant consistent with the provisions of Section 20120b(4) filed with the Register of Deeds for the county where the facility is located or provided with an institutional control consistent with the provisions of Section 20120b(5).

Types of Closures Under Part 213

The Michigan-specific risk-based corrective action approach utilizes a tiered evaluation to determine whether site conditions satisfy generic criteria or allow for the utilization of facility-specific data to adjust the generic criteria; or whether site-specific criteria or institutional controls allow for closure. Closure categories include:

a) Tier 1 residential unrestricted closure
b) Tier 1 commercial or industrial closure with Notice of Corrective Action (NoCA)
c) Tier 2 or 3 residential, commercial, or industrial closure with site-specific criteria
d) Tier 2 or 3 residential, commercial, or industrial closure with institutional controls

A description of the types of closures allowed under Part 213 follow:

Residential Unrestricted Closures: Under this type of closure, the site has been fully characterized and the closure is based on the generic residential criteria or applicable site-specific target levels (SSTLs) that are as protective as the generic residential criteria.

Commercial and Industrial Closures: Under commercial and industrial closures, the site has been fully characterized and the closure is based on the commercial or industrial generic criteria or applicable SSTLs that are as equally protective as the generic criteria. Commercial and industrial closures allow for the property to be used without any type of restriction except an assurance that the land use will continue to be consistent with the generic land use category. A NoCA on the property consistent with the provisions of Section 21310a(1) filed with the Register of Deeds for the county in which the property is located is acceptable assurance regarding applicable commercial or industrial land use.

Restricted Closures: In the case of restricted closures, the site contaminants exceed the generic criteria and use controls, exposure barriers, and/or restrictions need to be in place to control exposure to the contaminants of concern. These controls generally take the form of a restrictive covenant on all properties in the affected area consistent with the provisions of Section 21310a(2) filed with the Register of Deeds for the county in which the property is located. Section 21310a(3) also provides for alternative mechanisms that may be effective in protecting against unacceptable exposures.

Land Use Categories Under Part 201 and Part 213

Descriptions of residential, commercial, and industrial land use categories are presented below. This information can be used to identify the most appropriate land use category for a property. Only the soil direct contact criteria have commercial III and IV subcategories. With the exception of commercial subcategory I, all other criteria that are protective of the worker population are applied to both industrial and commercial land uses.

Residential Land Use Category: The primary activity of the property is residential and includes single family dwellings, condominiums, and apartment buildings. The generic residential remedial action allows the property to be used for any unrestricted use. The generic residential category can be applied to properties that are zoned commercial or industrial, unlike the industrial or commercial category which can only be applied to properties zoned industrial or commercial. The limited residential category cannot be applied to industrial or commercially zoned property.

Industrial and Commercial Land Use Categories: Activities and uses are extremely variable within the industrial and commercial land uses. It is the responsibility of the party proposing a remedy to identify the category of cleanup criteria that is being relied upon and to demonstrate that the facility and exposure setting is consistent with the characteristics of the land use category/subcategory and the cleanup criteria. Similarly, the party proposing the remedy will have to describe those measures that will be put in place (NAER, NoCA, etc.) to assure that the exposure setting of the facility is maintained consistent with the exposure characteristics of the category/subcategory. This will serve to assure that uses of the facility that might yield unacceptable exposures will be precluded in the future. Proper characterization of those facility-specific activities or exposures may warrant the use of generic criteria from another subcategory or category.

Industrial Land Use Category: Industrial land use includes both of the following two elements:

1. The primary activity at the property is and will continue to be industrial in nature (e.g., manufacturing, utilities, industrial research and development, petroleum bulk storage) and access is and will continue to be reliably restricted consistent with its use (e.g., by fences, security personnel, or both). Inactive or abandoned properties can be included in this category if the use was and/or will be industrial, as described above, and access is controlled as necessary to assure unacceptable exposures do not occur. The industrial category does not include farms, gasoline service stations, or other commercial establishments where children may commonly be present.

2. The current zoning of the property is industrial, the zoning is anticipated to be industrial (see below), or the RAP/CAP includes documentation that the current industrial use is a legal nonconforming use. This may include different zoning designations, depending on the community, such as "light industrial" or "heavy industrial." Documentation of zoning must be included in the RAP/CAP and must include a map or current property record card that shows the zoning status of the facility and all adjacent properties. For each designated zoning category, the documentation must also include the text of the zoning code or ordinance for that designation. If the text for the zoning category refers to any other categories, text for those categories must also be included. If the RAP/CAP is based on anticipated zoning changes, documentation of how and when the zoning changes are to be accomplished and that the proposed criteria are consistent with the new zoning designation must be provided. The MDEQ shall not grant final approval until a final determination of that zoning change has been made by the local unit of government. The RAP/CAP must identify the nearest current residential land uses and nearest properties which are zoned for residential use. Any legal nonconforming land uses in the vicinity of the facility must be identified in the RAP/CAP (e.g., residential use on a parcel zoned "transitional industrial").

Commercial Land Use Category: The commercial land use category is extremely varied, encompassing everything from day care centers and schools to gas stations and warehouse operations. The physical setting of commercial properties and the activities which workers and the general public engage in are also extremely variable. Given the breadth of the commercial land use category, it is impossible to assign a single set of "typical" or generic exposure assumptions to characterize the activities of all potentially exposed populations.

In order to facilitate the development of generic commercial criteria, all commercial land uses have been divided into four subcategories based on factors that are critical to the assessment of potential risk. These factors include the potentially exposed populations (workers or general public) and the nature, duration, and frequency of the exposures likely to occur when people occupy, work, visit, or patronize the facility. The division of the commercial land use category into subcategories allows for some useful generalizations to be made.

Some commercial properties may be located in or near residential areas and, therefore, may be used by other populations for purposes (e.g., recreational) other than the intended commercial use. It may be inappropriate to apply the generic criteria developed for a given subcategory of commercial land use if anticipated exposure from noncommercial, unintended uses (e.g., children playing) exceeds the exposures assumed under that subcategory. Adjustments can be made to the exposure assumptions to represent these other uses consistent with the applicable rule provisions, or criteria for a more representative category can be used. Adjustments to the

exposure assumptions may require site-specific remedial action under Section 20120a(2). Alternatively, the RAP/CAP may denote measures designed to preclude uses inconsistent with the exposure assumptions used to develop the criteria.

For the purpose of determining if the generic commercial criteria presented in Attachment 1 are applicable, the party proposing a remedy must first determine that the facility falls within the definition of commercial land use and that the facility-related exposures are similar to those assumed for this category. The definition of commercial land use includes both of the following two elements:

1. The primary activity at the property is and will continue to be commercial in nature (e.g., retail, warehouse, office/business space). This could include abandoned or inactive commercial properties as long as they fit both the definition of a commercial land use and one of the subcategory definitions described below.

2. The current zoning of the property is commercial, future zoning is anticipated to be commercial, or the RAP/CAP includes documentation that the current commercial use is a legal nonconforming use. This may include different zoning designations, depending on the community, such as "community commercial," "regional commercial," "retail," or "office/business." Documentation of zoning must be included in the RAP/CAP and must include a map or current property record card that shows the zoning status of the facility and all adjacent properties. For each designated zoning category, the documentation must also include the text of the zoning code or ordinance for that designation. If the text for the zoning category refers to any other categories, text for those categories must also be included. If the RAP/CAP is based on anticipated zoning changes, documentation of how and when the zoning changes are to be accomplished and that the proposed criteria are consistent with the new zoning designation must be provided. Final MDEQ approval is dependent upon a final determination of the zoning change by the local unit of government. The RAP/CAP must identify the nearest current residential land uses and nearest parcels which are zoned for residential use. Any nonconforming land uses in the vicinity of the property must be identified in the RAP/CAP (e.g., residential use on a parcel zoned "transitional commercial").

Caution should be used when categorizing land uses on the basis of business type. Activities may vary considerably even among businesses of the same type. Current and future activities and exposures should be the primary considerations when determining a land use category for a specific facility.

If the property meets the definition of commercial land use, the party proposing the remedy must document which of the four subcategories of commercial land use defined below is most representative of the exposure setting of the subject property. The subcategories and the features that define them are described below:
Subcategory I: This commercial land use subcategory is characterized by any use which is intended to house, educate, or provide care for children, the elderly, the infirm, or other sensitive subpopulations. The activities engaged in by these populations at the facility are characterized by exposures of relatively significant duration and/or frequency approximating the magnitude of exposures used to develop the residential criteria. The setting may include areas containing surficial soils that may be frequented by potentially exposed populations (e.g., play areas). Any soil contaminants present may, therefore, be readily accessible to the resident populations. If relied on for drinking water, exposure to groundwater would also be significant. In addition, this

subcategory of commercial land use is usually, but not always, located in or near residential areas and, therefore, may be used by other populations for purposes other than the intended commercial use (e.g., recreational). This subcategory could include, but is not limited to, the following uses:

a) day care centers
b) any form of educational facility
c) hospitals, elder care facilities, and nursing homes

Although a site-specific risk assessment may be conducted on properties within this category, no generic commercial cleanup criteria will be developed because in most cases, the site setting and uses will warrant the application of generic residential criteria. There are forms of subcategory I commercial land use that do not possess the exposure characteristics of the residential exposure setting; for example, long-term or convalescent care facilities where patients are not expected to come into contact with soils on a frequent basis. In such cases, site-specific cleanup criteria or criteria from another subcategory can be utilized with proper written documentation.

Subcategory II: The degree of exposure for such employees under subcategory II property is assumed to be equivalent to the exposures used to model outdoor activities in the development of the generic industrial criteria. As a result, a unique set of generic criteria has not been defined for this subcategory of commercial land use. Properties that fall into this subcategory should be addressed through the application of the generic industrial criteria or through a site-specific risk assessment.

This commercial land use subcategory is characterized by the following features. Access to the public is reliably restricted, consistent with its use by fences, security, or both. Affected surficial soils are located in unpaved or landscaped areas that are frequently contacted by worker populations such as groundskeepers, maintenance workers, or other employees whose primary duties are performed outdoors. If groundwater is relied on for drinking water, it is assumed that worker populations receive one-half of their total daily drinking water exposure from the facility.

This subcategory could include, but is not limited to, the following uses:

a) large scale commercial warehouse operations
b) wholesale lumber yards
c) building supply warehouses

Subcategory III (low soil intensive): A worker whose primary duties take place indoors but also include some outdoor activities such as collecting trash is the receptor for this subcategory. A subcategory III commercial property is characterized by the following features. Access to the public is unrestricted, however, the general public's occupancy of the property is expected to be intermittent and significantly less in frequency and duration relative to the population working at the facility. Although some of the activities for both worker populations and the general public at a subcategory III commercial property are conducted indoors, a significant component of their activity will likely be outdoors. The worker/receptor population at these commercial facilities is expected to engage in low soil intensive activities. Routine outdoor tasks performed by these workers are unlikely to result in significant physical interaction with the soil. Affected surficial soils may be contacted, primarily by the worker populations (as may be the cases at gas stations, auto dealerships, or building supply warehouses with unpaved areas). If on-site groundwater is relied on for drinking water, it is assumed that worker populations receive one-half of their total daily

drinking water exposure from the facility. The receptors for this subcategory are expected to work at the kinds of establishments that are listed below and conducting activities that take place both indoors and outdoors.

This subcategory could include, but is not limited to, the following uses:

a) retail gas stations
b) auto service stations
c) auto dealerships
d) retail warehouses selling the majority of their merchandise indoors but including some limited storage or stockpiling of materials in an outdoor yard (building supply, retail flower, and garden shops not involving on-site plant horticulture and excluding open air nurseries, tree farms, and sod farms which would fall into an agricultural land use).
e) repair and service establishments including but not limited to, lawn mower, boat, snowmobile, or small appliance repair shops that have small outdoor yards.
f) small warehouse operations

Subcategory IV (high soil intensive): A groundskeeper worker population has been identified as the appropriate receptor population for development in this subcategory. The worker/receptor population at these commercial facilities is expected to engage in high soil intensive activities. The primary tasks performed by these workers will result in significant physical interaction with the soil.

A subcategory IV commercial property is characterized by the following features. Access to the public is unrestricted, however, the general public's occupancy of the facility is intermittent in frequency and of short duration relative to the worker populations at the facility (i.e., the frequency and duration of general public occupancy at the property is typified by the time necessary to transact business at a retail establishment or to receive personal services). At least a portion of the worker population at this type of commercial property conducts most of their work activities outdoors; this includes those workers from off-site who work at multiple properties such as commercial landscapers. General public contact with these areas is anticipated to be significantly less than the worker's contact, both in terms of frequency and duration. If groundwater is relied upon for drinking water, worker populations would receive one-half of their total daily drinking water exposure at the facility. This subcategory could include, but is not limited to, the following uses where landscaping exists or has the potential to exist:

a) professional offices (lawyers, architects, engineers, real estate, insurance, etc.)
b) medical/dental offices and clinics (not including hospitals)
c) banks, credit unions, savings and loan institutions, etc.
d) publicly owned office buildings
e) any retail business whose principal activity is the sale of food or merchandise within an enclosed building
f) personal service establishments which perform services indoors (health clubs, barber/beauty salons, mortuaries, photographic studios, etc.)

CONCERNS NOT ADDRESSED BY CLEANUP CRITERIA

There are several concerns that have not been addressed with generic cleanup criteria, and as a result, they must be addressed in a RAP/CAP. These concerns are listed and discussed below.

Source Control: Free-phase liquids and abandoned hazardous substances not yet dispersed represent source materials that have the potential to cause harm to public health, natural resources, and the environment. Source removal often provides the greatest opportunity to permanently and significantly reduce volume, toxicity, and mobility of hazardous substances as specified in Section 20118(4). All RAPs must include an analysis of source control measures already implemented, proposed, or both (Section 20118(8), R 299.5532(7)). Also, for persons that are liable and owned or operated the facility after June 5, 1995, there are additional requirements related to source control specified in Section 20114. Under Part 213, if free product is discovered, it must be reported within 24 hours of the discovery. Section 21307(2)(c)(i) requires that free product removal be conducted in a manner that minimizes the spread of contamination into previously uncontaminated zones. In addition, Section 21307(2)(c)(ii) requires the abatement of free product migration as a minimum objective for the design of the free product removal system. The extent of the free product must be defined to adequately demonstrate that the free product is not migrating and that contamination is not spreading into previously uncontaminated areas. Delineation of the free product must be completed and removal of free product initiated within 90 days of its discovery. Interim recovery methods must be initiated immediately upon discovery of the free product.

Contaminated Soil Runoff to Surface Waters: Consideration must be given to the potential for contaminated soil to erode into surface water, and if the potential exists, what response activity may be appropriate (R 299.5732(7)(x)). This concern is relevant for all land uses. It is applicable to facilities where significant potential exists for contaminated soil to reach surface water via direct transport or runoff. The following should be considered in determining whether the transport of contaminated soil to surface waters is a relevant pathway:

a) proximity to surface waters
b) extent of exposed and/or erodable soils
c) extent of erodable contamination
d) transport or erosion potential based on soil types, compaction, and slope
e) presence in soil of metals or persistent bioaccumulative chemicals

If this pathway is determined to be relevant, then the following should be considered in determining if the pathway is or will be adequately controlled pursuant to a RAP/CAP:

a) whether vegetation is adequate and not expected to require maintenance (this would not require a limited closure)
b) whether an impervious surface or another engineering measure is required to provide adequate control of potential runoff (this would require a limited closure)

If the pathway is relevant, then the RAP/CAP must provide for effective control of the erosion of contaminated soil. Compliance with Part 201/Part 213 should be considered in judging the effectiveness of the control measures.

Surface Water Sediments: Contaminated surface water sediments can cause adverse impacts to aquatic flora or fauna, the food chain, or aesthetics. If this potential exists, the pathway is relevant (R 299.5732(7)(xii)). This pathway has the potential to be relevant for all land uses. Any RAP/CAP that addresses surface water or sediments must include site-specific cleanup criteria based on the evaluation of bulk sediment chemistry, sediment toxicity, and benthic community populations. Additional guidance is available in RRD Operational Memorandum No. 4, Attachment 3. Development of the criteria must also include consideration

of the following use impairments such that those impairments are eliminated or mitigated following implementation of the criteria (R 299.5730).

a) restrictions on fish or wildlife consumption
b) tainting of fish and wildlife flavor
c) degraded fish or wildlife populations
d) fish tumors or other deformities
e) bird or animal deformities or reproductive problems
f) degradation of benthos
g) restrictions on dredging activities
h) eutrophication or undesirable algae
i) restrictions on drinking water consumption, taste, or odor problems
j) beach closings
k) degradation of aesthetics
l) added costs to agriculture or industry, or a local unit of government
m) degradation of phytoplankton or zooplankton populations
n) loss of fish and wildlife habitat
o) unacceptable risk through human contact as a result of absorption of hazardous substances through the skin or by incidental ingestion of sediments
p) other unacceptable risks to human receptors exposed to hazardous substances in sediments

Acute Toxicity and Physical Hazards

Acute toxicity and physical hazards need to be considered at every facility. Acute inhalation toxicity and flammability/explosivity potential have been addressed via development of FESLs and AISLs for a limited number of hazardous substances where sufficient chemical-specific information is available (Attachment 10). When FESLs/AISLs cannot be developed, an evaluation for flammability/explosivity and acute inhalation toxicity will need to be conducted on a case-by-case basis. In addition, other physical hazards must be evaluated for groundwater (R 299.5532(7)(xiv)). Since AISLs and FESLs have not been developed for soil, it may be necessary to give special consideration to these hazards in soil.

Acute toxicity to aquatic organisms must also be considered. Specific response activities are required if there is a release to surface waters, either directly or through venting groundwater that is acutely toxic (R 299.5526(4)(d) and R 299.5716(14)). Contaminant-specific values for acute toxicity to aquatic life are listed in the R 323.1057 Water Quality Values (available at www.michigan.gov/deq select "Water," "Water Quality Monitoring," "Assessment of Michigan Waters").

Some of the hazardous substances in the criteria tables may present other physical hazards such as ignitability, corrosivity, or reactivity. These substances were identified using the definitions provided in the Resource Conservation and Recovery Act (RCRA; 40 Code of Federal Regulations, Sections 261.20-261.23). Substances which have the hazardous properties of ignitability, corrosivity, or reactivity when in pure form are footnoted in the criteria tables with an (I), (U), or (R), respectively. Further information about these characteristics follows below. Special attention and caution must be exercised when these hazardous substances are known or expected to be present in soil and/or groundwater. Additional hazardous substances listed in the criteria tables may also pose acute or physical hazards that may need to be addressed.

Hazardous substances that are ignitable in pure form may present a combustion hazard under normal environmental conditions (i.e., standard temperature and pressure) and/or may be strong oxidizers capable of exacerbating a fire once ignited. Corrosive substances have either a very high or a very low pH, destroy living tissue upon direct contact, corrode or destroy building materials or other equipment, and mobilize other hazardous substances. Reactive substances may explode under normal environmental conditions when exposed to moisture or when subject to an initiating force. Reactive substances may also generate toxic fumes as is the case for cyanide or sulfide containing substances. All physical and acute hazards need to be evaluated on a case-by-case basis.

Ecological and Aesthetic Impacts: Additional impacts that need to be considered are aesthetics, phytotoxicity, food web contamination, adverse impacts to soil organisms, and adverse impacts to aquatic and terrestrial wildlife (R 299.5532(7)(xv), R 299.5728). Observable evidence of a problem including, but not limited to, soil discoloration, odors, stressed vegetation, and injured wildlife requires that further evaluation of aesthetic and/or ecological impacts occur. In addition, certain hazardous substances such as dioxins, furans, and polychlorinated biphenyl (PCB) compounds present their greatest ecological impacts in reduced reproductive success, embryo survival, and contaminant biomagnification through the food web. These impacts are generally not visibly evident, but these ecological impacts are very significant and must also be evaluated to ensure that the proposed remedy is adequately protective of the environment.

The GSI criteria do consider certain impacts to some aquatic organisms, in addition to human health effects. However, Part 201 generic criteria do not fully address ecological impacts. In addition, only a few criteria account for adverse aesthetic impacts, and this is complicated by the fact that the presence of multiple contaminants may result in aesthetic impacts that would not otherwise be observed or expected. Consequently, aesthetic-based criteria and ecologic-based criteria may need to be developed. The development of these criteria is made difficult because only limited quantitative information currently exists in the published literature. As a result, professional judgment may be required.

The generic criteria for soil do not fully address aesthetic impacts. Soils which are in compliance with the appropriate health-based chemical-specific criteria, yet still exhibit adverse aesthetic impacts, must be addressed on a case-by-case basis. In determining if additional action is required for soils with adverse aesthetic impacts, consideration will be given to the intended use of the property, the depth of the impacted soils, the source of the contamination, and the specific aesthetic impacts exhibited in the soil.

Generic ecologic-based soil or sediment criteria have not been established by the MDEQ. Nonetheless, it is important that all RAPs/CAPs consider the need for conducting ecological risk assessment at the facility. Ecological risk assessments are useful to define the risks to aquatic and/or terrestrial wildlife that are posed by the contaminant concentrations present at the facility. The presence of bioaccumulative contaminants is of particular concern. These contaminants include, but are not limited to, chlordane, 4-4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclohexanes, alpha-hexachlorobenzene, beta-hexachlorocyclohexane, delta-hexachlorocyclohexane, lindane, mercury, mirex, octachlorostyrene, PCBs, pentachlorobenzene, photomirex, dioxins (2,3,7,8-tetrachlorodibenzo-p-dioxin being the most toxic congener), furans (2,3,7,8-tetrachlorodibenzo-p-furans being the most toxic congener), 1,2,3,4-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene, and toxaphene.

In most cases, it is important that some form of ecological risk assessment be conducted when aquatic and/or terrestrial habitat(s) will remain at a facility after completion of the RAP/CAP construction activities. In most instances, the initial form of this assessment effort will be what is generally referred to as a prescreening, or screening level, ecological risk assessment. A prescreening risk assessment must examine whether there will be an unacceptable risk to organisms expected to live in habitats located at or near the facility. If unacceptable, ecological risks cannot be ruled out at the facility, then some additional action will be necessary. This additional action could lead to the completion of a more detailed ecological risk assessment involving definition of habitats, identification of receptor species, review of available ecological risk data, food chain modeling, and potentially the collection and analysis of biological samples. This additional assessment effort could eventually lead to the development of ecologically-based criteria at the facility. Alternatively, presumptive actions can be implemented to prevent unacceptable ecological exposures at the facility (e.g., capping or otherwise isolating the contaminants from ecological exposure, or removal of the contaminant). It may be more cost effective to implement presumptive remedies than to conduct a detailed ecological risk assessment.

To assist in conducting or evaluating screening level ecological assessments, the ecological screening level guidance document, dated August 22, 2003, prepared for the U.S. EPA Region 5 RCRA Corrective Action and Permit Program office (http://www.epa.gov/RCRIS-Region-5/ca/ESL.pdf) is recommended. The document provides comparison concentration values for a variety of chemical compounds in air, water, sediment, and soil. If concentrations at a facility clearly and consistently exceed these comparison values for the environmental media of concern, then unacceptable ecological risk cannot be ruled out at the facility.

For those facilities regulated under Part 111, Hazardous Waste Management, of NREPA, additional response activities to address ecological risk may be required to assure consistency with the Federal RCRA Program. Please contact the WHMD, Hazardous Waste and Radiological Protection Section for additional information.

For questions concerning the criteria/RBSL tables, criteria/RBSL development, or the technical support documents, please contact Christine Flaga, MDEQ, RRD Toxicology Unit Chief, at 517-373-0160, or flagac@michigan.gov. For questions regarding application of the criteria or RBSLs to specific sites, please contact the appropriate project manager.

Andrew W. Hogarth, Chief
Remediation and Redevelopment Division

Dated: 12/10/04

Attachments

Attachment 1: Tables 1, Groundwater, and 2 and 3, Soil:
Part 201 Cleanup Criteria and Screening Levels
Part 213 Tier 1 Risk-Based Screening Levels Risk-Based Screening Levels
(Table in alpha order: pdf format = 1, 2, 3 and excel format = 1,2,3)

Footnotes for the Part 201 Criteria and Screening Levels
Part 213 Risk-Based Screening Levels

Table 4: Toxicological and Chemical-Physical Data for Part 201 Cleanup Criteria and Screening Levels (excel format= table 4)
Part 213 Risk-Based Screening Levels

Attachment 2: List of Revisions to Criteria Since December 2002

Attachment 3: Part 201 Drinking Water Criteria/Part 213 Tier 1 Drinking Water Risk-Based Screening Levels Technical Support Document

Attachment 4: Part 201 Groundwater Contact Criteria
Part 213 Tier 1 Groundwater Contact Risk-Based Screening Levels
Technical Support Document

Attachment 5: Part 201 Groundwater and Soil Volatilization to Indoor Air Inhalation Criteria
Part 213 Tier 1 Groundwater and Soil Volatilization to Indoor Air Inhalation Risk-Based Screening Levels
Technical Support Document

Attachment 6: Part 201 Soil Direct Contact Criteria
Part 213 Tier 1 Soil Direct Contact Risk-Based Screening Levels
Technical Support Document

Attachment 7: Part 201 Soil Inhalation Criteria for Ambient Air
Part 213 Tier 1 Soil Inhalation Risk-Based Screening Levels for Ambient Air
Technical Support Document

Attachment 8: Part 201 C_{sat} Concentrations/Part 213 Tier 1 C_{sat} Concentrations
Technical Support Document

Attachment 9: Part 201 Soil-Water Partition Value/Part 213 Tier 1 Soil-Water Partition Risk-Based Screening Levels
Technical Support Document

Attachment 10: Part 201 and Part 213 Flammability and Explosivity Screening Levels, and Acute Inhalation Screening Levels
Technical Support Document

This memorandum is intended to provide guidance to foster consistent application of Part 201 and Part 213 of NREPA and the associated Administrative Rules. This document is not intended to convey any rights to any person nor itself create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

December 10, 2004

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 3
PART 201 DRINKING WATER CRITERIA
PART 213 TIER I DRINKING WATER RISK-BASED SCREENING LEVELS

Developed under R 299.5710

Key definitions for terms used in this document:

NREPA:	**The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended**
Part 201:	**Part 201, Environmental Remediation, of NREPA**
Part 213:	**Part 213, Leaking Underground Storage Tanks, of NREPA**
MDEQ:	**Michigan Department of Environmental Quality**
RRD:	**Remediation and Redevelopment Division**
Criteria or criterion:	**Includes the cleanup criteria for Part 201 of NREPA and the Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)**
DWC:	**Drinking Water Criteria or Criterion**
Facility:	**Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA**
TSD:	**Technical Support Document**

This TSD presents the methodology for development of the generic drinking water criteria. The DWC were developed pursuant to Sections 20120a(1)(a), (b), and (d); 20120(a)(3) and (5); and 21304a(1) (2) of NREPA. This methodology is presented in R 299.5710(3). This TSD supercedes previous MDEQ documents regarding the DWC.

In addition to the Part 201 Administrative Rules, the DWC are presented in Attachment 1 of the RRD Operational Memorandum No. 1: Part 201 Cleanup Criteria/Part 213 Risk-Based Screening Levels. Residential and commercial I DWC are presented in column 1 of the groundwater criteria table. Industrial and commercial DWC are presented in column 2 of the groundwater criteria table. The DWC represent water concentrations of contaminants in units of micrograms per liter (µg/L) or parts per billion (ppb), unless otherwise noted.

IMPLEMENTATION

The DWC represent concentrations of hazardous substances in drinking water that are safe for long-term consumption. Where the health-based DWC is less than the target detection limit (TDL), the TDL is used in place of the DWC. Criteria that are based on

TDLs are presented in the criteria tables in RRD Operational Memorandum No. 1, Attachment 1 and are identified by the (M) footnote (R 299.5707 and R 299. 5750(M)). All TDLs are presented in the RRD Operational Memorandum No. 2. Where a state drinking water standard (SDWS) has been established pursuant to Act No. 399 of the Public Acts of 1976, the SDWS becomes the health-based DWC as specified by Section 20120a(5) and Section 21304a(4) of NREPA. The DWC based on a SDWS are designated in the criteria table by footnote (A) (R 299.5710(3) and R 299.5750(A)). The DWC for some inorganic hazardous substances default to background when the criteria are less than background (R 299.5707 and R 299.5750(B)). If proposed to be substituted for a cleanup criterion, background concentrations for groundwater must be determined on a regional or facility-specific basis. The RRD Operational Memorandum No. 4 provides guidance on establishing groundwater background values.

Section 20120a(5) and Section 21304a(4) of NREPA and R 299.5709 require that remediation of an aquifer address adverse aesthetic impacts (e.g., odor, taste, color, precipitate) resulting from one or a combination of hazardous substances. However, aesthetic criteria are available for only a limited number of individual hazardous substances. Aesthetic criteria are based on federal secondary maximum contaminant levels or the results of an acceptable taste or odor test. An existing aesthetic value becomes the DWC when it is less than the health-based DWC or the SDWS. Footnote (E) designates those DWC that are based on adverse aesthetic characteristics (R 299.5750(1)(E)). If adverse aesthetic impacts remain after the DWC have been achieved, further remedial measures may be required. Consult the RRD District Supervisor or the RRD Toxicology Unit if you encounter such a situation.

If a generic DWC is greater than the solubility limit for that specific hazardous substance, then the solubility limit is the generic DWC (R 299.5708(2)).

All pathways must be evaluated to determine if they are relevant for a particular facility. The drinking water pathway is relevant to all groundwater in an aquifer. An "aquifer" is defined in R 299.5101(d) as "a geological formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs." The drinking water pathway is also relevant to groundwater not in an aquifer if the groundwater can reasonably be expected to transport a hazardous substance into an aquifer in a concentration that exceeds the generic residential criterion. If the drinking water pathway is not relevant, the cleanup criteria are not applicable. Cleanup criteria for groundwater not in an aquifer and not reasonably expected to transport a hazardous substance into an aquifer must be determined by consideration of other exposure pathways and their associated criteria.

The DWC are applicable to all groundwater in an aquifer unless drinking water use is prohibited by enforceable land use restrictions in a restrictive covenant, notice of approved environmental remediation (NAER), notice of corrective action (NoCA), or an approved institutional control (Section 21310a, Section 20120b(4), and Section 20120b(5).

The generic industrial and commercial DWC are applicable to property that is zoned or being used for industrial or commercial II, III, or IV purposes, provided that a NAER, NoCA, or restrictive covenant will limit the property use to those commercial or industrial uses, as appropriate. These criteria are applicable unless drinking water use is prohibited by enforceable land use restrictions in a restrictive covenant or an approved institutional control. Generic residential DWC are applicable at the property boundary unless off-property use of the aquifer is controlled by a restrictive covenant, NAER, NoCA, or approved institutional control.

GENERIC HEALTH-BASED DRINKING WATER ALGORITHMS

The DWC are derived from the algorithms presented below except as provided in R 299.5734. Further details regarding the DWC are presented after the algorithms.

EQUATION FOR CARCINOGENIC EFFECTS:

$$DWC = \frac{TR \times BW \times AT \times CF}{SF \times EF \times ED \times IR_{dw}}$$

where,

DWC (Drinking water criterion)	= chemical-specific (µg/L or ppb)
TR (Target risk level)	= 10^{-5}
BW (Body weight)	= 70 kg
AT (Averaging time in days)	= 25,550 days (70 years x 365 days/year)
CF (Conversion factor)	= 1,000 µg/mg
SF (Oral cancer slope factor)	= chemical-specific $(mg/kg\text{-}day)^{-1}$
EF (Exposure frequency)	= 350 days/year (residential) = 245 days/year (industrial and commercial)
ED (Exposure duration)	= 30 years (residential) = 21 years (industrial and commercial)
IR_{dw} (Drinking water ingestion rate)	= 2 liters/day (residential) = 1 liter/day (industrial and commercial)

EQUATION FOR NONCARCINOGENS:

$$DWC = \frac{THQ \times RfD \times BW \times AT \times RSC \times CF}{EF \times ED \times IR_{dw}}$$

where,

DWC (Drinking water criterion)	= chemical-specific (µg/L or ppb)
THQ (Target hazard quotient)	= 1
RfD (Oral reference dose)	= chemical-specific (mg/kg-day)
BW (Body weight)	= 70 kg

AT (Averaging time)	= 10,950 days (30 years x 365 days/year - residential) = 7,665 days (21 years x 365 days/year - industrial and commercial)
RSC (Relative source contribution)	= chemical-specific or 0.2 if chemical-specific data are not available
CF (Conversion factor)	= 1,000 µg/mg
EF (Exposure frequency)	= 350 days/year (residential) = 245 days/year (industrial and commercial)
ED (Exposure duration)	= 30 years (residential) = 21 years (industrial and commercial)
IR_{dw} (Drinking water ingestion rate)	= 2 liters/day (residential) = 1 liter/day (industrial and commercial)

GENERAL INFORMATION ABOUT THE DWC ALGORITHMS

The AT represents the number of days over which the exposure is averaged. The AT value depends upon the type of toxic effect being evaluated. When evaluating long-term exposure to noncarcinogenic compounds, exposure is calculated by averaging over the period of exposure (i.e., subchronic or chronic exposures). For carcinogenic compounds, exposures are calculated by prorating the total cumulative dose over a lifetime (also called lifetime average daily dose). The approach for carcinogens is based on the assumption that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose received over a lifetime.

The acceptable level of risk for carcinogens is one in one hundred thousand (10^{-5}) pursuant to Section 20120a(4) and Section 21304a(3) of NREPA. Exposure to noncarcinogens is evaluated through the use of a hazard quotient (HQ). The HQ is the ratio of the assumed exposure level and a reference or safe dose, both for a similar exposure period. An acceptable THQ is equal to or less than one (R 299.5710(3)). A THQ of greater than one (i.e., the exposure level is greater than the reference dose) is considered unacceptable.

The RSC factor of 20 percent (0.2) is included in the algorithm for noncarcinogens to maintain consistency with the United States Environmental Protection Agency (EPA) and State of Michigan development of drinking water standards. The 20 percent RSC represents a default value that may be replaced with a chemical-specific value when data are available. The RSC accounts for the fact that there are many chemicals to which people are exposed through a variety of media and activities. The default RSC of 0.2 assumes that a receptor gets 20 percent of his/her exposure to a contaminant from drinking water while 80 percent of their exposure comes from other sources. For example, solvents

are common industrial contaminants that are found in products routinely used by the general consumer. Ignoring exposures from other sources when generating cleanup criteria for solvents could underestimate the risk posed by these types of chemicals. In light of the fact that chemical-specific data regarding RSCs are extremely limited and significant exposures to certain chemicals do occur from a variety of sources, it is necessary to identify a conservative default value for this generic approach.

The ED of 30 years represents the national upper-bound for time of occupancy (90th percentile) at one residence (EPA, 1989). The EF of 350 represents the number of days per year that a resident is exposed to drinking water at their home; it assumes that people spend approximately 15 days per year away from their homes for vacations or other reasons.

An ED of 21 years for a commercial/industrial worker is extrapolated from 1991 statistics from the United States Department of Labor (EPA, 1991b) as the 90th percentile. The EF of 245 days for the worker drinking water scenario is derived from the assumption that there are 260 work days per year minus 3 work weeks (15 days) of vacation and sick time. The assumed amount of water ingested at work (1 liter/day) is based on EPA's recommendation (EPA, 1991a). Adjustments to these algorithms can be made only as allowed for under R 299.5706a(9).

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REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part A). Interim Final. *EPA/540/1-89/002. December 1989.*

EPA (U.S. Environmental Protection Agency). 1991a. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals). Interim. Publication 9285.7-01B. December 1991.

EPA (U.S. Environmental Protection Agency). 1991b. Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final. OSWER Directive: 9285.6-03. March 25, 1991.

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per liter (ug/L). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 ppb is presented as 2.0E+5. The lowest generic groundwater criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are presented in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based or solubility value, whichever is lower (R 299.5708). Criteria were promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. These tables reflect modifications to the TDLs and new criteria consistent with the provisions of R299.5103(l) and R299.5706a, respectively.

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria & RBSLs	Industrial & Commercial II, III & IV Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Acenaphthene	83329	1,300	3,800	19	4,200 (S)	4,200 (S)	4,200 (S)	4,240	ID	ID
Acenaphthylene	208968	52	150	ID	3,900 (S)	3,900 (S)	3,900 (S)	3,930	ID	ID
Acetaldehyde (I)	75070	950	2,700	130	1.1E+6	2.3E+6	4.2E+7	1.0E+9	8.9E+6	2.6E+7
Acetate	71501	4,200	12,000	(G)	ID	ID	ID	ID	ID	ID
Acetic acid	64197	4,200	12,000	1,000 (M); 360	NLV	NLV	1.8E+8	6.0E+9	1.0E+9 (D)	1.0E+9 (D)
Acetone (I)	67641	730	2,100	1,700	1.0E+9 (D,S)	1.0E+9 (D,S)	3.1E+7	1.0E+9	1.5E+7	1.0E+9 (D)
Acetonitrile	75058	140	400	NA	2.4E+7	4.5E+7	5.6E+6	2.00E+8	2.1E+7	2.0E+8
Acetophenone	98862	1,500	4,400	ID	6.1E+6 (S)	6.1E+6 (S)	6.1E+6 (S)	6.1E+6	ID	ID
Acrolein (I)	107028	120	330	NA	2,100	4,200	3.4E+6	2.10E+8	6.7E+6	3.4E+5
Acrylamide	79061	0.5 (A)	0.5 (A)	NA	NLV	NLV	13,000	2.20E+9	NA	ID
Acrylic acid	79107	3,900	11,000	NA	1.2E+7	2.8E+7	7.6E+7	1.0E+9	1.0E+9 (D)	ID
Acrylonitrile (I)	107131	2.6	11	4.9 (X)	34,000	1.9E+5	14,000	7.50E+7	6.4E+6	ID
Alachlor	15972608	2.0 (A)	2.0 (A)	11 (X)	NLV	NLV	1,700	1.83E+5	ID	ID
Aldicarb	116063	3.0 (A)	3.0 (A)	NA	NLV	NLV	1.2E+5	6.00E+6	ID	ID
Aldicarb sulfoxide	1646873	4.0 (A)	4.0 (A)	NA	NLV	NLV	2.7E+6	2.80E+7	ID	ID
Aldicarb sulfone	1646884	2.0 (A)	2.0 (A)	NA	NLV	NLV	2.1E+6	7.80E+6	ID	ID
Aldrin	309002	0.098	0.4	0.01 (M,X); 8.7E-6	180 (S)	180 (S)	0.34 (AA)	180	ID	ID
Aluminum (B)	7429905	50 (V)	50 (V)	NA	NLV	NLV	6.4E+7	NA	ID	ID
Ammonia	7664417	10,000 (N)	10,000 (N)	(CC)	3.2E+6	7.1E+6	ID	5.30E+8	ID	3.5E+6

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
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t-Amyl methyl ether (TAME)	994058	190 (E)	190 (E)	NA	2.6E+5	5.7E+5	2.6E+6 (S)	2.64E+6	NA	NA
Aniline	62533	53	220	4	NLV	NLV	1.4E+5	3.60E+7	NA	ID
Anthracene	120127	43 (S)	43 (S)	ID	43 (S)	43 (S)	43 (S)	43.4	ID	ID
Antimony	7440360	6.0 (A)	6.0 (A)	130 (X)	NLV	NLV	68,000	NA	ID	ID
Arsenic	7440382	10 (A)	10 (A)	150 (X)	NLV	NLV	4,300	NA	ID	ID
Asbestos (BB)	1332214	7.0E+6 f/mL (A)	7.0E+6 f/mL (A)	NA	NLV	NLV	ID	NA	NA	ID
Atrazine	1912249	3.0 (A)	3.0 (A)	7.3 (X)	NLV	NLV	5,400	70,000	ID	ID
Azobenzene	103333	23	94	NA	6,400 (S)	6,400 (S)	1,600	6,400	ID	ID
Barium (B)	7440393	2,000 (A)	2,000 (A)	(G,X)	NLV	NLV	1.4E+7	NA	ID	ID
Benzene (I)	71432	5.0 (A)	5.0 (A)	200 (X)	5,600	35,000	11,000	1.75E+6	68,000	67,000
Benzidine	92875	0.3 (M); 0.0037	0.3 (M); 0.015	ID	NLV	NLV	7.1	5.20E+5	ID	ID
Benzo(a)anthracene (Q)	56553	2.1	8.5	ID	NLV	NLV	9.4 (S,AA)	9.4	ID	ID
Benzo(b)fluoranthene (Q)	205992	1.5 (S, AA)	1.5 (S, AA)	ID	ID	ID	1.5 (S,AA)	1.5	ID	ID
Benzo(k)fluoranthene (Q)	207089	1.0 (M); 0.8 (S)	1.0 (M); 0.8 (S)	NA	NLV	NLV	1.0 (M,AA); 0.8 (S)	0.8	ID	ID
Benzo(g,h,i)perylene	191242	1.0 (M); 0.26 (S)	1.0 (M); 0.26 (S)	NA	NLV	NLV	1.0 (M,AA); 0.26 (S)	0 26	ID	ID
Benzo(a)pyrene (Q)	50328	5.0 (A)	5.0 (A)	ID	NLV	NLV	1.0 (M,AA); 0.64	1.62	ID	ID
Benzoic acid	65850	32,000	92,000	NA	NLV	NLV	3.5E+6 (S)	3.50E+6	ID	ID
Benzyl alcohol	100516	10,000	29,000	NA	NLV	NLV	4.4E+7 (S)	4.40E+7	ID	ID
Benzyl chloride	100447	7.7	32	NA	12,000	77,000	3,600	4.90E+5	NA	ID
Beryllium	7440417	4.0 (A)	4.0 (A)	(G)	NLV	NLV	2.9E+5	NA	ID	ID
bis(2-Chloroethoxy)ethane	112265	ID	ID	ID	NLV	NLV	ID	1.89E+7	ID	ID
bis(2-Chloroethyl)ether (I)	111444	2.0	8.3	15 (X)	38,000	2.1E+5	5,700	1.72E+7	1.7E+7 (S)	1.7E+7 (S)
bis(2-Ethylhexyl)phthalate	117817	6.0 (A)	6.0 (A)	32	NLV	NLV	320 (AA)	340	NA	340 (S)
Boron (B)	7440428	500 (F)	500 (F)	1,900	NLV	NLV	6.2E+7	NA	ID	ID
Bromate	15541454	10 (A)	10 (A)	40 (X)	NLV	NLV	4,800	38,000	ID	ID
Bromobenzene (I)	108861	18	50	NA	1.8E+5	3.9E+5	12,000	4.13E+5	ID	ID

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
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Bromodichloromethane	75274	80 (A,W)	80 (A,W)	ID	4,800	37,000	14,000	6.74E+6	ID	ID
Bromoform	75252	80 (A,W)	80 (A,W)	ID	4.7E+5	3.1E+6 (S)	1.4E+5	3.10E+6	ID	ID
Bromomethane	74839	10	29	35	4,000	9,000	70,000	1.45E+7	ID	ID
n-Butanol (I)	71363	950	2,700	NA	NLV	NLV	8.8E+6	7.40E+7	4.7E+7	7.4E+7 (S)
2-Butanone (MEK) (I)	78933	13,000	38,000	2,200	2.4E+8 (S)	2.4E+8 (S)	2.4E+8 (S)	2.40E+8	ID	2.4E+8 (S)
n-Butyl acetate	123864	550	1,600	NA	6.7E+6 (S)	6.7E+6 (S)	1.8E+6	6.70E+6	2.5E+6	6.7E+6 (S)
t-Butyl alcohol	75650	3,900	11,000	NA	1.0E+9 (D,S)	1.0E+9 (D,S)	7.9E+7	1.0E+9	6.1E+7	ID
Butyl benzyl phthalate	85687	1,200	2,700 (S)	14 (X)	NLV	NLV	2,700 (S)	2,690	ID	ID
n-Butylbenzene	104518	80	230	ID	ID	ID	5,900	NA	ID	ID
sec-Butylbenzene	135988	80	230	ID	ID	ID	4,400	NA	ID	ID
tert-Butylbenzene (I)	98066	80	230	ID	ID	ID	8,900	NA	ID	ID
Cadmium (B)	7440439	5.0 (A)	5.0 (A)	(G,X)	NLV	NLV	1.9E+5	NA	ID	ID
Camphene (I)	79925	ID	ID	NA	ID	ID	ID	33,400	ID	ID
Caprolactam	105602	5,800	17,000	NA	NLV	NLV	3.9E+8	5.25E+9	NA	1.0E+9 (D)
Carbaryl	63252	700	2,000	NA	ID	ID	1.3E+5 (S)	1.26E+5	ID	ID
Carbazole	86748	85	350	10 (M); 3.9	NLV	NLV	7,400	7,480	ID	ID
Carbofuran	1563662	40 (A)	40 (A)	NA	NLV	NLV	3.4E+5	7.00E+5	ID	ID
Carbon disulfide (I,R)	75150	800	2,300	ID	2.5E+5	5.5E+5	1.2E+6 (S)	1.19E+6	13,000	ID
Carbon tetrachloride	56235	5.0 (A)	5.0 (A)	45 (X)	370	2,400	4,600	7.93E+5	ID	96,000
Chlordane (J)	57749	2.0 (A)	2.0 (A)	NA	56 (S)	56 (S)	15 (AA)	56	ID	ID
Chloride	16887006	2.5E+5 (E)	2.5E+5 (E)	(FF)	NLV	NLV	ID	NA	ID	ID
Chlorobenzene (I)	108907	100 (A)	100 (A)	47	2.1E+5	4.7E+5 (S)	86,000	4.72E+5	1.6E+5	ID
para-Chlorobenzenesulfonic acid	98668	7,300	21,000	NA	ID	ID	ID	NA	ID	ID
1-Chloro-1,1-difluoroethane	75683	15,000	44,000	NA	3.9E+6 (S)	3.9E+6 (S)	3.9E+6 (S)	3.9E+06	NA	ID
Chloroethane	75003	430	1,700	ID	5.7E+6 (S)	5.7E+6 (S)	4.4E+5	5.74E+6	1.1E+5	ID
2-Chloroethyl vinyl ether	110758	ID	ID	NA	ID	ID	ID	1.50E+7	ID	ID

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
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Chloroform	67663	80 (A,W)	80 (A,W)	170 (X)	28,000	1.8E+5	1.5E+5	7.92E+6	ID	ID
Chloromethane (I)	74873	260	1,100	ID	8,600	45,000	4.9E+5	6.34E+6	36,000	2.1E+5
4-Chloro-3-methylphenol	59507	150	420	7.4	NLV	NLV	79,000	3.90E+6	ID	ID
beta-Chloronaphthalene	91587	1,800	5,200	NA	ID	ID	6,700 (S)	6,740	ID	ID
2-Chlorophenol	95578	45	130	22	ID	ID	94,000	2.20E+7	ID	ID
o-Chlorotoluene (I)	95498	150	420	ID	2.2E+5	3.7E+5 (S)	44,000	3.73E+5	ID	ID
Chlorpyrifos	2921882	22	63	2.0 (M); 0.002	2.9	6.6	1,100 (S)	1,120	ID	ID
Chromium (III) (B,H)	16065831	100 (A)	100 (A)	(G,X)	NLV	NLV	2.9E+8	NA	ID	ID
Chromium (VI)	18540299	100 (A)	100 (A)	11	NLV	NLV	4.6E+5	NA	ID	ID
Chrysene (Q)	218019	1.6 (S)	1.6 (S)	ID	ID	ID	1.6 (S,AA)	1.6	ID	ID
Cobalt	7440484	40	100	100	NLV	NLV	2.4E+6	NA	ID	ID
Copper (B)	7440508	1,000 (E)	1,000 (E)	(G)	NLV	NLV	7.4E+6	NA	ID	ID
Cyanazine	21725462	2.3	9.4	56 (X)	NLV	NLV	2,800	1.70E+5	ID	ID
Cyanide (P,R)	57125	200 (A)	200 (A)	5.2	NLV	NLV	57,000	NA	ID	ID
Cyclohexanone	108941	33,000	94,000	NA	1,500	3,300	2.3E+7 (S)	2.30E+7	NA	ID
Dacthal	1861321	73	210	NA	NLV	NLV	500 (S)	500	ID	ID
Dalapon	75990	200 (A)	200 (A)	NA	NLV	NLV	1.2E+7	5.02E+8	ID	ID
4-4'-DDD	72548	9.1	37	NA	NLV	NLV	44 (AA)	90	ID	ID
4-4'-DDE	72559	4.3	15	NA	NLV	NLV	27 (AA)	120	ID	ID
4-4'-DDT	50293	3.6	10	0.02 (M); 1.1E-5	NLV	NLV	13 (AA)	25	NA	ID
Decabromodiphenyl ether	1163195	30 (S)	30 (S)	NA	30 (S)	30 (S)	30 (S)	30	ID	ID
Di-n-butyl phthalate	84742	880	2,500	9.7	NLV	NLV	11,000 (S)	11,200	NA	ID
Di(2-ethylhexyl) adipate	103231	400 (A)	400 (A)	ID	NLV	NLV	470 (S)	471	ID	ID
Di-n-octyl phthalate	117840	130	380	ID	NLV	NLV	400	3,000	ID	ID
Diacetone alcohol (I)	123422	ID	ID	NA	NLV	NLV	ID	1.0E+9	1.0E+9 (S)	ID
Diazinon	333415	1.3	3.8	NA	NLV	NLV	1,300	68,800	NA	ID

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Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
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Dibenzo(a,h)anthracene (Q)	53703	2.0 (M); 0.21	2.0 (M); 0.85	ID	NLV	NLV	2.0 (M,AA); 0.31	2.49	ID	ID
Dibenzofuran	132649	ID	ID	4	ID	ID	ID	10,000	ID	ID
Dibromochloromethane	124481	80 (A,W)	80 (A,W)	ID	14,000	1.1E+5	18,000	2.60E+6	ID	ID
Dibromochloropropane	96128	0.2 (A)	0.2 (A)	NA	1,200 (S)	1,200 (S)	390	1,230	NA	ID
Dibromomethane	74953	80	230	NA	ID	ID	5.3E+5	1.10E+7	ID	ID
Dicamba	1918009	220	630	NA	NLV	NLV	5.9E+5	4.5E+6	ID	ID
1,2-Dichlorobenzene	95501	600 (A)	600 (A)	16	1.6E+5 (S)	1.6E+5 (S)	1.6E+5 (S)	1.56E+5	NA	1.6E+5 (S)
1,3-Dichlorobenzene	541731	6.6	19	38	ID	ID	2,000	1.11E+5	ID	ID
1,4-Dichlorobenzene	106467	75 (A)	75 (A)	13	16,000	74,000 (S)	6,400	73,800	NA	ID
3,3'-Dichlorobenzidine	91941	1.1	4.3	0.3 (X)	NLV	NLV	180	3,110	ID	ID
Dichlorodifluoromethane	75718	1,700	4,800	ID	2.2E+5	3.0E+5 (S)	3.0E+5 (S)	3.00E+5	ID	ID
1,1-Dichloroethane	75343	880	2,500	740	1.0E+6	2.3E+6	2.4E+6	5.06E+6	3.8E+5	ID
1,2-Dichloroethane (I)	107062	5.0 (A)	5.0 (A)	360 (X)	9,600	59,000	19,000	8.52E+6	2.5E+6	ID
1,1-Dichloroethylene (I)	75354	7.0 (A)	7.0 (A)	65 (X)	200	1,300	11,000	2.25E+6	97,000	1.4E+5
cis-1,2-Dichloroethylene	156592	70 (A)	70 (A)	620	93,000	2.1E+5	2.0E+5	3.50E+6	5.3E+5	ID
trans-1,2-Dichloroethylene	156605	100 (A)	100 (A)	1,500	85,000	2.0E+5	2.2E+5	6.30E+6	2.3E+5	ID
2,6-Dichloro-4-nitroaniline	99309	2,200	6,300	NA	NLV	NLV	7,000 (S)	7,000	ID	ID
2,4-Dichlorophenol	120832	73	210	19	NLV	NLV	48,000	4.50E+6	ID	ID
2,4-Dichlorophenoxyacetic acid	94757	70 (A)	70 (A)	220	NLV	NLV	1.2E+5	6.80E+5	ID	ID
1,2-Dichloropropane (I)	78875	5.0 (A)	5.0 (A)	290 (X)	16,000	36,000	16,000	2.80E+6	5.5E+5	2.8E+6 (S)
1,3-Dichloropropene	542756	8.5	35	NA	3,900	26,000	5,500	2.80E+6	1.3E+5	ID
Dichlorovos	62737	1.6	6.7	NA	NLV	NLV	5,900	1.60E+7	NA	ID
Dicyclohexyl phthalate	84617	ID	ID	NA	ID	ID	ID	4,000	ID	ID
Dieldrin	60571	0.11	0.43	0.02 (M); 6.5E-6	200 (S)	200 (S)	2.4 (AA)	195	ID	ID
Diethyl ether	60297	10 (E)	10 (E)	ID	6.1E+7 (S)	6.1E+7 (S)	3.5E+7	6.10E+7	6.5E+5	6.1E+7 (S)
Diethyl phthalate	84662	5,500	16,000	110	NLV	NLV	1.1E+6 (S)	1.08E+6	NA	ID

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Diethylene glycol monobutyl ether	112345	88	250	NA	NLV	NLV	4.0E+6	1.0E+9	ID	ID
Diisopropyl ether	108203	30	86	ID	8,000 (S)	8,000 (S)	8,000 (S)	8,041	8,000 (S)	ID
Diisopropylamine (I)	108189	5.6	16	NA	ID	ID	21,000	3.69E+7	4.6E+6	ID
Dimethyl phthalate	131113	73,000	2.1E+5	NA	NLV	NLV	4.2E+6 (S)	4.19E+6	NA	ID
N,N-Dimethylacetamide	127195	180	520	4,100 (X)	NLV	NLV	2.3E+7	1.0E+9	NA	ID
N,N-Dimethylaniline	121697	16	46	NA	2.4E+5	1.3E+6 (S)	20,000	1.27E+6	NA	1.3E+6 (S)
Dimethylformamide (I)	68122	700	2,000	NA	NLV	NLV	1.1E+8	1.0E+9	ID	ID
2,4-Dimethylphenol	105679	370	1,000	380	NLV	NLV	5.2E+5	7.87E+6	ID	ID
2,6-Dimethylphenol	576261	4.4	13	NA	NLV	NLV	6,300	6.14E+6	ID	ID
3,4-Dimethylphenol	95658	10	29	NA	NLV	NLV	18,000	4.93E+6	ID	ID
Dimethylsulfoxide	67685	2.2E+5	6.3E+5	1.9E+5	NLV	NLV	1.7E+8 (S)	1.66E+8	ID	ID
2,4-Dinitrotoluene	121142	7.7	32	NA	NLV	NLV	8,600	2.70E+5	ID	ID
Dinoseb	88857	7.0 (A)	7.0 (A)	1.0 (M); 0.48	NLV	NLV	7,000	52,000	ID	ID
1,4-Dioxane (I)	123911	85	350	2,800 (X)	NLV	NLV	1.7E+6	9.00E+8	1.4E+8	ID
Diquat	85007	20 (A)	20 (A)	NA	NLV	NLV	7.0E+5 (S)	7.00E+5	ID	ID
Diuron	330541	31	90	NA	NLV	NLV	37,000 (S)	37,300	ID	ID
Endosulfan (J)	115297	44	130	0.03	ID	ID	510 (S)	510	ID	ID
Endothall	145733	100 (A)	100 (A)	NA	NLV	NLV	2.5E+7 (AA)	1.00E+8	ID	ID
Endrin	72208	2.0 (A)	2.0 (A)	NA	NLV	NLV	160 (AA)	250	ID	ID
Epichlorohydrin (I)	106898	5.0 (M); 2.0 (A)	5.0 (M); 2.0 (A)	NA	3.2E+5	6.3E+5	11,000	6.60E+7	4.7E+7	ID
Ethanol (I)	64175	1.9E+6	3.8E+6	NA	NLV	NLV	1.0E+9 (S)	1.0E+9	9.7E+7	ID
Ethyl acetate (I)	141786	6,600	19,000	NA	6.4E+7 (S)	6.4E+7 (S)	6.4E+7 (S)	6.40E+7	4.2E+6	ID
Ethyl-tert-butyl ether (ETBE)	637923	49 (E)	49 (E)	NA	2.9E+6	5.6E+6 (S)	ID	5.63E+6	ID	ID
Ethylbenzene (I)	100414	74 (E)	74 (E)	18	1.1E+5	1.7E+5 (S)	1.7E+5 (S)	1.69E+5	43,000	1.7E+5 (S)
Ethylene dibromide	106934	0.05 (A)	0.05 (A)	0.2 (X)	2,400	15,000	25	4.20E+6	ID	ID
Ethylene glycol	107211	15,000	42,000	1.9E+5 (X)	NLV	NLV	1.0E+9 (S)	1.0E+9	NA	1.0E+9 (S)

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Ethylene glycol monobutyl ether	111762	3,700	10,000	NA	2.9E+6	6.5E+6	5.3E+7	2.24E+8	NA	ID
Fluoranthene	206440	210 (S)	210 (S)	1.6	210 (S)	210 (S)	210 (S)	206	ID	ID
Fluorene	86737	880	2,000 (S)	12	2,000 (S)	2,000 (S)	2,000 (S)	1,980	ID	ID
Fluorine (soluble fluoride) (B)	7782414	2,000 (E)	2,000 (E)	NA	NLV	NLV	1.2E+7	NA	ID	ID
Formaldehyde	50000	1,300	3,800	120	63,000	3.6E+5	3.0E+7	5.50E+8	ID	61,000
Formic acid (I,U)	64186	10,000	29,000	ID	7.7E+6	1.5E+7	6.0E+8	1.0E+9	1.0E+9 (D)	3.5E+8
1-Formylpiperidine	2591868	80	230	NA	ID	ID	ID	NA	ID	ID
Gentian violet	548629	15	63	NA	NLV	NLV	1.0E+6 (S)	1.00E+6	ID	ID
Glyphosate	1071836	700 (A)	700 (A)	NA	NLV	NLV	1.2E+7 (S,AA)	1.16E+7	ID	ID
Heptachlor	76448	0.4 (A)	0.4 (A)	0.01 (M,X); 0.0018	180 (S)	180 (S)	2.9 (AA)	180	ID	ID
Heptachlor epoxide	1024573	0.2 (A)	0.2 (A)	ID	NLV	NLV	9.0 (AA)	200	ID	ID
n-Heptane	142825	2,700 (S)	2,700 (S)	NA	2,700 (S)	2,700 (S)	2,700 (S)	2,690	200	2,700 (S)
Hexabromobenzene	87821	0.17 (S); 20	0.17 (S); 58	ID	ID	ID	0.17 (S); 1,500	0.17	ID	ID
Hexachlorobenzene (C-66)	118741	1.0 (A)	1.0 (A)	0.2 (M); 0.0003	440	3,000	4.6	6,200	ID	ID
Hexachlorobutadiene (C-46)	87683	15	42	0.05	1,600	3,200 (S)	400	3,230	ID	ID
alpha-Hexachlorocyclohexane	319846	0.43	1.7	NA	2,000 (S)	2,000 (S)	60	2,000	ID	ID
beta-Hexachlorocyclohexane	319857	0.88	3.6	ID	NLV	NLV	120	240	ID	ID
Hexachlorocyclopentadiene (C-56)	77474	50 (A)	50 (A)	ID	130	420	1,600	1,800	ID	ID
Hexachloroethane	67721	7.3	21	6.7 (X)	27,000	50,000 (S)	1,900	50,000	ID	ID
n-Hexane	110543	3,000	8,600	NA	12,000 (S)	12,000 (S)	12,000 (S)	12,000	12,000 (S)	ID
2-Hexanone	591786	1,000	2,900	NA	4.2E+6	8.7E+6	5.2E+6	1.60E+7	NA	ID
Indeno(1,2,3-cd)pyrene (Q)	193395	2.0 (M); 0.022 (S)	2.0 (M); 0.022 (S)	ID	NLV	NLV	2.0 (M, AA); 0.022 (S)	0.022	ID	ID
Iron (B)	7439896	300 (E)	300 (E)	NA	NLV	NLV	5.8E+7	NA	ID	ID
Isobutyl alcohol (I)	78831	2,300	6,700	NA	7.6E+7 (S)	7.6E+7 (S)	2.5E+7	7.60E+7	ID	ID
Isophorone	78591	770	3,100	570 (X)	NLV	NLV	9.9E+5	1.20E+7	ID	1.2E+7 (S)
Isopropyl alcohol (I)	67630	470	1,300	57,000 (X)	NLV	NLV	1.3E+7	1.0E+9	6.0E+7	1.0E+9 (S)

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Isopropyl benzene	98828	800	2,300	ID	56,000 (S)	56,000 (S)	56,000 (S)	56,000	29,000	ID
Lead (B)	7439921	4.0 (L)	4.0 (L)	(G,X)	NLV	NLV	ID	NA	ID	ID
Lindane	58899	0.2 (A)	0.2 (A)	0.03	ID	ID	190	6,800	ID	ID
Lithium (B)	7439932	170	350	96	NLV	NLV	5.4E+6	NA	ID	ID
Magnesium (B)	7439954	4.0E+5	1.1E+6	NA	NLV	NLV	1.0E+9 (D)	NA	ID	ID
Manganese (B)	7439965	50 (E)	50 (E)	(G,X)	NLV	NLV	9.1E+6	NA	ID	ID
Mercury (Total) (B,Z)	Varies	2.0 (A)	2.0 (A)	0.0013	56 (S)	56 (S)	56 (S)	56	ID	ID
Methane (K)	74828	ID	ID	NA	(K)	(K)	ID	NA	520	ID
Methanol	67561	3,700	10,000	480	2.9E+7 (S)	2.9E+7 (S)	2.9E+7 (S)	2.90E+7	4.5E+6	2.9E+7 (S)
Methoxychlor	72435	40 (A)	40 (A)	NA	ID	ID	45 (S)	45	ID	ID
2-Methoxyethanol (I)	109864	7.3	21	NA	NLV	NLV	8.3E+5	1.0E+9	ID	ID
2-Methyl-4-chlorophenoxyacetic acid	94746	7.3	21	NA	NLV	NLV	9,200	9.24E+5	ID	ID
2-Methyl-4,6-dinitrophenol	534521	20 (M); 2.6	20 (M); 7.3	NA	NLV	NLV	9,500	2.00E+5	ID	ID
N-Methyl-morpholine (I)	109024	20	56	NA	NLV	NLV	1.5E+6	1.0E+9	ID	ID
Methyl parathion	298000	1.8	5.2	NA	NLV	NLV	3,000	50,000	ID	ID
4-Methyl-2-pentanone (MIBK) (I)	108101	1,800	5,200	ID	2.0E+7 (S)	2.0E+7 (S)	1.3E+7	2.00E+7	ID	2.0E+7 (S)
Methyl-tert-butyl ether (MTBE)	1634044	40 (E)	40 (E)	730 (X)	4.7E+7 (S)	4.7E+7 (S)	6.1E+5	4.68E+7	ID	ID
Methylcyclopentane (I)	96377	ID	ID	NA	ID	ID	ID	73,890	ID	ID
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	1.1	4.5	NA	NLV	NLV	110 (AA)	14,000	ID	ID
Methylene chloride	75092	5.0 (A)	5.0 (A)	940 (X)	2.2E+5	1.4E+6	2.2E+5	1.70E+7	ID	ID
2-Methylnaphthalene	91576	260	750	ID	ID	ID	25,000 (S)	24,600	ID	ID
Methylphenols (J)	1319773	370	1,000	71	NLV	NLV	8.1E+5	2.80E+7	NA	ID
Metolachlor	51218452	240	990	NA	NLV	NLV	91,000	5.30E+5	ID	ID
Metribuzin	21087649	180	520	NA	ID	ID	1.2E+6 (S)	1.2E+6	ID	ID
Mirex	2385855	0.02 (M); 6.8E-6 (S)	0.02 (M); 6.8E-6 (S)	0.02 (M); 6.8E-6 (S)	ID	ID	0.02 (M); 6.8E-6 (S)	6.8E-6	NA	ID
Molybdenum (B)	7439987	73	210	800 (X)	NLV	NLV	9.7E+5	NA	ID	ID

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Naphthalene	91203	520	1,500	13	31,000 (S)	31,000 (S)	31,000 (S)	31,000	NA	31,000 (S)
Nickel (B)	7440020	100 (A)	100 (A)	(G)	NLV	NLV	7.4E+7	NA	ID	ID
Nitrate (B,N)	14797558	10,000 (A,N)	10,000 (A,N)	NA	NLV	NLV	3.1E+8	NA	ID	ID
Nitrite (B,N)	14797650	1,000 (A,N)	1,000 (A,N)	NA	NLV	NLV	ID	NA	ID	ID
Nitrobenzene (I)	98953	3.4	9.6	180 (X)	2.8E+5	5.5E+5	11,000	2.09E+6	NA	ID
2-Nitrophenol	88755	20	58	ID	NLV	NLV	79,000	2.50E+6	ID	ID
n-Nitroso-di-n-propylamine	621647	5.0 (M); 0.19	5.0 (M); 0.77	NA	NLV	NLV	360	9.89E+6	ID	ID
N-Nitrosodiphenylamine	86306	270	1,100	NA	NLV	NLV	35,000 (S)	35,100	ID	ID
Oxamyl	23135220	200 (A)	200 (A)	NA	NLV	NLV	6.2E+7	2.80E+8	ID	ID
Oxo-hexyl acetate	88230357	73	210	NA	ID	ID	ID	NA	ID	ID
Pendimethalin	40487421	280 (S)	280 (S)	NA	NLV	NLV	280 (S)	275	ID	ID
Pentachlorobenzene	608935	6.1	17	5.0 (M); 0.019	ID	ID	240	650	ID	ID
Pentachloronitrobenzene	82688	32 (S)	32 (S)	NA	32 (S)	32 (S)	32 (S)	32	ID	ID
Pentachlorophenol	87865	1.0 (A)	1.0 (A)	(G,X)	NLV	NLV	200	1.85E+6	ID	ID
Pentane	109660	ID	ID	NA	38,000 (S)	38,000 (S)	ID	38,200	340	38,000 (S)
2-Pentene (I)	109682	ID	ID	NA	ID	ID	ID	2.03E+5	ID	ID
pH	NA	6.5 to 8.5 (E)	6.5 to 8.5 (E)	6.5 to 9.0	NA	NA	NA	NA	NA	NA
Phenanthrene	85018	52	150	2.4	1,000 (S)	1,000 (S)	1,000 (S)	1,000	ID	ID
Phenol	108952	4,400	13,000	210	NLV	NLV	2.9E+7	8.28E+7	NA	ID
Phosphorus (Total)	7723140	63,000	2.4E+5	(EE)	NLV	NLV	ID	NA	ID	ID
Phthalic acid	88993	14,000	40,000	NA	NLV	NLV	1.4E+7 (S)	1.42E+7	ID	ID
Phthalic anhydride	85449	15,000	44,000	NA	NLV	NLV	6.2E+6 (S)	6.2E+6	NA	ID
Picloram	1918021	500 (A)	500 (A)	46	NLV	NLV	4.3E+5 (S)	4.30E+5	ID	ID
Piperidine	110894	3.2	9.2	NA	NLV	NLV	34,000	1.0E+9	ID	ID
Polybrominated biphenyls (J)	67774327	0.03	0.09	NA	NLV	NLV	ID	1.66E+7	ID	ID
Polychlorinated biphenyls (PCBs) (J,T)	1336363	0.5 (A)	0.5 (A)	0.2 (M); 2.6E-5	45 (S)	45 (S)	3.3 (AA)	44.7	ID	ID

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria & RBSLs	Industrial & Commercial II, III & IV Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Prometon	1610180	160	460	NA	NLV	NLV	1.8E+5	7.50E+5	ID	ID
Propachlor	1918167	95	270	NA	NLV	NLV	4.4E+5	6.55E+5	ID	ID
Propazine	139402	200	560	NA	NLV	NLV	8,600 (S)	8,600	ID	ID
Propionic acid	79094	12,000	35,000	ID	NLV	NLV	2.8E+8	1.0E+9	1.0E+9 (D)	ID
Propyl alcohol (I)	71238	1,400	4,000	NA	NLV	NLV	2.8E+7	1.0E+9	7.1E+7	1.0E+9 (S)
n-Propylbenzene (I)	103651	80	230	ID	ID	ID	15,000	NA	ID	ID
Propylene glycol	57556	1.5E+5	4.2E+5	2.9E+5	NLV	NLV	1.0E+9 (D,S)	1.0E+9	ID	ID
Pyrene	129000	140 (S)	140 (S)	ID	140 (S)	140 (S)	140 (S)	135	ID	ID
Pyridine (I)	110861	20 (M); 7.3	21	NA	5,500	12,000	94,000	3.00E+5	81,000	ID
Selenium (B)	7782492	50 (A)	50 (A)	5.0	NLV	NLV	9.7E+5	NA	ID	ID
Silver (B)	7440224	34	98	0.2 (M); 0.06	NLV	NLV	1.5E+6	NA	ID	ID
Silvex (2,4,5-TP)	93721	50 (A)	50 (A)	30	NLV	NLV	43,000	1.40E+5	ID	ID
Simazine	122349	4.0 (A)	4.0 (A)	NA	NLV	NLV	4,500 (S)	4,470	ID	ID
Sodium	17341252	1.2E+5	3.5E+5	NA	NLV	NLV	1.0E+9 (D)	NA	ID	ID
Sodium azide	26628228	88	250	NA	ID	ID	ID	NA	ID	ID
Strontium (B)	7440246	4,600	13,000	2,300 (X)	NLV	NLV	1.2E+8	NA	ID	ID
Styrene	100425	100 (A)	100 (A)	80	1.7E+5	3.1E+5 (S)	9,700	3.10E+5	1.4E+5	3.1E+5 (S)
Sulfate	14808798	2.5E+5 (E)	2.5E+5 (E)	NA	NLV	NLV	ID	NA	ID	ID
Tebuthiuron	34014181	510	1,500	NA	NLV	NLV	2.5E+6 (S)	2.50E+6	ID	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	(O)	(O)	(O)	NLV	NLV	(O)	0.00996	ID	ID
1,2,4,5-Tetrachlorobenzene	95943	1,300 (S)	1,300 (S)	2.9 (X)	ID	ID	1,300 (S)	1,300	ID	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	3.0E-5 (A)	3.0E-5 (A)	1.0E-5 (M); 3E-9	NLV	NLV	1.0E-5 (M,O,AA)	0.019	ID	ID
1,1,1,2-Tetrachloroethane	630206	77	320	ID (X)	15,000	96,000	30,000	1.10E+6	ID	ID
1,1,2,2-Tetrachloroethane	79345	8.5	35	78 (X)	12,000	77,000	4,700	2.97E+6	ID	ID
Tetrachloroethylene	127184	5.0 (A)	5.0 (A)	45 (X)	25,000	1.7E+5	12,000	2.0E+5	ID	2.0E+5 (S)
Tetrahydrofuran	109999	95	270	11,000 (X)	6.9E+6	1.6E+7	1.6E+6	1.0E+9	60,000	3.6E+6

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria & RBSLs	Industrial & Commercial II, III & IV Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Tetranitromethane	509148	ID	ID	NA	580	3,200	ID	85,000	ID	ID
Thallium (B)	7440280	2.0 (A)	2.0 (A)	3.7 (X)	NLV	NLV	13,000	NA	ID	ID
Toluene (I)	108883	790 (E)	790 (E)	140	5.3E+5 (S)	5.3E+5 (S)	5.3E+5 (S)	5.26E+5	61,000	ID
p-Toluidine	106490	15	62	NA	NLV	NLV	24,000	7.60E+6	NA	ID
Total dissolved solids (TDS)	NA	5.0E+5 (E)	5.0E+5 (E)	(EE)	NA	NA	NA	NA	NA	NA
Toxaphene	8001352	3.0 (A)	3.0 (A)	1.0 (M); 6.8E-5	NLV	NLV	44	740	ID	740 (S)
Triallate	2303175	95	270	NA	ID	ID	4,000 (S)	4,000	ID	ID
Tributylamine	102829	10	29	ID	14,000	32,000	2,300	75,400	ID	ID
1,2,4-Trichlorobenzene	120821	70 (A)	70 (A)	30	3.0E+5 (S)	3.0E+5 (S)	19,000	3.00E+5	NA	3.0E+5 (S)
1,1,1-Trichloroethane	71556	200 (A)	200 (A)	200	6.6E+5	1.3E+6 (S)	1.3E+6 (S)	1.33E+6	ID	1.3E+6 (S)
1,1,2-Trichloroethane	79005	5.0 (A)	5.0 (A)	330 (X)	17,000	1.1E+5	21,000	4.42E+6	NA	ID
Trichloroethylene	79016	5.0 (A)	5.0 (A)	200 (X)	15,000	97,000	22,000	1.10E+6	ID	1.1E+6 (S)
Trichlorofluoromethane	75694	2,600	7,300	NA	1.1E+6 (S)	1.1E+6 (S)	1.1E+6 (S)	1.10E+6	ID	1.1E+6 (S)
2,4,5-Trichlorophenol	95954	730	2,100	NA	NLV	NLV	1.7E+5	1.20E+6	ID	ID
2,4,6-Trichlorophenol	88062	120	470	4.4	NLV	NLV	10,000	8.00E+5	ID	ID
1,2,3-Trichloropropane	96184	42	120	NA	ID	ID	84,000	1.90E+6	NA	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	1.7E+5 (S)	1.7E+5 (S)	32	1.7E+5 (S)	1.7E+5 (S)	1.7E+5 (S)	1.70E+5	ID	1.7E+5 (S)
Triethanolamine	102716	3,700	10,000	NA	NLV	NLV	1.0E+9 (D,S)	1.0E+9	ID	ID
Triethylene glycol	112276	4,300	12,000	NA	NLV	NLV	1.0E+6 (S)	1.00E+6	ID	ID
3-Trifluoromethyl-4-nitrophenol	88302	4,500	13,000	NA	NLV	NLV	5.0E+6 (S)	5.00E+6	ID	ID
Trifluralin	1582098	37	110	NA	ID	ID	2,400	8,100	ID	ID
2,2,4-Trimethyl pentane	540841	ID	ID	NA	ID	ID	ID	2,330	160	ID
2,4,4-Trimethyl-2-pentene (I)	107404	ID	ID	NA	ID	ID	ID	11,900	ID	ID
1,2,4-Trimethylbenzene (I)	95636	63 (E)	63 (E)	17	56,000 (S)	56,000 (S)	56,000 (S)	55,890	56,000 (S)	ID
1,3,5-Trimethylbenzene (I)	108678	72 (E)	72 (E)	45	61,000 (S)	61,000 (S)	61,000 (S)	61,150	ID	ID
Triphenyl phosphate	115866	1,200	1,400 (S)	NA	NLV	NLV	1,400 (S)	1,430	ID	ID

TABLE 1. GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
	Chemical Abstract Service Number	Residential & Commercial I Drinking Water Criteria & RBSLs	Industrial & Commercial II, III & IV Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
tris(2,3-Dibromopropyl)phosphate	126727	10 (M); 0.71	10 (M); 2.9	NA	4,700 (S)	4,700 (S)	2,100	4,700	ID	ID
Urea	57136	ID (N)	ID (N)	NA	NLV	NLV	ID	NA	ID	ID
Vanadium	7440622	4.5	62	12	NLV	NLV	9.7E+5	NA	ID	ID
Vinyl acetate (I)	108054	640	1,800	NA	4.1E+6	8.9E+6	8.0E+6	2.00E+7	1.8E+6	4.8E+6
Vinyl chloride	75014	2.0 (A)	2.0 (A)	15	1,100	13,000	1,000	2.76E+6	33,000	ID
White phosphorus (R)	12185103	0.11	0.31	NA	NLV	NLV	2,900	NA	ID	ID
Xylenes (I)	1330207	280 (E)	280 (E)	35	1.9E+5 (S)	1.9E+5 (S)	1.9E+5 (S)	1.86E+5	70,000	1.9E+5 (S)
Zinc (B)	7440666	2,400	5,000 (E)	(G)	NLV	NLV	1.1E+8	NA	ID	ID
Water Quality Characteristic										
Dissolved oxygen (DO)	NA	NA	NA	(EE)	NA	NA	NA	NA	NA	NA

TABLE 2. SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 ppb is presented as 2.0E+5. The lowest generic soil criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are presented in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. These tables reflect modifications to the TDLs and new criteria consistent with the provisions of R299.5103(l) and R299.5706a, respectively.

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	4,400	9.7E+5	1.9E+8	8.1E+7	8.1E+7	8.1E+7	1.4E+10	4.1E+7	NA
Acenaphthylene	208968	NA	5,900	ID	4.4E+5	1.6E+6	2.2E+6	2.2E+6	2.2E+6	2.3E+9	1.6E+6	NA
Acetaldehyde (I)	75070	NA	19,000	2,600	1.1E+8 (C)	2.2E+5	1.7E+5	1.7E+5	2.8E+5	6.0E+8	2.9E+7	1.1E+8
Acetate	71501	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Acetic acid	64197	NA	84,000	3.6E+5	6.5E+8 (C)	NLV	NLV	NLV	NLV	1.7E+10	1.3E+8	6.5E+8
Acetone (I)	67641	NA	15,000	34,000	1.1E+8 (C)	1.1E+8 (C)	1.3E+8	1.3E+8	1.9E+8	3.9E+11	2.3E+7	1.1E+8
Acetonitrile	75058	NA	2,800	NA	2.2E+7 (C)	4.8E+6	1.6E+6	1.6E+6	2.1E+6	4.0E+9	4.3E+6	2.2E+7
Acetophenone	98862	NA	30,000	NA	1.1E+6 (C)	1.1E+6 (C)	4.4E+7	4.4E+7	4.4E+7	3.3E+10	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	NA	2.3E+7 (C)	410	310	310	610	1.3E+6	3.6E+6	2.3E+7
Acrylamide	79061	NA	10	NA	2.6E+5	NLV	NLV	NLV	NLV	2.4E+6	1,900	NA
Acrylic acid	79107	NA	78,000	NA	1.1E+8 (C)	2.4E+6	1.9E+5	2.3E+5	2.3E+5	6.7E+7	3.5E+7 (DD)	1.1E+8
Acrylonitrile (I)	107131	NA	100 (M); 52	100 (M,X); 98	2.8E+5	6,600	5,000	5,100	10,000	4.6E+7	16,000	8.3E+6
Alachlor	15972608	NA	52	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	93,000	NA
Aldicarb	116063	NA	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	2.3E+5	NA
Aldicarb sulfoxide	1646873	NA	200 (M)	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	2.9E+5	NA
Aldicarb sulfone	1646884	NA	200 (M); 40	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	2.5E+5	NA
Aldrin	309002	NA	NLL	NLL	NLL	1.3E+6	58,000	58,000	58,000	6.4E+5	1,000	NA
Aluminum (B)	7429905	6.9E+6	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.0E+7 (DD)	NA
Ammonia	7664417	NA	ID	(CC)	ID	ID	ID	ID	ID	6.7E+9	ID	1.0E+7

TABLE 2. SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
t-Amyl methyl ether (TAME)	994058	NA	3,900	NA	4.4E+5 (C)	58,000	3.4E+5	7.6E+5	1.8E+6	4.1E+9	4.4E+5 (C)	4.4E+5
Aniline	62533	NA	1,100	330 (M); 80	2.8E+6	NLV	NLV	NLV	NLV	6.7E+7	3.3E+5	4.5E+6
Anthracene	120127	NA	41,000	ID	41,000	1.0E+9 (D)	1.4E+9	1.4E+9	1.4E+9	6.7E+10	2.3E+8	NA
Antimony	7440360	NA	4,300	94,000	4.9E+7	NLV	NLV	NLV	NLV	1.3E+7	1.8E+5	NA
Arsenic	7440382	5,800	4,600	70,000 (X)	2.0E+6	NLV	NLV	NLV	NLV	7.2E+5	7,600	NA
Asbestos (BB)	1332214	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+7 (M); 68,000	ID	NA
Atrazine	1912249	NA	60	150 (X)	1.1E+5	NLV	NLV	NLV	NLV	ID	71,000 (DD)	NA
Azobenzene	103333	NA	4,200	NA	3.0E+5	6.1E+6	6.3E+5	ID	ID	1.0E+8	1.4E+5	NA
Barium (B)	7440393	75,000	1.3E+6	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	3.7E+7	NA
Benzene (I)	71432	NA	100	4,000 (X)	2.2E+5	1,600	13,000	34,000	79,000	3.8E+8	1.8E+5	4.0E+5
Benzidine	92875	NA	1,000 (M); 6.0	ID	1,000 (M); 140	NLV	NLV	NLV	NLV	46,000	1,000 (M); 23	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	20,000	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	20,000	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	2.0E+5	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.0E+8	2.5E+6	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	2,000	NA
Benzoic acid	65850	NA	6.4E+5	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	9.9E+8	NA
Benzyl alcohol	100516	NA	2.0E+5	NA	5.8E+6 (C)	NLV	NLV	NLV	NLV	3.3E+11	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	150	NA	72,000	6,300	14,000	14,000	17,000	6.2E+7	48,000	2.3E+5
Beryllium	7440417	NA	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+6	4.1E+5	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	ID	ID	NLV	NLV	NLV	NLV	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	100	300	1.1E+5	8,300	3,800	3,800	3,800	9.4E+6	13,000	2.2E+6
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	7.0E+8	2.8E+6	1.0E+7
Boron (B)	7440428	NA	10,000	38,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	4.8E+7 (DD)	NA

TABLE 2. SOIL: RESIDENTIAL AND COMMERCIAL I
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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Bromate	15541454	NA	200	800	96,000	NLV	NLV	NLV	NLV	ID	17,000	NA
Bromobenzene (I)	108861	NA	550	NA	3.6E+5	3.1E+5	4.5E+5	4.5E+5	4.5E+5	5.3E+8	5.4E+5	7.6E+5
Bromodichloromethane	75274	NA	1,600 (W)	ID	2.8E+5	1,200	9,100	9,700	19,000	8.4E+7	1.1E+5	1.5E+6
Bromoform	75252	NA	1,600 (W)	ID	8.7E+5 (C)	1.5E+5	9.0E+5	9.0E+5	9.0E+5	2.8E+9	8.2E+5	8.7E+5
Bromomethane	74839	NA	200	700	1.4E+6	860	11,000	57,000	1.4E+5	3 3E+8	3.2E+5	2.2E+6
n-Butanol (I)	71363	NA	19,000	NA	8.7E+6 (C)	NLV	NLV	NLV	NLV	2.3E+10	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	44,000	2.7E+7 (C)	2.7E+7 (C)	2.9E+7	2.9E+7	3.5E+7	6.7E+10	2.7E+7 (C,DD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.1E+8	2.6E+8	3.2E+8	4.7E+11	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	NA	1.1E+8 (C)	1.1E+8 (C)	9.7E+7	2.0E+8	2.0E+8	1.3E+11	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	26,000 (X)	3.1E+5 (C)	NLV	NLV	NLV	NLV	4.7E+10	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	ID	1.2E+5	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
sec-Butylbenzene	135988	NA	1.600	ID	88,000	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
t-Butylbenzene (I)	98066	NA	1,600	NA	1.8E+5	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
Cadmium (B)	7440439	1.200	6.000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	1.7E+6	5.5E+5	NA
Camphene (I)	79925	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA
Caprolactam	105602	NA	1.2E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+8	5.3E+7 (DD)	NA
Carbaryl	63252	NA	14,000	NA	2.6E+6	ID	ID	ID	ID	ID	2.2E+7	NA
Carbazole	86748	NA	9,400	1,100	8.2E+5	NLV	NLV	NLV	NLV	ID	5.3E+5	NA
Carbofuran	1563662	NA	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	1.1E+6	NA
Carbon disulfide (I,R)	75150	NA	16,000	ID	2.8E+5 (C)	76,000	1.3E+6	7.9E+6	1.9E+7	4.7E+10	2.8E+5 (C,DD)	2.8E+5
Carbon tetrachloride	56235	NA	100	900 (X)	92,000	190	3,500	12,000	28,000	1.3E+8	96,000	3.9E+5
Chlordane (J)	57749	NA	NLL	NLL	NLL	1.1E+7	1.2E+6	1.2E+6	1.2E+6	3.1E+7	31,000	NA
Chloride	16887006	NA	5.0E+6	2.5E+6 (X)	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 (F)	NA
Chlorobenzene (I)	108907	NA	2,000	940	2.6E+5 (C)	1.2E+5	7.7E+5	9.9E+5	2.1E+6	4.7E+9	2.6E+5 (C)	2.6E+5

TABLE 2. SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
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para-Chlorobenzenesulfonic acid	98668	NA	1.5E+05	NA	NA	ID	ID	ID	ID	ID	2.3E+8	ID
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	NA	9.6E+5 (C)	9.6E+5 (C)	7.9E+7	5.6E+8	1.4E+9	3.3E+12	9.6E+5 (C)	9.6E+5
Chloroethane	75003	NA	8,600	ID	9.5E+5 (C)	9.5E+5 (C)	3.0E+7	1.2E+8	2.8E+8	6.7E+11	9.5E+5 (C)	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	1,600 (W)	3,400 (X)	1.5E+6 (C)	7,200	45,000	1.2E+5	2.7E+5	1.3E+9	1.2E+6	1.5E+6
Chloromethane (I)	74873	NA	5,200	ID	1.1E+6 (C)	2,300	40,000	4.1E+5	1.0E+6	4.9E+9	1.1E+6 (C)	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	280	3.0E+6	NLV	NLV	NLV	NLV	ID	4.5E+6	NA
beta-Chloronaphthalene	91587	NA	6.2E+5	NA	2.3E+6	ID	ID	ID	ID	ID	5.6E+7	NA
2-Chlorophenol	95578	NA	900	440	1.9E+6	ID	ID	ID	ID	ID	1.4E+6	1.9E+7
o-Chlorotoluene (I)	95498	NA	3,300	NA	5.0E+5 (C)	2.7E+5	1.2E+6	2.9E+6	6.3E+6	4.7E+9	5.0E+5 (C)	5.0E+5
Chlorpyrifos	2921882	NA	17,000	1,500	8.4E+5	130	4,600	23,000	55,000	1.3E+8	1.1E+7	NA
Chromium (III) (B,H)	16065831	18,000 (total)	1.0E+9 (D)	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	7.9E+8	NA
Chromium (VI)	18540299	NA	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.6E+5	2.5E+6	NA
Chrysene (Q)	218019	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	2.0E+6	NA
Cobalt	7440484	6,800	800	2,000	4.8E+7	NLV	NLV	NLV	NLV	1.3E+7	2.6E+6	NA
Copper (B)	7440508	32,000	5.8E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+8	2.0E+7	NA
Cyanazine	21725462	NA	200	1,100 (X)	56,000	NLV	NLV	NLV	NLV	ID	14,000	NA
Cyanide (P,R)	57125	390 (total)	4,000	100	2.5E+5	NLV	NLV	NLV	NLV	2.5E+5	12,000	NA
Cyclohexanone	108941	NA	5.2E+6	NA	2.2E+8 (C)	17,000	1.0E+6	1.1E+7	2.7E+7	6.7E+10	2.2E+8 (C)	2.2E+8
Dacthal	1861321	NA	50,000	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	2.3E+6	NA
Dalapon	75990	NA	4,000	NA	5.9E+7 (C)	NLV	NLV	NLV	NLV	ID	1.9E+7	5.9E+7
4-4'-DDD	72548	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.4E+7	95,000	NA
4-4'-DDE	72559	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	45,000	NA
4-4'-DDT	50293	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	57,000	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
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Decabromodiphenyl ether	1163195	NA	1.4E+5	NA	1.4E+5	1.0E+9 (D)	8.6E+7	8.6E+7	8.6E+7	2.3E+9	3.8E+6	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	11,000	7.6E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	NA	9.6E+5 (C)	NLV	NLV	NLV	NLV	9.2E+9	9.6E+5 (C,DD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	ID	6.9E+6	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	NA	ID	NLV	NLV	NLV	NLV	1.6E+11	ID	1.1E+8
Diazinon	333415	NA	95	NA	95,000	NLV	NLV	NLV	NLV	ID	12,000 (DD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	2,000	NA
Dibenzofuran	132649	NA	ID	1,700	ID	ID	ID	ID	ID	ID	ID	NA
Dibromochloromethane	124481	NA	1,600 (W)	ID	3.6E+5	3,900	24,000	24,000	33,000	1.3E+8	1.1E+5	6.1E+5
Dibromochloropropane	96128	NA	10 (M); 4.0	NA	1,200 (C)	1,200 (C)	13,000	13,000	13,000	1.3E+7	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6
Dicamba	1918009	NA	4,400	NA	1.2E+7	NA	NLV	NLV	NLV	ID	3.4E+6	NA
1,2-Dichlorobenzene	95501	NA	14,000	360	2.1E+5 (C)	2.1E+5 (C)	3.9E+7	3.9E+7	5.2E+7	1.0E+11	2.1E+5 (C)	2.1E+5
1,3-Dichlorobenzene	541731	NA	170	1,100	51,000	ID	ID	ID	ID	ID	1.7E+5 (C)	1.7E+5
1,4-Dichlorobenzene	106467	NA	1,700	290	1.4E+5	19,000	77,000	77,000	1.1E+5	4.5E+8	4.0E+5	NA
3,3'-Dichlorobenzidine	91941	NA	2,000 (M); 28	2,000 (M,X); 510	4,600	NLV	NLV	NLV	NLV	6.5E+6	6,600	NA
Dichlorodifluoromethane	75718	NA	95,000	ID	1.0E+6 (C)	9.0E+5	5.3E+7	5.5E+8	1.4E+9	3.3E+12	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	15,000	8.9E+5 (C)	2.3E+5	2.1E+6	5.9E+6	1.4E+7	3.3E+10	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	100	7,200 (X)	3.8E+5	2,100	6,200	11,000	26,000	1.2E+8	91,000	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	1,300 (X)	2.2E+5	62	1,100	5,300	13,000	6.2E+7	2.0E+5	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	1,400	12,000	6.4E+5 (C)	22,000	1.8E+5	4.2E+5	9.9E+5	2.3E+9	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	2,000	30,000	1.4E+6 (C)	23,000	2.8E+5	8.3E+5	2.0E+6	4.7E+9	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	6.8E+7	NA
2,4-Dichlorophenol	120832	NA	1,500	380	9.6E+5	NLV	NLV	NLV	NLV	5.1E+9	6.6E+5 (DD)	1.8E+6

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
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2,4-Dichlorophenoxyacetic acid	94757	NA	1,400	4,400	2.4E+6	NLV	NLV	NLV	NLV	6.7E+9	2.5E+6	NA
1,2-Dichloropropane (I)	78875	NA	100	5,800 (X)	3.2E+5	4,000	25,000	50,000	1.1E+5	2.7E+8	1.4E+5	5.5E+5
1,3-Dichloropropene	542756	NA	170	NA	1.1E+5	1,000	18,000	68,000	1.6E+5	7.8E+8	10,000	6.2E+5
Dichlorovos	62737	NA	50 (M); 32	NA	1.2E+5	NLV	NLV	NLV	NLV	3.3E+7	10,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA
Dieldrin	60571	NA	NLL	NLL	NLL	1.4E+5	19,000	19,000	19,000	6.8E+5	1,100	NA
Diethyl ether	60297	NA	200	ID	7.4E+6 (C)	7.4E+6 (C)	8.5E+7	1.5E+8	3.4E+8	8.0E+11	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	2,200	7.4E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.4E+5 (C)	7.4E+5
Diethylene glycol monobutyl ether	112345	NA	1,800	NA	8.0E+7	NLV	NLV	NLV	NLV	1.3E+9	2.7E+6	1.1E+8
Diisopropyl ether	108203	NA	600	ID	1,300 (C)	1,300 (C)	3.4E+5	7.6E+5	1.8E+6	4.1E+9	1,300 (C)	1,300
Diisopropylamine (I)	108189	NA	110	NA	4.2E+5	ID	ID	ID	ID	ID	1.7E+5	6.7E+6
Dimethyl phthalate	131113	NA	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	3,600	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	5.6E+6	1.1E+8
N,N-Dimethylaniline	121697	NA	320	NA	4.0E+5	1.7E+5	1.5E+5	1.5E+5	1.5E+5	2.6E+8	5.0E+5	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+9	2.2E+7	1.1E+8
2,4-Dimethylphenol	105679	NA	7,400	7,600	1.0E+7	NLV	NLV	NLV	NLV	4.7E+9	1.1E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M); 88	NA	1.3E+5	NLV	NLV	NLV	NLV	ID	1.4E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M); 200	NA	3.6E+5	NLV	NLV	NLV	NLV	ID	3.2E+5	NA
Dimethylsulfoxide	67685	NA	4.4E+6	3.8E+6	1.8E+7 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	NA	1.7E+5	NLV	NLV	NLV	NLV	1.6E+7	48,000	NA
Dinoseb	88857	NA	300	200 (M); 43	1.4E+5 (C)	NLV	NLV	NLV	NLV	ID	66,000 (DD)	1.4E+5
1,4-Dioxane (I)	123911	NA	1,700	56,000	3.4E+7	NLV	NLV	NLV	NLV	5.7E+8	5.3E+5	9.7E+7
Diquat	85007	NA	400	NA	1.4E+7	NLV	NLV	NLV	NLV	ID	5.0E+5	NA
Diuron	330541	NA	620	NA	7.4E+5	NLV	NLV	NLV	NLV	4.7E+8	9.7E+5	NA

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Endosulfan (J)	115297	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	1.4E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	2.3E+9	3.8E+6	NA
Endrin	72208	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	65,000	NA
Epichlorohydrin (I)	106898	NA	100	NA	2.2E+5	64,000	31,000	31,000	35,000	6.7E+7	8,900	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.3E+12	1.1E+8 (C,DD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	NA	7.5E+6 (C)	7.5E+6 (C)	4.9E+7	4.9E+7	9.8E+7	2.1E+11	7.5E+6 (C)	7.5E+6
Ethyl-tert-butyl ether (ETBE)	637923	NA	980	ID	ID	5.4E+5	1.9E+6	4.5E+6	1.1E+7	2.5E+10	ID	6.5E+5
Ethylbenzene (I)	100414	NA	1,500	360	1.4E+5 (C)	87,000	7.2E+5	1.0E+6	2.2E+6	1.0E+10	1.4E+5 (C)	1.4E+5
Ethylene dibromide	106934	NA	20 (M); 1.0	20 (M); 4.0	500	670	1,700	1,700	3,300	1.4E+7	92	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.7E+10	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	NA	4.1E+7 (C)	7.4E+5	1.8E+7	1.5E+8	3.6E+8	8.7E+11	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	7.4E+8	7.4E+8	7.4E+8	9.3E+9	4.6E+7	NA
Fluorene	86737	NA	3.9E+5	5,300	8.9E+5	5.8E+8	1.3E+8	1.3E+8	1.3E+8	9.3E+9	2.7E+7	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	NA	2.4E+8	NLV	NLV	NLV	NLV	ID	9.0E+6 (DD)	NA
Formaldehyde	50000	NA	26,000	2,400	6.0E+7 (C)	12,000	13,000	23,000	52,000	2.4E+8	4.1E+7	6.0E+7
Formic acid (I,U)	64186	NA	2.0E+5	ID	1.1E+8 (C)	1.5E+6	2.1E+5	1.4E+5	1.4E+5	1.3E+8	1.1E+8 (C)	1.1E+8
1-Formylpiperidine	2591868	NA	1,600	NA	ID	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
Gentian violet	548629	NA	300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	96,000	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.1E+7 (DD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	3.5E+5	62,000	62,000	62,000	2.4E+6	5,600	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.2E+6	3,100	NA
n-Heptane	142825	NA	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.1E+7	4.4E+7	1.0E+8	2.3E+11	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	5,400	ID	5,400	ID	ID	ID	ID	ID	1.1E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	350	8,200	41,000	17,000	17,000	17,000	6.8E+6	8,900	NA

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PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Hexachlorobutadiene (C-46)	87683	NA	26,000	91	3.5E+5 (C)	1.3E+5	1.3E+5	1.3E+5	1.3E+5	1.4E+8	1.0E+5	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	NA	2,500	30,000	12,000	22,000	25,000	1.7E+6	2,600	NA
beta-Hexachlorocyclohexane	319857	NA	37	ID	5,100	NLV	NLV	NLV	NLV	5.9E+6	5,400	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	ID	7.2E+5 (C)	30,000	50,000	50,000	50,000	1.3E+7	7.2E+5 (C)	7.2E+5
Hexachloroethane	67721	NA	430	1,800 (X)	1.1E+5	40,000	5.5E+5	9.3E+5	9.3E+5	2.3E+8	2.3E+5	NA
n-Hexane	110543	NA	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.0E+6	3.2E+6	6.2E+6	1.3E+10	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	NA	2.5E+6 (C)	9.9E+5	1.1E+6	1.1E+6	1.4E+6	2.7E+9	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	20,000	NA
Iron (B)	7439896	1.2E+7	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.6E+8	NA
Isobutyl alcohol (I)	78831	NA	46,000	NA	8.9E+6 (C)	8.9E+6 (C)	7.9E+7	7.9E+7	7.9E+7	1.0E+11	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	11,000 (X)	2.4E+6 (C)	NLV	NLV	NLV	NLV	1.2E+10	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	9,400	1.1E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+10	1.4E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	ID	3.9E+5 (C)	3.9E+5 (C)	1.7E+6	1.7E+6	2.8E+6	5.8E+9	3.9E+5 (C)	3.9E+5
Lead (B)	7439921	21,000	7.0E+5	(G,X)	ID	NLV	NLV	NLV	NLV	1.0E+8	4.0E+5	NA
Lindane	58899	NA	20 (M); 7.0	20 (M); 0.99	7,100	ID	ID	ID	ID	ID	8,300	NA
Lithium (B)	7439932	9,800	3,400	1,900	1.1E+8	NLV	NLV	NLV	NLV	ID	4.2E+6 (DD)	NA
Magnesium (B)	7439954	NA	8.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+9	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	3.3E+6	2.5E+7	NA
Mercury (Total) (B,Z)	Varies	130	1,700	50 (M); 1.2	47,000	48,000	52,000	52,000	52,000	2.0E+7	1.6E+5	NA
Methane	74828	NA	ID	NA	ID	8.4E+6 ug/m3 (GG)	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	9,600	3.1E+6 (C)	3.1E+6 (C)	3.1E+7	4.4E+7	9.6E+7	2.2E+11	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	NA	18,000	ID	ID	ID	ID	ID	1.9E+6	NA
2-Methoxyethanol (I)	109864	NA	150	NA	1.7E+7	NLV	NLV	NLV	NLV	1.3E+9	2.3E+5	1.1E+8
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	2.3E+5	NA

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2-Methyl-4,6-dinitrophenol	534521	NA	830 (M); 400	NA	1.9E+5	NLV	NLV	NLV	NLV	ID	79,000	NA
N-Methyl-morpholine (I)	109024	NA	400	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	6.1E+5	1.1E+8
Methyl parathion	298000	NA	46	NA	76,000	NLV	NLV	NLV	NLV	ID	56,000	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	36,000	ID	2.7E+6 (C)	2.7E+6 (C)	4.5E+7	4.5E+7	6.7E+7	1.4E+11	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	800	15,000 (X)	5.9E+6 (C)	5.9E+6 (C)	2.5E+7	3.9E+7	8.7E+7	2.0E+11	1.5E+6	5.9E+6
Methylcyclopentane (I)	96377	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	3.5E+5
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.4E+7	6,800	NA
Methylene chloride	75092	NA	100	19,000 (X)	2.3E+6 (C)	45,000	2.1E+5	5.9E+5	1.4E+6	6.6E+9	1.3E+6	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	ID	5.5E+6	ID	ID	ID	ID	ID	8.1E+6	NA
Methylphenols (J)	1319773	NA	7,400	1,400	1.6E+7	NLV	NLV	NLV	NLV	6.7E+9	1.1E+7	NA
Metolachlor	51218452	NA	4,800	NA	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,DD)	4.4E+5
Metribuzin	21087649	NA	3,600	NA	2.4E+7	ID	ID	ID	ID	ID	9 6E+6	NA
Mirex	2385855	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	9,600	NA
Molybdenum (B)	7439987	NA	1,500	16,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	2.6E+6	NA
Naphthalene	91203	NA	35,000	870	2.1E+6	2.5E+5	3.0E+5	3.0E+5	3.0E+5	2.0E+8	1.6E+7	NA
Nickel (B)	7440020	20,000	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+7	4.0E+7	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrobenzene (I)	98953	NA	330 (M); 68	3,600 (X)	2.2E+5	91,000	54,000	54,000	54,000	4.7E+7	1.0E+5	4.9E+5
2-Nitrophenol	88755	NA	400	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	6.3E+5	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M); 100	NA	7,200	NLV	NLV	NLV	NLV	1.6E+6	1,200	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	NA	7.0E+5	NLV	NLV	NLV	NLV	ID	1.7E+6	NA
Oxamyl	23135220	NA	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	8.6E+6	NA
Oxo-hexyl acetate	88230357	NA	1,500	NA	ID	ID	ID	ID	ID	5.4E+9	2.3E+6	1.0E+7

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
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Pendimethalin	40487421	NA	1.1E+6	NA	1.1E+6	NLV	NLV	NLV	NLV	ID	4.6E+7	NA
Pentachlorobenzene	608935	NA	29,000	9,500	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	NA	37,000	1.2E+5	2.3E+5	2.3E+5	2.3E+5	3.3E+8	1.7E+6	NA
Pentachlorophenol	87865	NA	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.0E+8	90,000	NA
Pentane	109660	NA	ID	NA	ID	2.4E+5 (C)	3.7E+7	3.1E+8	5.8E+8	1.2E+12	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	5,300	1.1E+6	2.8E+6	1.6E+5	1.6E+5	1.6E+5	6.7E+6	1.6E+6	NA
Phenol	108952	NA	88,000	4,200	1.2E+7 (C)	NLV	NLV	NLV	NLV	4.0E+10	1.2E+7 (C,DD)	1.2E+7
Phosphorus (Total)	7723140	NA	1.3E+6	(EE)	ID	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	NA	1.7E+6 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	NA	1.1E+6 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+6
Picloram	1918021	NA	10,000	920	8.6E+6	NLV	NLV	NLV	NLV	ID	1.6E+7	NA
Piperidine	110894	NA	64	NA	6.8E+5	NLV	NLV	NLV	NLV	9.3E+9	99,000	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1,200	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	3.0E+6	2.4E+5	7.9E+6	7.9E+6	5.2E+6	(T)	NA
Prometon	1610180	NA	4,900	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	5.0E+6	NA
Propachlor	1918167	NA	1,900	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	2.9E+6	NA
Propazine	139402	NA	4,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	6.1E+6	NA
Propionic acid	79094	NA	2.4E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+10	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.9E+10	1.3E+7 (DD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	NA	3.0E+5	ID	ID	ID	ID	1.3E+9	2.5E+6	1.0E+7
Propylene glycol	57556	NA	3.0E+6	5.8E+6	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.0E+11	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	ID	4.8E+5	1.0E+9 (D)	6.5E+8	6.5E+8	6.5E+8	6.7E+9	2.9E+7	NA
Pyridine (I)	110861	NA	400	NA	37,000 (C)	1,100	8,200	40,000	97,000	2.3E+8	37,000 (C)	37,000

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Selenium (B)	7782492	410	4,000	400	7.8E+7	NLV	NLV	NLV	NLV	1.3E+8	2.6E+6	NA
Silver (B)	7440224	1,000	4,500	100 (M); 27	2.0E+8	NLV	NLV	NLV	NLV	6.7E+6	2.5E+6	NA
Silvex (2,4,5-TP)	93721	NA	3,600	2,200	3.1E+6	NLV	NLV	NLV	NLV	ID	1.7E+6	NA
Simazine	122349	NA	80	NA	90,000	NLV	NLV	NLV	NLV	ID	1.2E+6	NA
Sodium	17341252	NA	2.5E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Sodium azide	26628228	NA	1,800	NA	ID	ID	ID	ID	ID	ID	2.7E+6	NA
Strontium (B)	7440246	NA	92,000	46,000 (X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.3E+8	NA
Styrene	100425	NA	2,700	2,200	2.7E+5	2.5E+5	9.7E+5	9.7E+5	1.4E+6	5.5E+9	4.0E+5	5.2E+5
Sulfate	14808798	NA	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	4.6E+6 (DD)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	3,400 (X)	1.5E+6	ID	ID	ID	ID	ID	7.7E+7	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	71 (O)	0.09 (O)	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	ID (X)	4.4E+5 (C)	6,200	36,000	54,000	1.0E+5	4.2E+8	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	170	1,600 (X)	94,000	4,300	10,000	10,000	14,000	5.4E+7	53,000	8.7E+5
Tetrachloroethylene	127184	NA	100	900 (X)	88,000 (C)	11,000	1.8E+5	4.8E+5	1.1E+6	5.4E+9	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	1,900	2.2E+5 (X)	3.2E+7	1.3E+6	1.3E+7	6.7E+7	1.6E+8	3.9E+11	2.9E+6	1.2E+8
Tetranitromethane	509148	NA	ID	ID	ID	500 (M); 110	500 (M); 51	ID	ID	2.1E+5	ID	ID
Thallium (B)	7440280	NA	2,300	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	ID	35,000	NA
Toluene (I)	108883	NA	16,000	2,800	2.5E+5 (C)	2.5E+5 (C)	2.8E+6	5.1E+6	1.2E+7	2.7E+10	2.5E+5 (C)	2.5E+5
p-Toluidine	106490	NA	660 (M); 300	NA	4.8E+5	NLV	NLV	NLV	NLV	1.0E+8	94,000	1.2E+6
Toxaphene	8001352	NA	24,000	860	3.6E+5	NLV	NLV	NLV	NLV	9.7E+6	20,000	NA
Triallate	2303175	NA	95,000	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	ID	1.8E+6	5.8E+5	6.0E+5	6.0E+5	6.0E+5	4.7E+8	7.9E+5	3.7E+6

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1,2,4-Trichlorobenzene	120821	NA	4,200	1,800	1.1E+6	1.1E+6 (C)	2.8E+7	2.8E+7	2.8E+7	2.5E+10	9.9E+5 (DD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	4,000	4.6E+5 (C)	2.5E+5	3.8E+6	1.2E+7	2.8E+7	6.7E+10	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	100	6,600 (X)	4.2E+5	4,600	17,000	21,000	44,000	1.9E+8	1.8E+5	9.2E+5
Trichloroethylene	79016	NA	100	4,000 (X)	4.4E+5	7,100	78,000	1.7E+5	3.9E+5	1.8E+9	5.0E+5 (C,DD)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	NA	5.6E+5 (C)	5.6E+5 (C)	9.2E+7	6.3E+8	1.5E+9	3.8E+12	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	NA	9.1E+6	NLV	NLV	NLV	NLV	2.3E+10	2.3E+7	NA
2,4,6-Trichlorophenol	88062	NA	2,400	NA	2.0E+5	NLV	NLV	NLV	NLV	1.0E+9	7.1E+5	NA
1,2,3-Trichloropropane	96184	NA	840	NA	8.3E+5 (C)	ID	ID	ID	ID	ID	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	NA	5.5E+5 (C)	1,700	5.5E+5 (C)	5.5E+5 (C)	1.8E+8	8.8E+8	2.1E+9	5.1E+12	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	3.3E+9	1.1E+8	1.1E+8
Triethylene glycol	112276	NA	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,DD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	4.1E+7 (DD)	NA
Trifluralin	1582098	NA	1.9E+5	NA	1.2E+7	ID	ID	ID	ID	ID	2.0E+6	NA
2,2,4-Trimethyl pentane	540841	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	19,000
2,4,4-Trimethyl-2-pentene (I)	107404	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (I)	95636	NA	2,100	570	1.1E+5 (C)	1.1E+5 (C)	2.1E+7	5.0E+8	5.0E+8	8.2E+10	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (I)	108678	NA	1,800	1,100	94,000 (C)	94,000 (C)	1.6E+7	3.8E+8	3.8E+8	8.2E+10	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	930	NA	27,000 (C)	27,000 (C)	18,000	18,000	18,000	5.9E+6	4,400	27,000
Urea	57136	NA	ID (N)	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Vanadium	7440622	NA	72,000	1.9E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	7.5E+5 (DD)	NA
Vinyl acetate (I)	108054	NA	13,000	NA	2.4E+6 (C)	7.9E+5	1.7E+6	2.6E+6	5.8E+6	1.3E+10	2.4E+6 (C,DD)	2.4E+6
Vinyl chloride	75014	NA	40	300	20,000	270	4,200	30,000	73,000	3.5E+8	3,800	4.9E+5
White phosphorus (R)	12185103	NA	2.2	NA	58,000	NLV	NLV	NLV	NLV	ID	2,300 (DD)	NA

TABLE 2. SOIL: RESIDENTIAL AND COMMERCIAL I
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number →		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Xylenes (I)	1330207	NA	5,600	700	1.5E+5 (C)	1.5E+5 (C)	4.6E+7	6.1E+7	1.3E+8	2.9E+11	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.7E+8	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 ppb is presented as 2.0E+5. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are presented in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. These tables reflect modifications to the TDLs and new criteria consistent with the provisions of R299.5103(l) and R299.5706a, respectively.

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	8.8E+5	4,400	9.7E+5	3.5E+8	9.7E+7	9.7E+7	9.7E+7	6.2E+9	1.3E+8	1.8E+8	1.5E+8	NA
Acenaphthylene	208968	NA	5,900	17,000	ID	4.4E+5	3.0E+6	2.7E+6	2.7E+6	2.7E+6	1.0E+9	5.2E+6	7.2E+6	6.1E+6	NA
Acetaldehyde (I)	75070	NA	19,000	54,000	2,600	1.1E+8 (C)	4.0E+5	2.1E+5	2.1E+5	2.9E+5	2.6E+8	9.5E+7	1.1E+8 (C)	1.1E+8	1.1E+8
Acetate	71501	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Acetic acid	64197	NA	84,000	2.4E+5	3.6E+5	6.5E+8 (C)	NLV	NLV	NLV	NLV	7.4E+9	4.2E+8	5.8E+8	4.9E+8	6.5E+8
Acetone (I)	67641	NA	15,000	42,000	34,000	1.1E+8 (C)	1.1E+8 (C)	1.6E+8	1.6E+8	2.0E+8	1.7E+11	7.3E+7	1.0E+8	8.6E+7	1.1E+8
Acetonitrile	75058	NA	2,800	8,000	NA	2.2E+7 (C)	8.8E+6	1.9E+6	1.9E+6	2.2E+6	1.8E+9	1.4E+7	1.9E+7	1.6E+7	2.2E+7
Acetophenone	98862	NA	30,000	88,000	NA	1.1E+6 (C)	1.1E+6 (C)	5.2E+7	5.2E+7	5.2E+7	1.4E+10	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	6,600	NA	2.3E+7 (C)	760	370	370	630	5.9E+5	1.2E+7	1.6E+7	1.4E+7	2.3E+7
Acrylamide	79061	NA	10	10	NA	2.6E+5	NLV	NLV	NLV	NLV	3.0E+6	8,700	12,000	10,000	NA
Acrylic acid	79107	NA	78,000	2.2E+5	NA	1.1E+8 (C)	5.5E+6	2.2E+5	2.7E+5	2.7E+5	2.9E+7	1.1E+8 (C,DD)	1.1E+8 (C,DD)	1.1E+8 (C,DD)	1.1E+8
Acrylonitrile (I)	107131	NA	*100 (M); 52*	*220*	*100 (M,X); 98*	2.8E+5	*35,000*	*17,000*	*17,000*	*31,000*	5.8E+7	*74,000*	*1.0E+5*	*87,000*	*8.3E+6*
Alachlor	15972608	NA	52	52	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	3.9E+5	6.9E+5	5.1E+5	NA
Aldicarb	116063	NA	60	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	7.3E+5	1.0E+6	8.6E+5	NA
Aldicarb sulfoxide	1646873	NA	200 (M)	200 (M)	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	9.5E+5	1.3E+6	1.1E+6	NA
Aldicarb sulfone	1646884	NA	200 (M); 40	200 (M); 40	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	8.0E+5	1.1E+6	9.4E+5	NA
Aldrin	309002	NA	NLL	NLL	NLL	NLL	7.1E+6	2.0E+5	2.0E+5	2.0E+5	8.0E+5	4,300	7,700	5,600	NA
Aluminum (B)	7429905	6.9E+6	1,000	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.7E+8 (DD)	4.1E+8 (DD)	3.9E+8 (DD)	NA
Ammonia	7664417	NA	ID	ID	(CC)	ID	ID	ID	ID	ID	2.9E+9	ID	ID	ID	1.0E+7

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
t-Amyl methyl ether (TAME)	994058	NA	3,900	3,900	NA	4.4E+5 (C)	1.1E+5	4.0E+5	7.8E+5	1.8E+6	1.8E+9	4.4E+5 (C)	4.4E+5 (C)	4.4E+5 (C)	4.4E+5
Aniline	62533	NA	1,100	4,400	330 (M); 80	2.8E+6	NLV	NLV	NLV	NLV	2.9E+7	1.5E+6	2.1E+6	1.8E+6	4.5E+6
Anthracene	120127	NA	41,000	41,000	ID	41,000	1.0E+9 (D)	1.6E+9	1.6E+9	1.6E+9	2.9E+10	7.3E+8	1.0E+9	8.6E+8	NA
Antimony	7440360	NA	4,300	4,300	94,000	4.9E+7	NLV	NLV	NLV	NLV	5.9E+6	6.7E+5	7.3E+5	7.0E+5	NA
Arsenic	7440382	5,800	4,600	4,600	70,000 (X)	2.0E+6	NLV	NLV	NLV	NLV	9.1E+5	37,000	46,000	41,000	NA
Asbestos (BB)	1332214	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+7 (M); 85,000	ID	ID	ID	NA
Atrazine	1912249	NA	60	60	150 (X)	1.1E+5	NLV	NLV	NLV	NLV	ID	3.3E+5 (DD)	4.6E+5 (DD)	3.9E+5 (DD)	NA
Azobenzene	103333	NA	4,200	17,000	NA	3.0E+5	3.2E+7	2.1E+6	ID	ID	1.3E+8	6.6E+5	9.2E+5	7.7E+5	NA
Barium (B)	7440393	75,000	1.3E+6	1.3E+6	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.5E+8	1.3E+8	1.5E+8	1.4E+8	NA
Benzene (I)	71432	NA	100	100	4,000 (X)	2.2E+5	8,400	45,000	99,000	2.3E+5	4.7E+8	4.0E+5 (C)	4.0E+5 (C)	4.0E+5 (C)	4.0E+5
Benzidine	92875	NA	1,000 (M); 6.0	1,000 (M); 6.0	ID	1,000 (M); 140	NLV	NLV	NLV	NLV	59,000	1,000 (M); 110	1,000 (M); 150	1,000 (M); 120	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	80,000	1.6E+5	1.1E+5	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	80,000	1.6E+5	1.1E+5	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	8.0E+5	1.6E+6	1.1E+6	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.5E+8	7.0E+6	1.4E+7	9.5E+6	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.9E+6	8,000	16,000	11,000	NA
Benzoic acid	65850	NA	6.4E+5	1.8E+6	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Benzyl alcohol	100516	NA	2.0E+5	5.8E+5	NA	5.8E+6 (C)	NLV	NLV	NLV	NLV	1.5E+11	5.8E+6 (C)	5.8E+6 (C)	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	150	640	NA	72,000	33,000	48,000	48,000	52,000	7.8E+7	2.2E+5	2.3E+5 (C)	2.3E+5 (C)	2.3E+5
Beryllium	7440417	NA	51,000	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	5.9E+5	1.6E+6	1.6E+6	1.6E+6	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	ID	ID	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	100	170	300	1.1E+5	44,000	13,000	13,000	13,000	1.2E+7	58,000	81,000	68,000	2.2E+6
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.9E+8	1.0E+7 (C)	1.0E+7 (C)	1.0E+7 (C)	1.0E+7
Boron (B)	7440428	NA	10,000	10,000	38,000	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.5E+8 (DD)	3.9E+8 (DD)	3.7E+8 (DD)	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Bromate	15541454	NA	200	200	800	96,000	NLV	NLV	NLV	NLV	ID	91,000	99,000	95,000	NA
Bromobenzene (I)	108861	NA	550	1,500	NA	3.6E+5	5.8E+5	5.4E+5	5.4E+5	5.4E+5	2.4E+8	7.6E+5 (C)	7.6E+5 (C)	7.6E+5 (C)	7.6E+5
Bromodichloromethane	75274	NA	1,600 (W)	1,600 (W)	ID	2.8E+5	6,400	31,000	31,000	57,000	1.1E+8	4.9E+5	6.8E+5	5.7E+5	1.5E+6
Bromoform	75252	NA	1,600 (W)	1,600 (W)	ID	8.7E+5 (C)	7.7E+5	3.1E+6	3.1E+6	3.1E+6	3.6E+9	8.7E+5 (C)	8.7E+5 (C)	8.7E+5 (C)	8.7E+5
Bromomethane	74839	NA	200	580	700	1.4E+6	1,600	13,000	57,000	1.4E+5	1.5E+8	1.0E+6	1.4E+6	1.2E+6	2.2E+6
n-Butanol (I)	71363	NA	19,000	54,000	NA	8.7E+6 (C)	NLV	NLV	NLV	NLV	1.0E+10	8.7E+6 (C)	8.7E+6 (C)	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	7.6E+5	44,000	2.7E+7 (C)	2.7E+7 (C)	3.5E+7	3.5E+7	3.6E+7	2.9E+10	2.7E+7 (C,DD)	2.7E+7 (C,DD)	2.7E+7 (C,DD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	32,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.4E+8	3.1E+8	3.5E+8	2.1E+11	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	2.2E+5	NA	1.1E+8 (C)	1.1E+8 (C)	1.2E+8	2.4E+8	2.4E+8	5.6E+10	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	3.1E+5 (C)	26,000 (X)	3.1E+5 (C)	NLV	NLV	NLV	NLV	2.1E+10	3.1E+5 (C)	3.1E+5 (C)	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	4,600	ID	1.2E+5	ID	ID	ID	ID	ID	8.0E+6	1.0E+7 (C)	9.4E+6	1.0E+7
sec-Butylbenzene	135988	NA	1,600	4,600	ID	88,000	ID	ID	ID	ID	ID	8.0E+6	1.0E+7 (C)	9.4E+6	1.0E+7
t-Butylbenzene (I)	98066	NA	1,600	4,600	NA	1.8E+5	ID	ID	ID	ID	ID	8.0E+6	1.0E+7 (C)	9.4E+6	1.0E+7
Cadmium (B)	7440439	1,200	6,000	6,000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	2.2E+6	2.1E+6	2.1E+6	2.1E+6	NA
Camphene (I)	79925	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Caprolactam	105602	NA	1.2E+5	3.4E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+8	3.1E+8 (DD)	4.8E+8 (DD)	3.8E+8 (DD)	NA
Carbaryl	63252	NA	14,000	40,000	NA	2.6E+6	ID	ID	ID	ID	ID	7.0E+7	9.8E+7	8.2E+7	NA
Carbazole	86748	NA	9,400	39,000	1,100	8.2E+5	NLV	NLV	NLV	NLV	ID	2.4E+6	3.4E+6	2.9E+6	NA
Carbofuran	1563662	NA	800	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	3.6E+6	5.1E+6	4.3E+6	NA
Carbon disulfide (I R)	75150	NA	16,000	46,000	ID	2.8E+5 (C)	1.4E+5	1.6E+6	8.0E+6	1.9E+7	2.1E+10	2.8E+5 (C,DD)	2.8E+5 (C,DD)	2.8E+5 (C,DD)	2.8E+5
Carbon tetrachloride	56235	NA	100	100	900 (X)	92,000	990	12,000	34,000	79,000	1.7E+8	3.9E+5 (C)	3.9E+5 (C)	3.9E+5 (C)	3.9E+5
Chlordane (J)	57749	NA	NLL	NLL	NLL	NLL	5.9E+7	4.2E+6	4.2E+6	4.2E+6	2.1E+7	1.5E+5	2.0E+5	1.7E+5	NA
Chloride	16887006	NA	5.0E+6	5.0E+6	2.5E+6 (X)	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 (F)	5.0E+5 (F)	5.0E+5 (F)	NA
Chlorobenzene (I)	108907	NA	2,000	2,000	940	2.6E+5 (C)	2.2E+5	9.2E+5	1.1E+6	2.1E+6	2.1E+9	2.6E+5 (C)	2.6E+5 (C)	2.6E+5 (C)	2.6E+5

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Cutdesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
para-Chlorobenzenesulfonic acid	98668	NA	1.5E+05	4.2E+05	NA	NA	ID	ID	ID	ID	ID	7.3E+08	1.0E+09	8.6E+08	ID
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	8.8E+05	NA	9.6E+5 (C)	9.6E+5 (C)	9.4E+7	5.7E+8	1.4E+9	1.5E+12	9.6E+5 (C)	9.6E+5 (C)	9.6E+5 (C)	9.6E+5
Chloroethane	75003	NA	8,600	34,000	ID	9.5E+5 (C)	9.5E+5 (C)	3.6E+7	1.2E+8	2.8E+8	2.9E+11	9.5E+5 (C)	9.5E+5 (C)	9.5E+5 (C)	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	1,600 (W)	1,600 (W)	3,400 (X)	1.5E+6 (C)	38,000	1.5E+5	3.4E+5	7.9E+5	1.6E+9	1.5E+6 (C)	1.5E+6 (C)	1.5E+6 (C)	1.5E+6
Chloromethane (I)	74873	NA	5,200	22,000	ID	1.1E+6 (C)	10,000	1.2E+5	1.0E+6	2.5E+6	2.6E+9	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	16,000	280	3.0E+6	NLV	NLV	NLV	NLV	ID	1.5E+7	2.0E+7	1.7E+7	NA
beta-Chloronaphthalene	91587	NA	6.2E+5	1.8E+6	NA	2.3E+6	ID	ID	ID	ID	ID	1.8E+8	2.6E+8	2.1E+8	NA
2-Chlorophenol	95578	NA	900	2,600	440	1.9E+6	ID	ID	ID	ID	ID	4.5E+6	6.3E+6	5.3E+6	1.9E+7
o-Chlorotoluene (I)	95498	NA	3,300	9,300	NA	5.0E+5 (C)	5.0E+5 (C)	1.5E+6	3.1E+6	6.4E+6	2.1E+9	5.0E+5 (C)	5.0E+5 (C)	5.0E+5 (C)	5.0E+5
Chlorpyrifos	2921882	NA	17,000	48,000	1,500	8.4E+5	240	5,500	23,000	56,000	5.9E+7	3.4E+7	6.0E+7	4.4E+7	NA
Chromium (III) (B,H)	16065831	18,000 (total)	1.0E+9 (D)	1.0E+9 (D)	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.5E+8	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Chromium (VI)	18540299	NA	30,000	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.4E+5	9.2E+6	1.0E+7	9.6E+6	NA
Chrysene (Q)	218019	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	8.0E+6	1.6E+7	1.1E+7	NA
Cobalt	7440484	6,800	800	2,000	2,000	4.8E+7	NLV	NLV	NLV	NLV	5.9E+6	9.0E+6	1.0E+7	1.0E+7	NA
Copper (B)	7440508	32,000	5.8E+6	5.8E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	5.9E+7	7.3E+7	7.9E+7	7.6E+7	NA
Cyanazine	21725462	NA	200	200	1,100 (X)	56,000	NLV	NLV	NLV	NLV	ID	66,000	92,000	77,000	NA
Cyanide (P,R)	57125	390 (total)	4,000	4,000	100	2.5E+5	NLV	NLV	NLV	NLV	2.5E+5	2.5E+5	2.5E+5	2.5E+5	NA
Cyclohexanone	108941	NA	5.2E+6	1.5E+7	NA	2.2E+8 (C)	32,000	1.3E+6	1.1E+7	2.7E+7	2.9E+10	2.2E+8 (C)	2.2E+8 (C)	2.2E+8 (C)	2.2E+8
Dacthal	1861321	NA	50,000	1.4E+5	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	7.3E+6	1.0E+7	8.6E+6	NA
Dalapon	75990	NA	4,000	4,000	NA	5.9E+7 (C)	NLV	NLV	NLV	NLV	ID	5.9E+7 (C)	5.9E+7 (C)	5.9E+7 (C)	5.9E+7
4-4'-DDD	72548	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	5.6E+7	4.0E+5	7.1E+5	5.2E+5	NA
4-4'-DDE	72559	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	1.9E+5	3.3E+5	2.4E+5	NA
4-4'-DDT	50293	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	2.8E+5	3.4E+5	3.1E+5	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Decabromodiphenyl ether	1163195	NA	1.4E+5	1.4E+5	NA	1.4E+5	1.0E+9 (D)	1.0E+8	1.0E+8	1.0E+8	1.0E+9	1.1E+7	2.0E+7	1.5E+7	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	7.6E+5 (C)	11,000	7.6E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.6E+5 (C)	7.6E+5 (C)	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	9.6E+5 (C)	NA	9.6E+5 (C)	NLV	NLV	NLV	NLV	1.2E+10	9.6E+5 (C,DD)	9.6E+5 (C,DD)	9.6E+5 (C,DD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	1.4E+8 (C)	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	ID	2.0E+7	3.6E+7	2.6E+7	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	ID	NA	ID	NLV	NLV	NLV	NLV	7.1E+10	ID	ID	ID	1.1E+8
Diazinon	333415	NA	95	280	NA	95,000	NLV	NLV	NLV	NLV	ID	70,000 (DD)	1.1E+5 (DD)	86,000 (DD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	8,000	16,000	11,000	NA
Dibenzofuran	132649	NA	ID	ID	1,700	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Dibromochloromethane	124481	NA	1,600 (W)	1,600 (W)	ID	3.6E+5	21,000	80,000	80,000	98,000	1.6E+8	5.0E+5	6.1E+5 (C)	5.8E+5	6.1E+5
Dibromochloropropane	96128	NA	10 (M); 4.0	10 (M); 4.0	NA	1,200 (C)	1,200 (C)	15,000	15,000	15,000	5.9E+6	1,200 (C)	1,200 (C)	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	4,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6 (C)	2.0E+6 (C)	2.0E+6
Dicamba	1918009	NA	4,400	13,000	NA	1.2E+7	NLV	NLV	NLV	NLV	ID	1.7E+7	3.5E+7	2.3E+7	NA
1,2-Dichlorobenzene	95501	NA	14,000	14,000	360	2.1E+5 (C)	2.1E+5 (C)	4.6E+7	4.6E+7	5.5E+7	4.4E+10	2.1E+5 (C)	2.1E+5 (C)	2.1E+5 (C)	2.1E+5
1,3-Dichlorobenzene	541731	NA	170	480	1,100	51,000	ID	ID	ID	ID	ID	1.7E+5 (C)	1.7E+5 (C)	1.7E+5 (C)	1.7E+5
1,4-Dichlorobenzene	106467	NA	1,700	1,700	290	1.4E+5	1.0E+5	2.6E+5	2.6E+5	3.4E+5	5.7E+8	1.9E+6	2.6E+6	2.2E+6	NA
3,3'-Dichlorobenzidine	91941	NA	2,000 (M); 28	2,000 (M); 110	2,000 (M,X); 510	4,600	NLV	NLV	NLV	NLV	8.2E+6	30,000	43,000	36,000	NA
Dichlorodifluoromethane	75718	NA	95,000	2.7E+5	ID	1.0E+6 (C)	1.7E+6	6.3E+7	5.5E+8	1.4E+9	1.5E+12	1.0E+6 (C)	1.0E+6 (C)	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	50,000	15,000	8.9E+5 (C)	4.3E+5	2.5E+6	6.0E+6	1.4E+7	1.5E+10	8.9E+5 (C)	8.9E+5 (C)	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	100	100	7,200 (X)	3.8E+5	11,000	21,000	33,000	74,000	1.5E+8	4.2E+5	5.9E+5	4.9E+5	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	140	1,300 (X)	2.2E+5	330	3,700	15,000	37,000	7.8E+7	5.7E+5 (C)	5.7E+5 (C)	5.7E+5 (C)	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	1,400	1,400	12,000	6.4E+5 (C)	41,000	2.1E+5	4.3E+5	1.0E+6	1.0E+9	6.4E+5 (C)	6.4E+5 (C)	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	2,000	2,000	30,000	1.4E+6 (C)	43,000	3.3E+5	8.4E+5	2.0E+6	2.1E+9	1.4E+6 (C)	1.4E+6 (C)	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	1.3E+5	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	2.2E+8	3.1E+8	2.6E+8	NA
2,4-Dichlorophenol	120832	NA	1,500	4,200	380	9.6E+5	NLV	NLV	NLV	NLV	2.3E+9	1.8E+6 (C,DD)	1.8E+6 (C,DD)	1.8E+6 (C,DD)	1.8E+6

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
2,4-Dichlorophenoxyacetic acid	94757	NA	1,400	1,400	4,400	2.4E+6	NLV	NLV	NLV	NLV	2.9E+9	8.6E+6	1.0E+7	9.4E+6	NA
1,2-Dichloropropane (I)	78875	NA	100	100	5,800 (X)	3.2E+5	7,400	30,000	51,000	1.2E+5	1.2E+8	5.5E+5 (C)	5.5E+5 (C)	5.5E+5 (C)	5.5E+5
1,3-Dichloropropene	542756	NA	170	700	NA	1.1E+5	5,400	60,000	2.0E+5	4.7E+5	5.9E+8	2.4E+5	3.4E+5	2.9E+5	6.2E+5
Dichlorovos	62737	NA	50 (M); 32	130	NA	1.2E+5	NLV	NLV	NLV	NLV	1.5E+7	47,000	65,000	55,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	NA
Dieldrin	60571	NA	NLL	NLL	NLL	NLL	7.2E+5	64,000	64,000	64,000	8.5E+5	4,700	8,300	6,100	NA
Diethyl ether	60297	NA	200	200	ID	7.4E+6 (C)	7.4E+6 (C)	1.0E+8	1.6E+8	3.5E+8	3.5E+11	7.4E+6 (C)	7.4E+6 (C)	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	3.2E+5	2,200	7.4E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.4E+5 (C)	7.4E+5 (C)	7.4E+5 (C)	7.4E+5
Diethylene glycol monobutyl ether	112345	NA	1,800	5,000	NA	8.0E+7	NLV	NLV	NLV	NLV	5.9E+8	8.7E+6	1.2E+7	1.0E+7	1.1E+8
Diisopropyl ether	108203	NA	600	1,300 (C)	ID	1,300 (C)	1,300 (C)	3.2E+6	4.8E+6	1.0E+7	1.1E+10	1,300 (C)	1,300 (C)	1,300 (C)	1,300
Diisopropylamine (I)	108189	NA	110	320	NA	4.2E+5	ID	ID	ID	ID	ID	5.6E+5	7.9E+5	6.6E+5	6.7E+6
Dimethyl phthalate	131113	NA	7.9E+5 (C)	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.9E+5 (C)	7.9E+5 (C)	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	3,600	10,000	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7	2.6E+7	2.1E+7	1.1E+8
N,N-Dimethylaniline	121697	NA	320	920	NA	4.0E+5	8.0E+5 (C)	5.2E+5	5.2E+5	5.2E+5	3.3E+8	8.0E+5 (C)	8.0E+5 (C)	8.0E+5 (C)	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	40,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+8	7.0E+7	9.8E+7	8.2E+7	1.1E+8
2,4-Dimethylphenol	105679	NA	7,400	20,000	7,600	1.0E+7	NLV	NLV	NLV	NLV	2.1E+9	3.6E+7	5.1E+7	4.3E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M); 88	330 (M); 260	NA	1.3E+5	NLV	NLV	NLV	NLV	ID	4.4E+5	6.1E+5	5.1E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M); 200	580	NA	3.6E+5	NLV	NLV	NLV	NLV	ID	1.0E+6	1.4E+6	1.2E+6	NA
Dimethylsulfoxide	67685	NA	4.4E+6	1.3E+7	3.8E+6	1.8E+7 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7 (C)	1.8E+7 (C)	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	640	NA	1.7E+5	NLV	NLV	NLV	NLV	2.0E+7	2.2E+5	3.1E+5	2.6E+5	NA
Dinoseb	88857	NA	300	300	200 (M); 43	1.4E+5 (C)	NLV	NLV	NLV	NLV	ID	1.4E+5 (C,DD)	1.4E+5 (C,DD)	1.4E+5 (C,DD)	1.4E+5
1,4-Dioxane (I)	123911	NA	1,700	7,000	56,000	3.4E+7	NLV	NLV	NLV	NLV	7.1E+8	2.4E+6	3.4E+6	2.9E+6	9.7E+7
Diquat	85007	NA	400	400	NA	1.4E+7	NLV	NLV	NLV	NLV	ID	1.6E+6	2.2E+6	1.9E+6	NA
Diuron	330541	NA	620	1,800	NA	7.4E+5	NLV	NLV	NLV	NLV	2.1E+8	3.1E+6	4.4E+6	3.7E+6	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Endosulfan (J)	115297	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	4.4E+6	6.1E+6	5.1E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+9	1.2E+7	1.7E+7	1.5E+7	NA
Endrin	72208	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.9E+5	3.4E+5	2.5E+5	NA
Epichlorohydrin (I)	106898	NA	100	100	NA	2.2E+5	1.2E+5	37,000	37,000	37,000	2.9E+7	41,000	58,000	48,000	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	7.6E+7	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	5.6E+11	1.1E+8 (C,DD)	1.1E+8 (C,DD)	1.1E+8 (C,DD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	3.8E+5	NA	7.5E+6 (C)	7.5E+6 (C)	5.9E+7	5.9E+7	1.0E+8	9.4E+10	7.5E+6 (C)	7.5E+6 (C)	7.5E+6 (C)	7.5E+6
Ethyl-tert-butyl ether (ETBE)	637923	NA	980	980	ID	ID	6.5E+5 (C)	2.3E+6	4.6E+6	1.1E+7	1.1E+10	ID	ID	ID	6.5E+5
Ethylbenzene (I)	100414	NA	1,500	1,500	360	1.4E+5 (C)	1.4E+5 (C)	2.4E+6	3.1E+6	6.5E+6	1.3E+10	1.4E+5 (C)	1.4E+5 (C)	1.4E+5 (C)	1.4E+5
Ethylene dibromide	106934	NA	20 (M); 1.0	20 (M); 1.0	20 (M); 4.0	500	3,600	5,800	5,800	9,800	1.8E+7	430	600	500	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	8.4E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.9E+10	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	2.0E+5	NA	4.1E+7 (C)	1.4E+6	2.1E+7	1.5E+8	3.6E+8	3.8E+11	4.1E+7 (C)	4.1E+7 (C)	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	8.9E+8	8.8E+8	8.8E+8	4.1E+9	1.3E+8	2.4E+8	1.7E+8	NA
Fluorene	86737	NA	3.9E+5	8.9E+5	5,300	8.9E+5	1.0E+9 (D)	1.5E+8	1.5E+8	1.5E+8	4.1E+9	8.7E+7	1.2E+8	1.0E+8	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	40,000	NA	2.4E+8	NLV	NLV	NLV	NLV	ID	6.7E+7 (DD)	7.4E+7 (DD)	7.0E+7 (DD)	NA
Formaldehyde	50000	NA	26,000	76,000	2,400	6.0E+7 (C)	65,000	43,000	69,000	1.5E+5	3.0E+8	6.0E+7 (C)	6.0E+7 (C)	6.0E+7 (C)	6.0E+7
Formic acid (I,U)	64186	NA	2.0E+5	5.8E+5	ID	1.1E+8 (C)	2.8E+6	2.6E+5	1.6E+5	1.6E+5	5.9E+7	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
1-Formylpiperidine	2591868	NA	1,600	4,600	NA	ID	ID	ID	ID	ID	ID	8.0E+6	1.0E+7 (C)	9.4E+6	1.0E+7
Gentian violet	548629	NA	300	1,300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	4.4E+5	6.2E+5	5.2E+5	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	5.7E+7 (DD)	1.2E+8 (DD)	7.8E+7 (DD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	NLL	1.9E+6	2.1E+5	2.1E+5	2.1E+5	3.0E+6	23,000	42,000	30,000	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	9,500	17,000	12,000	NA
n-Heptane	142825	NA	2.4E+5 (C)	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.5E+7	4.5E+7	1.0E+8	1.0E+11	2.4E+5 (C)	2.4E+5 (C)	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	5,400	5,400	ID	5,400	ID	ID	ID	ID	ID	3.1E+6	5.6E+6	4.1E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	1,800	350	8,200	2.2E+5	56,000	56,000	56,000	8.5E+6	37,000	67,000	49,000	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Hexachlorobutadiene (C-46)	87683	NA	26,000	72,000	91	3.5E+5 (C)	3.5E+5 (C)	4.6E+5	4.6E+5	4.6E+5	1.8E+8	3.5E+5 (C)	3.5E+5 (C)	3.5E+5 (C)	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	71	NA	2,500	1.6E+5	41,000	86,000	86,000	2.1E+6	12,000	17,000	14,000	NA
beta-Hexachlorocyclohexane	319857	NA	37	150	NA	5,100	NLV	NLV	NLV	NLV	7.4E+6	25,000	35,000	29,000	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	3.2E+5	ID	7.2E+5 (C)	56,000	60,000	60,000	60,000	5.9E+6	7.2E+5 (C)	7.2E+5 (C)	7.2E+5 (C)	7.2E+5
Hexachloroethane	67721	NA	430	1,200	1,800 (X)	1.1E+5	79,000	6.6E+5	1.4E+6	1.4E+6	1.0E+8	7.3E+5	1.0E+6	8.6E+5	NA
n-Hexane	110543	NA	44,000 (C)	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.5E+6	3.5E+6	6.4E+6	5.9E+9	44,000 (C)	44,000 (C)	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	58,000	NA	2.5E+6 (C)	1.8E+6	1.3E+6	1.3E+6	1.5E+6	1.2E+9	2.5E+6 (C)	2.5E+6 (C)	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	80,000	1.6E+5	1.1E+5	NA
Iron (B)	7439896	1.2E+7	6,000	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.8E+8	6.2E+8	6.0E+8	NA
Isobutyl alcohol (I)	78831	NA	46,000	1.3E+5	NA	8.9E+6 (C)	8.9E+6 (C)	9.5E+7	9.5E+7	9.5E+7	4.4E+10	8.9E+6 (C)	8.9E+6 (C)	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	62,000	11,000 (X)	2.4E+6 (C)	NLV	NLV	NLV	NLV	8.2E+9	2.4E+6 (C)	2.4E+6 (C)	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	9,400	26,000	1.1E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.5E+9	4.7E+7	6.5E+7	5.5E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	2.6E+5	ID	3.9E+5 (C)	3.9E+5 (C)	2.0E+6	2.0E+6	3.0E+6	2.6E+9	3.9E+5 (C)	3.9E+5 (C)	3.9E+5 (C)	3.9E+5
Lead (B)	7439921	21,000	7.0E+5	7.0E+5	(G,X)	ID	NLV	NLV	NLV	NLV	4.4E+7	9.0E+5 (DD)	4.0E+5	4.0E+5	NA
Lindane	58899	NA	20 (M); 7.0	20 (M); 7.0	20 (M); 0.99	7,100	ID	ID	ID	ID	ID	42,000	49,000	45,000	NA
Lithium (B)	7439932	9,800	3,400	7,000	1,900	1.1E+8	NLV	NLV	NLV	NLV	ID	3.1E+7 (DD)	3.5E+7 (DD)	3.3E+7 (DD)	NA
Magnesium (B)	7439954	NA	8.0E+6	2.2E+7	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+9	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	1.5E+6	9.0E+7	9.8E+7	9.4E+7	NA
Mercury (Total) (B,Z)	Varies	130	1,700	1,700	50 (M); 1.2	47,000	89,000	62,000	62,000	62,000	8.8E+6	5.8E+5	6.2E+5	6.0E+5	NA
Methane	74828	NA	ID	ID	NA	ID	8.4E+6 ug/m3 (GG)	ID	ID	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	2.0E+5	9,600	3.1E+6 (C)	3.1E+6 (C)	3.7E+7	4.6E+7	9.7E+7	9.6E+10	3.1E+6 (C)	3.1E+6 (C)	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	16,000	NA	18,000	ID	ID	ID	ID	ID	5.6E+6	1.0E+7	7.3E+6	NA
2-Methoxyethanol (I)	109864	NA	150	420	NA	1.7E+7	NLV	NLV	NLV	NLV	5.9E+8	7.3E+5	1.0E+6	8.6E+5	1.1E+8
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	1,100	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	7.3E+5	1.0E+6	8.6E+5	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
2-Methyl-4,6-dinitrophenol	534521	NA	830 (M); 400	830 (M), 400	NA	1.9E+5	NLV	NLV	NLV	NLV	ID	2.6E+5	3.6E+5	3.0E+5	NA
N-Methyl-morpholine (I)	109024	NA	400	1,100	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	2.0E+6	2.8E+6	2.3E+6	1.1E+8
Methyl parathion	298000	NA	46	130	NA	76,000	NLV	NLV	NLV	NLV	ID	1.8E+5	2.6E+5	2.1E+5	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	36,000	1.0E+5	ID	2.7E+6 (C)	2.7E+6 (C)	5.3E+7	5.3E+7	7.0E+7	6.0E+10	2.7E+6 (C)	2.7E+6 (C)	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	800	800	15,000 (X)	5.9E+6 (C)	5.9E+6 (C)	3.0E+7	4.1E+7	8.9E+7	8.8E+10	5.9E+6 (C)	5.9E+6 (C)	5.9E+6 (C)	5.9E+6
Methylcyclopentane (I)	96377	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	3.5E+5
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.1E+8	32,000	44,000	37,000	NA
Methylene chloride	75092	NA	100	100	19,000 (X)	2.3E+6 (C)	2.4E+5	7.0E+5	1.7E+6	4.0E+6	8.3E+9	2.3E+6 (C)	2.3E+6 (C)	2.3E+6 (C)	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	1.7E+5	ID	5.5E+6	ID	ID	ID	ID	ID	2.6E+7	3.7E+7	3.1E+7	NA
Methylphenols (J)	1319773	NA	7,400	20,000	1,400	1.6E+7	NLV	NLV	NLV	NLV	2.9E+9	3.6E+7	5.1E+7	4.3E+7	NA
Metolachlor	51218452	NA	4,800	20,000	NA	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,DD)	4.4E+5 (C,DD)	4.4E+5 (C,DD)	4.4E+5
Metribuzin	21087649	NA	3,600	10,000	NA	2.40E+07	ID	ID	ID	ID	ID	2.8E+7	5.0E+7	3.6E+7	NA
Mirex	2385855	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	40,000	72,000	52,000	NA
Molybdenum (B)	7439987	NA	1,500	4,200	16,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	9.6E+6	1.0E+7	1.0E+7	NA
Naphthalene	91203	NA	35,000	1.0E+5	870	2.1E+6	4.7E+5	3.5E+5	3.5E+5	3.5E+5	8.8E+7	5.2E+7	7.2E+7	6.1E+7	NA
Nickel (B)	7440020	20,000	1.0E+5	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.6E+7	1.5E+8	1.6E+8	1.5E+8	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	2.0E+5 (N)	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Nitrobenzene (I)	98953	NA	330 (M); 68	330 (M); 190	3,600 (X)	2.2E+5	1.7E+5	64,000	64,000	64,000	2.1E+7	3.4E+5	4.7E+5	3.9E+5	4.9E+5
2-Nitrophenol	88755	NA	400	1,200	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	2.0E+6	2.9E+6	2.4E+6	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M); 100	330 (M); 100	NA	7,200	NLV	NLV	NLV	NLV	2.0E+6	5,400	7,600	6,400	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	22,000	NA	7.0E+5	NLV	NLV	NLV	NLV	ID	7.8E+6	1.1E+7	9.2E+6	NA
Oxamyl	23135220	NA	4,000	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	2.8E+7	3.9E+7	3.3E+7	NA
Oxo-hexyl acetate	88230357	NA	1,500	4,200	NA	ID	ID	ID	ID	ID	2.4E+9	7.3E+6	1.0E+7	8.6E+6	1.0E+7

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
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Pendimethalin	40487421	NA	1.1E+6	1.1E+6	NA	1.1E+6	NLV	NLV	NLV	NLV	ID	1.3E+8	2.4E+8	1.7E+8	NA
Pentachlorobenzene	608935	NA	29,000	81,000	9,500	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5 (C)	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	37,000	NA	37,000	2.2E+5	2.8E+5	2.8E+5	2.8E+5	1.5E+8	5.5E+6	7.7E+6	6.4E+6	NA
Pentachlorophenol	87865	NA	22	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.3E+8	3.2E+5	9.2E+5	4.9E+5	NA
Pentane	109660	NA	ID	ID	NA	ID	1.8E+5	4.4E+7	3.4E+8	6.0E+08	5.3E+11	ID	ID	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	1.6E+5	5,300	1.1E+6	5.1E+6	1.9E+5	1.9E+5	1.9E+5	2.9E+6	5.2E+6	7.2E+6	6.1E+6	NA
Phenol	108952	NA	88,000	2.6E+5	4,200	1.2E+7 (C)	NLV	NLV	NLV	NLV	1.8E+10	1.2E+7 (C,DD)	1.2E+7 (C,DD)	1.2E+7 (C,DD)	1.2E+7
Phosphorus (Total)	7723140	NA	1.3E+6	4.8E+6	(EE)	ID	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	8.0E+5	NA	1.7E+6 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6 (C)	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	8.8E+5	NA	1.1E+6 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+6 (C)	1.1E+6 (C)	1.1E+6
Picloram	1918021	NA	10,000	10,000	920	8.6E+6	NLV	NLV	NLV	NLV	ID	5.1E+7	7.1E+7	6.0E+7	NA
Piperidine	110894	NA	64	180	NA	6.8E+5	NLV	NLV	NLV	NLV	4.1E+9	3.2E+5	4.5E+5	3.8E+5	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	4,800	8,600	6,300	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	NLL	1.6E+7	8.1E+5	2.8E+7	2.8E+7	6.5E+6	(T)	(T)	(T)	NA
Prometon	1610180	NA	4,900	14,000	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	1.6E+7	2.2E+7	1.9E+7	NA
Propachlor	1918167	NA	1,900	5,400	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	9.5E+6	1.3E+7	1.1E+7	NA
Propazine	139402	NA	4,000	11,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	2.0E+7	2.8E+7	2.3E+7	NA
Propionic acid	79094	NA	2.4E+5	7.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+9	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	80,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.1E+10	7.4E+7 (DD)	1.1E+8 (DD)	9.1E+7(DD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	4,600	NA	3.0E+5	ID	ID	ID	ID	5.9E+8	8.0E+6	1.0E+7 (C)	9.4E+6	1.0E+7
Propylene glycol	57556	NA	3.0E+6	8.4E+6	5.8E+6	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.8E+11	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	4.8E+5	ID	4.8E+5	1.0E+9 (D)	7.8E+8	7.8E+8	7.8E+8	2.9E+9	8.4E+7	1.5E+8	1.1E+8	NA
Pyridine (I)	110861	NA	400	420	NA	37,000 (C)	2,000	9,800	40,000	97,000	1.0E+8	37,000 (C)	37,000 (C)	37,000 (C)	37,000

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Selenium (B)	7782492	410	4,000	4,000	400	7.8E+7	NLV	NLV	NLV	NLV	5.9E+7	9.6E+6	1.0E+7	1.0E+7	NA
Silver (B)	7440224	1,000	4,500	13,000	100 (M); 27	2.0E+8	NLV	NLV	NLV	NLV	2.9E+6	9.0E+6	9.8E+6	9.4E+6	NA
Silvex (2,4,5-TP)	93721	NA	3,600	3,600	2,200	3.1E+6	NLV	NLV	NLV	NLV	ID	5.5E+6	7.7E+6	6.4E+6	NA
Simazine	122349	NA	80	80	NA	90,000	NLV	NLV	NLV	NLV	ID	3.8E+6	5.3E+6	4.5E+6	NA
Sodium	17341252	NA	2.5E+6	7.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Sodium azide	26628228	NA	1,800	5,000	NA	ID	ID	ID	ID	ID	ID	8.70E+06	1.20E+07	1.00E+07	NA
Strontium (B)	7440246	NA	92,000	2.6E+5	46,000 (X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	1.0E+9 (D)	1.0E+9 (D)	NA
Styrene	100425	NA	2,700	2,700	2,200	2.7E+5	5.2E+5 (C)	3.3E+6	3.3E+6	4.2E+6	6.9E+9	5.2E+5 (C)	5.2E+5 (C)	5.2E+5 (C)	5.2E+5
Sulfate	14808798	NA	5.0E+6	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	30,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	2.7E+7 (DD)	4.2E+7 (DD)	3.3E+7 (DD)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	1.5E+6	3,400 (X)	1.5E+6	ID	ID	ID	ID	ID	2.5E+8	3.5E+8	2.9E+8	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	89 (O)	0.99 (O)	1.4 (O)	2.9 (O)	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	6,400	ID (X)	4.4E+5 (C)	33,000	1.2E+5	2.1E+5	3.3E+5	5.3E+8	4.4E+5 (C)	4.4E+5 (C)	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	170	700	1,600 (X)	94,000	23,000	34,000	34,000	34,000	6.8E+7	2.4E+5	3.4E+5	2.9E+5	8.7E+5
Tetrachloroethylene	127184	NA	100	100	900 (X)	88,000 (C)	60,000	6.0E+5	1.4E+6	3.3E+6	6.8E+9	88,000 (C)	88,000 (C)	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	1,900	5,400	2.2E+5 (X)	3.2E+7	2.4E+6	1.5E+7	6.7E+7	1.6E+8	1.7E+11	9.5E+6	1.3E+7	1.1E+7	1.2E+8
Tetranitromethane	509148	NA	ID	ID	ID	ID	600	500 (M); 180	ID	ID	2.6E+5	ID	ID	ID	ID
Thallium (B)	7440280	NA	2,300	2,300	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	ID	1.3E+5	1.4E+5	1.3E+5	NA
Toluene (I)	108883	NA	16,000	16,000	2,800	2.5E+5 (C)	2.5E+5 (C)	3.3E+6	3.6E+7	3.6E+7	1.2E+10	2.5E+5 (C)	2.5E+5 (C)	2.5E+5 (C)	2.5E+5
p-Toluidine	106490	NA	660 (M); 300	1,200	NA	4.8E+5	NLV	NLV	NLV	NLV	1.3E+8	4.3E+5	6.1E+5	5.1E+5	1.2E+6
Toxaphene	8001352	NA	24,000	24,000	860	3.6E+5	NLV	NLV	NLV	NLV	1.2E+7	85,000	1.5E+5	1.1E+5	NA
Tnallate	2303175	NA	95,000	2.5E+5 (C)	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5 (C)	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	23,000	ID	1.8E+6	1.1E+6	7.2E+5	7.2E+5	7.2E+5	2.1E+8	2.6E+6	3.6E+6	3.0E+6	3.7E+6

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
1,2,4-Trichlorobenzene	120821	NA	4,200	4,200	1,800	1.1E+6	1.1E+6 (C)	3.4E+7	3.4E+7	3.4E+7	1.1E+10	1.1E+6 (C,DD)	1.1E+6 (C,DD)	1.1E+6 (C,DD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	4,000	4,000	4.6E+5 (C)	4.6E+5	4.5E+6	1.5E+7	3.1E+7	2.9E+10	4.6E+5 (C)	4.6E+5 (C)	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	100	100	6,600 (X)	4.2E+5	24,000	57,000	57,000	1.2E+5	2.5E+8	8.4E+5	9.2E+5 (C)	9.2E+5 (C)	9.2E+5
Trichloroethylene	79016	NA	100	100	4,000 (X)	4.4E+5	37,000	2.6E+5	4.4E+5	1.1E+6	2.3E+9	5.0E+5 (C,DD)	5.0E+5 (C,DD)	5.0E+5 (C,DD)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	1.5E+5	NA	5.6E+5 (C)	5.6E+5 (C)	1.1E+8	1.4E+11	1.4E+11	1.7E+12	5.6E+5 (C)	5.6E+5 (C)	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	1.1E+5	NA	9.1E+6	NLV	NLV	NLV	NLV	1.0E+10	7.3E+7	1.0E+8	8.6E+7	NA
2,4,6-Trichlorophenol	88062	NA	2,400	9,400	330 (M), 100	2.0E+5	NLV	NLV	NLV	NLV	1.3E+9	3.3E+6	4.6E+6	3.9E+6	NA
1,2,3-Trichloropropane	96184	NA	840	2,400	NA	8.3E+5 (C)	ID	ID	ID	ID	ID	8.3E+5 (C)	8.3E+5 (C)	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	NA	5.5E+5 (C)	5.5E+5 (C)	1,700	5.5E+5 (C)	5.5E+5 (C)	2.1E+8	8.9E+8	2.1E+9	2.3E+12	5.5E+5 (C)	5.5E+5 (C)	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	2.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+9	1.1E+8 (C)	1.1E+8 (C)	1.1E+8 (C)	1.1E+8
Triethylene glycol	112276	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,DD)	1.1E+5 (C,DD)	1.1E+5 (C,DD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	3.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	2.4E+8 (DD)	3.7E+8 (DD)	3.0E+8 (DD)	NA
Trifluralin	1582098	NA	1.9E+5	5.7E+5	NA	1.2E+7	ID	ID	ID	ID	ID	5.7E+6	1.0E+7	7.4E+6	NA
2,2,4-Trimethyl pentane	540841	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	19,000
2,4,4-Trimethyl-2-pentene (l)	107404	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (l)	95636	NA	2,100	2,100	570	1.1E+5 (C)	1.1E+5 (C)	2.5E+7	6.0E+8	6.0E+8	3.6E+10	1.1E+5 (C)	1.1E+5 (C)	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (l)	108678	NA	1,800	1,800	1,100	94,000 (C)	94,000 (C)	1.9E+7	4.6E+8	4.6E+8	3.6E+10	94,000 (C)	94,000 (C)	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C)	1.1E+5 (C)	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	930	930	NA	27,000 (C)	27,000 (C)	60,000	60,000	60,000	7.4E+6	20,000	27,000 (C)	24,000	27,000
Urea	57136	NA	ID (N)	ID (N)	NA	ID	NLV	NLV	NLV	NLV	ID	ID	ID	ID	NA
Vanadium	7440622	NA	72,000	9.9E+5	1.9E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.5E+6 (DD)	6.2E+6 (DD)	5.9E+6 (DD)	NA
Vinyl acetate (l)	108054	NA	13,000	36,000	NA	2.4E+6 (C)	1.5E+6	2.0E+6	2.7E+6	5.9E+6	5.9E+9	2.4E+6 (C,DD)	2.4E+6 (C,DD)	2.4E+6 (C,DD)	2.4E+6
Vinyl chloride	75014	NA	40	40	300	20,000	2,800	29,000	1.7E+5	4.2E+5	8.9E+8	34,000	47,000	40,000	4.9E+5
White phosphorus (R)	12185103	NA	2.2	6.0	NA	58,000	NLV	NLV	NLV	NLV	ID	17,000 (DD)	18,000 (DD)	18,000 (DD)	NA

TABLE 3. SOIL: INDUSTRIAL AND COMMERCIAL II, III, AND IV PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact			
Guidesheet Number →		#10	#21		#12	#13	#22	#23	#24	#25	#26	#27	#28	#29	#30
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Industrial and Commercial Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Industrial and Commercial II	Commercial III	Commercial IV	Soil Saturation Concentration Screening Levels
Xylenes (I)	1330207	NA	5,600	5,600	700	1.5E+5 (C)	1.5E+5 (C)	5.4E+7	6.5E+7	1.3E+8	1.3E+11	1.5E+5 (C)	1.5E+5 (C)	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	5.0E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	6.3E+8	6.9E+8	6.6E+8	NA

FOOTNOTES

FOR THE PART 201 CRITERIA/ PART 213 RISK-BASED SCREENING LEVELS RRD OPERATIONAL MEMORANDUM No. 1

(A) Criterion is the state of Michigan drinking water standard established pursuant to Section 5 of 1976 PA 399, MCL 325.1005.

(B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion. Background levels may be less than criteria for some inorganic compounds.

(C) Value presented is a screening level based on the chemical-specific generic soil saturation concentration (C_{sat}) since the calculated risk-based criterion is greater than C_{sat}. Concentrations greater than C_{sat} are acceptable cleanup criteria for this pathway where a site-specific demonstration indicates that free-phase material containing a hazardous substance is not present.

(D) Calculated criterion exceeds 100 percent, hence it is reduced to 100 percent or 1.0E+9 parts per billion (ppb).

(E) Criterion is the aesthetic drinking water value, as required by Section 20120a(5) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A notice of aesthetic impact may be employed as an institutional control mechanism if groundwater concentrations exceed the aesthetic drinking water criterion, but do not exceed the applicable health-based drinking water value provided in the following table:

Hazardous Substance	Chemical Abstract Service Number	Residential Health-Based Drinking Water Value	Industrial-Commercial Health-Based Drinking Water Value
Aluminum	7429905	300	4,100
tertiary Amyl methyl ether	994058	910	2,600
Copper	7440508	1,400	4,000
Diethyl ether	60297	3,700	10,000
Ethylbenzene	100414	700	700
Iron	7439896	2,000	5,600
Manganese	7439965	860	2,500
Methyl-tert-butyl ether (MTBE)	1634044	240	690
Toluene	108883	1,000	1,000
1,2,4-Trimethylbenzene	95636	1,000	2,900
1,3,5-Trimethylbenzene	108678	1,000	2,900
Xylenes	1330207	10,000	10,000

(F) Criterion is based on adverse impacts to plant life and phytotoxicity.

(G) Groundwater surface water interface (GSI) criterion depends on the pH or water hardness, or both, of the receiving surface water. The final chronic value (FCV) for the protection of aquatic life shall be calculated based on

the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg $CaCO_3$/L, use 400 mg $CaCO_3$/L for the FCV calculation. The FCV formula provides values in units of ug/L or ppb. The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV), and the surface water human non-drinking water value (HNDV). The soil GSI protection criteria for these hazardous substances are the greater of the 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	FCV Formula ug/L	FCV Conversion Factor (CF)	WV ug/L	HNDV ug/L
Acetate	EXP(0.2732*(pH) + 7.0362)	NA	NA	1.3E+6
Barium⊗	EXP(1.0629*(LnH)+1.1869)	NA	NA	1.6E+5
Beryllium	EXP(2.5279*(LnH)-10.7689)	NA	NA	1,200
Cadmium⊗	(EXP(0.7852*(LnH)-2.715))*CF	1.101672-((LnH)*(0.041838))	NA	130
Chromium (III) ⊗	(EXP(0.819*(LnH)+0.6848))*CF	0.86	NA	9,400
Copper	(EXP(0.8545*(LnH)-1.702)) *CF	0.96	NA	64,000
Lead⊗	(EXP(1.273*(LnH)-3.296))*CF	1.46203-((LnH)*(0.14571))	NA	190
Manganese	EXP(0.8784*(LnH)+3.5199)	NA	NA	59,000
Nickel	(EXP(0.846*(LnH)+0.0584))*CF	0.997	NA	2.1E+5
Pentachlorophenol	EXP(1.005*(pH)-5.134)	NA	NA	2.8
Zinc	(EXP(0.8473*(LnH)+0.884))*CF	0.986	NA	22,000

where,

EXP(x) = The base of the natural logarithm raised to power x (e^x).
LnH = The natural logarithm of water hardness in mg $CaCO_3$/L.
* = The multiplication symbol.
⊗ = The GSI criterion developed here may not be protective for surface water that is used as a drinking water source. Refer to footnote (X) for further guidance.

A spreadsheet that may be used to calculate GSI and GSI protection criteria for (G)-footnoted hazardous substances is available on the Department of Environmental Quality (DEQ) internet web site.

(H) Valence-specific chromium data (Cr III and Cr VI) shall be compared to the corresponding valence-specific cleanup criteria. If both Cr III and Cr VI are present in groundwater, the total concentration of both cannot exceed the drinking water criterion of 100 ug/L. If analytical data are provided for total chromium only, they shall be compared to the cleanup criteria for Cr VI. Cr III soil cleanup criterion for protection of drinking water can only be used at sites where groundwater is prevented from being used as a public water supply, currently and in the future, through an approved land or resource use restriction.

(I) Hazardous substance may exhibit the characteristic of ignitability as defined in 40 C.F.R. §261.21 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these

rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, Remediation and Redevelopment Division (RRD), 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations shall be added together for comparison to criteria.

(K) Hazardous substance may be flammable or explosive, or both.

(L) Criteria for lead are derived using a biologically based model, as allowed for under Section 20120a(10) of the NREPA, and are not calculated using the algorithms and assumptions specified in pathway-specific rules. The generic residential drinking water criterion of 4 ug/L is linked to the generic residential soil direct contact criterion of 400 mg/kg. A higher concentration in the drinking water, up to the state action level of 15 ug/L, may be allowed as a site-specific remedy and still allow for drinking water use, under Section 20120a(2) of the NREPA if soil concentrations are appropriately lower than 400 mg/kg. If a site-specific criterion is approved based on this subdivision, a notice shall be filed on the deed for all property where the groundwater concentrations will exceed 4 ug/L to provide notice of the potential for unacceptable risk if soil or groundwater concentrations increase. Acceptable combinations of site-specific soil and drinking water concentrations are presented in the following table:

Acceptable Combinations of Lead in Drinking Water and Soil

Drinking Water Concentration (ug/L)	Soil Concentration (mg/kg)
5	386-395
6	376-385
7	376-385
8	366-375
9	356-365
10	346-355
11	336-345
12	336-345
13	326-335
14	316-325
15	306-315

(M) Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit.

(N) The concentrations of all potential sources of nitrate-nitrogen (e.g., ammonia-N, nitrite-N, nitrate-N) in groundwater that is used as a source of drinking water shall not, when added together, exceed the nitrate drinking water criterion of 10,000 ug/L. Where leaching to groundwater is a relevant pathway, soil concentrations of all potential sources of nitrate-nitrogen shall not, when added together, exceed the nitrate drinking water protection criterion of 2.0E+5 ug/kg.

(O) The concentration of all polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent

concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, shall be added together and compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin. The generic cleanup criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin are not calculated according to the algorithms presented in R 299.5714 to R 299.5726. The generic cleanup criteria are being held at the values that the DEQ has used since August 1998, in recognition of the fact that national efforts to reassess risks posed by dioxin are not yet complete. Until these studies are complete, it is premature to select a revised slope factor and/or reference dose for calculation of generic cleanup criteria.

(P) Amenable cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with all groundwater criteria. Total cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with soil criteria. Industrial-commercial direct contact criteria may not be protective of the potential for release of hydrogen cyanide gas. Additional land or resource use restrictions may be necessary to protect for the acute inhalation concerns associated with hydrogen cyanide gas.

(Q) Criteria for carcinogenic polycyclic aromatic hydrocarbons were developed using relative potential potencies to benzo(a)pyrene.

(R) Hazardous substance may exhibit the characteristic of reactivity as defined in 40 C.F.R. §261.23 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(S) Criterion defaults to the hazardous substance-specific water solubility limit.

(T) Refer to the federal Toxic Substances Control Act (TSCA), 40 C.F.R. §761, Subpart D and 40 C.F.R. §761, Subpart G, to determine the applicability of TSCA cleanup standards. Subpart D and Subpart G of 40 C.F.R. §761 (July 1, 2001) are adopted by reference in these rules and are available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulations may be purchased, at a cost as of the time of adoption of these rules of $55, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401, or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost. Alternatives to compliance with the TSCA standards listed below are possible under 40 C.F.R. §761 Subpart D. New releases may be subject to the standards identified in 40 C.F.R. §761, Subpart G. Use Part 201 soil direct contact cleanup criteria in the following table if TSCA standards are not applicable.

Land Use Category	TSCA, Subpart D Cleanup Standards	Part 201 Soil Direct Contact Cleanup Criteria
Residential & Commercial I	1,000 ppb, or 10,000 ppb if capped	4,000 ppb
Industrial & Commercial II	1,000 ppb, or 10,000 ppb if capped	16,000 ppb
Commercial III	1,000 ppb, or 10,000 ppb if capped	33,000 ppb
Commercial IV	1,000 ppb, or 10,000 ppb if capped	22,000 ppb

(U) Hazardous substance may exhibit the characteristic of corrosivity as defined in 40 C.F.R. §261.22 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(V) Criterion is the aesthetic drinking water value as required by Section 20120(a)(5) of the NREPA. Concentrations up to 200 ug/L may be acceptable, and still allow for drinking water use, as part of a site-specific cleanup under Section 20120a(2) of the NREPA.

(W) Concentrations of trihalomethanes in groundwater shall be added together to determine compliance with the Michigan drinking water standard of 80 ug/L. Concentrations of trihalomethanes in soil shall be added together to determine compliance with the drinking water protection criterion of 1,600 ug/kg.

(X) The GSI criterion shown in the generic cleanup criteria tables is not protective for surface water that is used as a drinking water source. For a groundwater discharge to the Great Lakes and their connecting waters or discharge in close proximity to a water supply intake in inland surface waters, the generic GSI criterion shall be the surface water human drinking water value (HDV) listed in the table in this footnote, except for those HDV indicated with an asterisk. For HDV with an asterisk, the generic GSI criterion shall be the lowest of the HDV, the WV, and the calculated FCV. See formulas in footnote (G). Soil protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria for compounds with an asterisk shall be the greater of 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	Chemical Abstract Service Number	Surface Water Human Drinking Water Values (HDV) (ug/L)	Soil GSI Protection Criteria for HDV (ug/kg)
Acrylonitrile	107131	2.0 (M); 0.87	100 (M); 17
Alachlor	15972608	3.5	91
Antimony	7440360	2	1,400
Arsenic	7440382	50	23,000
Atrazine	1912249	4.3	86
Barium	7440393	1,900*	*
Benzene	71432	12	240
bis(2-Chloroethyl)ether	111444	1 (M); 0.79	100 (M); 20
Bromate	15541454	10 (M); 0.5	200 (M); 10
Butyl benzyl phthalate	85687	6.9	13,000
Cadmium	7440439	2.5*	*
Carbon tetrachloride	56235	5.6	110
Chloride	16887006	50,000	1.0E+6
Chloroform	67663	77	1,500
Chromium (III)	16065831	120*	*
Cyanazine	21725462	2 (M); 0.93	200 (M); 40
3,3'-Dichlorobenzidine	91941	0.3 (M); 0.14	2,000 (M); 7.7
1,2-Dichloroethane	107062	6	120
1,1-Dichloroethylene	75354	24	480
1,2-Dichloropropane	78875	9.1	180
N,N-Dimethylacetamide	127195	700	14,000
1,4-Dioxane	123911	34	680
Ethylene dibromide	106934	0.05 (M); 0.006	20 (M); 1.0
Ethylene glycol	107211	56,000	1.1E+6
Heptachlor	76448	0.01 (M); 0.0017	NLL
beta-Hexachlorocyclohexane	319857	0.024	20 (M)
Hexachloroethane	67721	5.3	310
Isophorone	78591	310	6,200
Isopropyl alcohol	67630	28,000	5.6E+5
Lead	7439921	14*	*
Manganese	7439965	3600	72,000
Methyl-tert-butyl ether (MTBE)	1634044	100	2,000
Methylene chloride	75092	47	940
Mirex	2385855	0.02 (M); 1.6E-5	NLL
Molybdenum	7439987	120	2,400
Nitrobenzene	98953	4.7	330 (M); 94
Pentachlorophenol	87865	1.8*	*
1,2,4,5-Tetrachlorobenzene	95943	2.8	3,300
1,1,1,2-Tetrachloroethane	630206	19	380
1,1,2,2-Tetrachloroethane	79345	3.2	64
Tetrachloroethylene	127184	11	220
Tetrahydrofuran	109999	350	7,000
Thallium	7440280	2.0 (M); 1.2	2,300
1,1,2-Trichloroethane	79005	12	240
Trichloroethylene	79016	29	580

(Y) Source size modifiers shown in the following table shall be used to determine soil inhalation criteria for ambient air when the source size is not one-half acre. The modifier shall be multiplied by the generic soil inhalation criteria shown in the table of generic cleanup criteria to determine the applicable criterion.

Source Size sq. feet or acres	Modifier
400 sq feet	3.17
1000 sq feet	2.2
2000 sq feet	1.76
1/4 acre	1.15
1/2 acre	1
1 acre	0.87
2 acre	0.77
5 acre	0.66
10 acre	0.6
32 acre	0.5
100 acre	0.43

(Z) Mercury is typically measured as total mercury. The generic cleanup criteria, however, are based on data for different species of mercury. Specifically, data for elemental mercury, chemical abstract service (CAS) number 7439976, serve as the basis for the soil volatilization to indoor air criteria, groundwater volatilization to indoor air, and soil inhalation criteria. Data for methyl mercury, CAS number 22967926, serve as the basis for the GSI criterion; and data for mercuric chloride, CAS number 7487947, serve as the basis for the drinking water, groundwater contact, soil direct contact, and the groundwater protection criteria. Comparison to criteria shall be based on species-specific analytical data only if sufficient facility characterization has been conducted to rule out the presence of other species of mercury.

(AA) Comparison to these criteria may take into account an evaluation of whether the hazardous substances are adsorbed to particulates rather than dissolved in water and whether filtered groundwater samples were used to evaluate groundwater.

(BB) The state drinking water standard for asbestos is in units of fibers per milliliter of water (f/mL) longer than 10 millimicrons. Soil concentrations of asbestos are determined by polarized light microscopy.

(CC) Groundwater: The generic GSI criteria are based on the toxicity of unionized ammonia (NH_3); the criteria are 29 ug/L and 53 ug/L for cold water and warm water surface water, respectively. As a result, the GSI criterion shall be compared to the percent of the total ammonia concentration in the groundwater that will become NH_3 in the surface water. This percent NH_3 is a function of the pH and temperature of the receiving surface water and can be estimated using the following table,

taken from Emerson, et al., (Journal of the Fisheries Research Board of Canada, Volume 32(12):2382, 1975).

Percent NH_3 in Aqueous Ammonia Solutions for 0-30 °C and pH 6-10

Temp (°F)	Temp (°C)	pH 6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
32.0	0	0.00827	0.0261	0.0826	0.261	0.820	2.55	7.64	20.7	45.3
33.8	1	0.00899	0.0284	0.0898	0.284	0.891	2.77	8.25	22.1	47.3
35.6	2	0.00977	0.0309	0.0977	0.308	0.968	3.00	8.90	23.6	49.4
37.4	3	0.0106	0.0336	0.106	0.335	1.05	3.25	9.60	25.1	51.5
39.2	4	0.0115	0.0364	0.115	0.363	1.14	3.52	10.3	26.7	53.5
41.0	5	0.0125	0.0395	0.125	0.394	1.23	3.80	11.1	28.3	55.6
42.8	6	0.0136	0.0429	0.135	0.427	1.34	4.11	11.9	30.0	57.6
44.6	7	0.0147	0.0464	0.147	0.462	1.45	4.44	12.8	31.7	59.5
46.4	8	0.0159	0.0503	0.159	0.501	1.57	4.79	13.7	33.5	61.4
48.2	9	0.0172	0.0544	0.172	0.542	1.69	5.16	14.7	35.3	63.3
50.0	10	0.0186	0.0589	0.186	0.586	1.83	5.56	15.7	37.1	65.1
51.8	11	0.0201	0.0637	0.201	0.633	1.97	5.99	16.8	38.9	66.8
53.6	12	0.0218	0.0688	0.217	0.684	2.13	6.44	17.9	40.8	68.5
55.4	13	0.0235	0.0743	0.235	0.738	2.30	6.92	19.0	42.6	70.2
57.2	14	0.0254	0.0802	0.253	0.796	2.48	7.43	20.2	44.5	71.7
59.0	15	0.0274	0.0865	0.273	0.859	2.67	7.97	21.5	46.4	73.3
60.8	16	0.0295	0.0933	0.294	0.925	2.87	8.54	22.8	48.3	74.7
62.6	17	0.0318	0.101	0.317	0.996	3.08	9.14	24.1	50.2	76.1
64.4	18	0.0343	0.108	0.342	1.07	3.31	9.78	25.5	52.0	77.4
66.2	19	0.0369	0.117	0.368	1.15	3.56	10.5	27.0	53.9	78.7
68.0	20	0.0397	0.125	0.396	1.24	3.82	11.2	28.4	55.7	79.9
69.8	21	0.0427	0.135	0.425	1.33	4.10	11.9	29.9	57.5	81.0
71.6	22	0.0459	0.145	0.457	1.43	4.39	12.7	31.5	59.2	82.1
73.4	23	0.0493	0.156	0.491	1.54	4.70	13.5	33.0	60.9	83.2
75.2	24	0.0530	0.167	0.527	1.65	5.03	14.4	34.6	62.6	84.1
77.0	25	0.0569	0.180	0.566	1.77	5.38	15.3	36.3	64.3	85.1
78.8	26	0.0610	0.193	0.607	1.89	5.75	16.2	37.9	65.9	85.9
80.6	27	0.0654	0.207	0.651	2.03	6.15	17.2	39.6	67.4	86.8
82.4	28	0.0701	0.221	0.697	2.17	6.56	18.2	41.2	68.9	87.3
84.2	29	0.0752	0.237	0.747	2.32	7.00	19.2	42.9	70.4	88.3
86.0	30	0.0805	0.254	0.799	2.48	7.46	20.3	44.6	71.8	89.0

The generic approach for estimating NH_3 assumes a default pH of 8 and default temperatures of 68°F and 85°F for cold water and warm water surface water, respectively. The resulting percent NH_3 is 3.8 percent and 7.2 percent for cold water and warm water, respectively. This default percentage shall be multiplied by the total ammonia-nitrogen (NH_3-N) concentration in the groundwater and the resulting NH_3 concentration

compared to the applicable GSI criterion. As an alternative, the maximum pH and temperature data from the specific receiving surface water can be used to estimate, from the table in this footnote, a lower percent unionized ammonia concentration for comparison to the generic GSI.

Soil: The generic soil GSI protection criteria for unionized ammonia are 580 ug/kg and 1,100 ug/kg for cold water and warm water surface water, respectively.

(DD) Hazardous substance causes developmental effects. Residential and commercial I direct contact criteria are protective of both prenatal and postnatal exposure. Industrial and commercial II, III and IV direct contact criteria are protective for a pregnant adult receptor.

(EE) The following are applicable generic GSI criteria as required by Section 20120a(15) of the NREPA.

Hazardous Substance	GSI (ug/L)	Notes
Phosphorus	1,000	Criteria applicable unless receiving water is a surface water that has a phosphorus waste load allocation or is an inland lake. In those cases, contact the department for applicable values.
Total dissolved solids (TDS)	5.0E+5	If TDS data are not available, the TDS criterion may be used a screening level for the sum of the concentrations of the following substances: Calcium, Chlorides, Iron, Magnesium, Potassium, Sodium, Sulfate.
Dissolved Oxygen (DO): Cold receiving waters Warm receiving waters	 ≥ 7,000 ≥ 5,000	Since a low level of DO can be harmful to aquatic life, the criterion represents a minimum level that on-site samples must exceed. This is in contrast to other criteria which represent "not to exceed" concentrations. DO criteria are not applicable if groundwater Carbonaceous Biochemical Oxygen Demand (CBOD) is less than 10,000 ug/L and groundwater ammonia concentration is less than 2,000 ug/L.

(FF) The chloride GSI criterion shall be 125 mg/l when the discharge is to surface waters of the state designated as public water supply sources or 50 mg/l when the discharge is to the Great Lakes or connecting waters. Chloride GSI criteria shall not apply for surface waters of the state that are not designated as a public water supply source, however, the total dissolved solids criterion is applicable.

(GG) Risk-based criteria are not available for methane due to insufficient toxicity data. An acceptable soil gas concentration (presented for both residential and commercial/industrial land uses) was derived utilizing 25 percent of the lower explosive level for methane. This equates to 1.25 percent or 8.4E+6 ug/m^3.

"ID" means insufficient data to develop criterion.
"NA" means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.

"NLL" means hazardous substance is not likely to leach under most soil conditions.

"NLV" means hazardous substance is not likely to volatilize under most conditions.

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Developed pursuant to R 299.5752 of the Administrative Rules for Part 201 Environmental Remediation of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Scientific notation is represented by E+ or E- a value. for example 2 x 10^6 is reported as 2 0E+6.

Units are as indicated in each column heading.

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Dissolved oxygen (DO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
Total dissolved solids (TDS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
Acenaphthene	83329	1 8E-1	NA	2.1E+2	NA	NA	0.2	1.0	0.1	1.0	3.92	7,140
Acenaphthylene	208968	7.1E-3	NA	3 5E+1	NA	NA	0.2	1.0	0.1	1.0	3.6	3,460
Acetaldehyde (I)	75070	1.3E-1	NA	9 0E+0	2.2E-6	4 5E+4	0.2	1.0	0 1	1 0	-0 367	0 613
Acetate	71501	5 70E-01	NA	NA	NA	NA	0.2	NA	NA	NA	NA	NA
Acetic acid	64197	5 7E-1	NA	2.5E+2	NA	3 7E+4	0.2	1.0	0.1	1 0	-0.23	0.595
Acetone (I)	67641	1.0E-1	NA	5.9E+3	NA	1.7E+06	0.2	1.0	0 1	1 0	-0.240	0.581
Acetonitrile	75058	1 9E-2	NA	6.0E+1	NA	1.01E+5	0 2	1 0	0.1	1 0	-0.337	0.648
Acetophenone	98862	2.1E-1	NA	4 9E+2	NA	NA	0.2	1.0	0.1	1 0	1 6	37.4
Acrolein (I)	107028	1.6E-2	NA	2.0E-2	NA	6 9E+2	0.2	1.0	0 1	1.0	-0.01	1.18
Acrylamide	79061	2.0E-4	2.8E+0	NA	1.3E-3	NA	0.2	1.0	0 1	1 0	-0.96	0.114
Acrylic acid	79107	5 3E-1	NA	1.0E+0	NA	NA	0.2	1.0	0 1	1.0	0.35	2.21
Acrylonitrile (I)	107131	NA	3 3E-1	2.0E+0	6.8E-5	NA	0 2	1.0	0 1	1 0	0.255	1.78
Alachlor	15972608	1 0E-2	9.6E-2	NA	NA	NA	0 2	0 5	0.1	1 0	3 52	734
Aldicarb	116063	1 0E-3	NA	NA	NA	NA	0.2	1 0	0.1	1 0	1.1	12.1
Aldicarb sulfoxide	1646873	1 3E-3	NA	NA	NA	NA	0.2	1 0	0.1	1 0	-0.67	0.22
Aldicarb sulfone	1646884	1.1E-3	NA	NA	NA	NA	0 2	1 0	0 1	1.0	-0.57	0.275
Aldrin	309002	2.5E-5	8.7E+0	NA	4.9E-3	NA	0.2	0 5	0.1	1 0	6 5	2.45E+6
Aluminum (B)	7429905	3.3E-1	NA	NA	NA	NA	0.2	0 5	0 01	1 0	NR	NR
Ammonia	7664417	NA	NA	1.0E+2	NA	2 4E+4	0.2	1 0	0 1	1 0	NA	NA
t-Amyl methyl ether (TAME)	994058	1.3E-1	NA	6.2E+1	NA	NA	0 2	1 0	0 1	1.0	1.73	28 1
Aniline	62533	NA	1.6E-2	1.0E+0	NA	NA	0.2	1 0	0.1	1.0	0 978	9.15
Anthracene	120127	1.0E+0	NA	1.0E+3	NA	NA	0.2	1 0	0.1	1.0	4.55	29,700
Antimony	7440360	3.5E-4	NA	2.0E-1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Arsenic	7440382	2.7E-4	1.5E+0	NA	4.3E-3	NA	0 2	0 5	0 03	1 0	NR	NR
Asbestos (BB)	1332214	NA	NA	NA	0.046	NA	1.0	1.0	0	1.0	NR	NR
Atrazine	1912249	3.5E-2	7.4E-2	NA	NA	NA	0.2	1 0	0 1	1.0	2.7	451
Azobenzene	103333	NA	3.7E-2	NA	3.1E-5	NA	0.2	1.0	0.1	1.0	3 82	5,690

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

The dataset for each hazardous substance requires 22 columns Review all 22 columns across 2 pages when evaluating data for a specific hazardous substance.

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6 8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Dissolved oxygen (DO)	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
pH	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
Total dissolved solids (TDS)	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	NR	NR	1.55E-4	0.0421	7.69E-6	NA	NA	4,240	Solid	154 2
Acenaphthylene	NR	NR	1.48E-3	0.08	8.0E-6	NA	NA	3,930	Solid	152.271
Acetaldehyde (I)	NR	NR	7.95E-5	0.08	8 0E-6	0.04	-36	1.0E+9	Liquid	44.1
Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetic acid	NR	NR	1.00E-7	0.08	8.0E-6	0.04	103	6.0E+9	Liquid	60.05
Acetone (I)	NR	NR	3 88E-5	0 124	1 14E-5	0.025	0.0	1.0E+9	Liquid	58 08
Acetonitrile	NR	NR	2.40E-5	0.13	1.7E-5	0.03	42	2.00E+8	Liquid	41 05
Acetophenone	NR	NR	1.1E-5	0.08	8.0E-6	NA	NA	6.1E+6	Liquid	120 2
Acrolein (I)	NR	NR	9.40E-5	0 11	1.2E-5	0.028	-15	2 10E+8	Liquid	56 06
Acrylamide	NR	NR	3.22E-10	0 097	1.1E-4	NA	280	2.20E+9	Solid	71 08
Acrylic acid	NR	NR	3.20E-7	0 08	8 0E-6	0.024	121	1 0E+9	Liquid	72 06
Acrylonitrile (I)	NR	NR	1 00E-4	0 12	1 3E-5	0.03	30	7 50E+7	Liquid	53 06
Alachlor	NR	NR	8.32E-9	0 08	8.0E-6	NA	NA	1.83E+5	Solid	269 77
Aldicarb	NR	NR	4.17E-9	0 08	8.0E-6	NA	NA	6.00E+6	Solid	190 25
Aldicarb sulfoxide	NR	NR	9.69E-10	0.08	8.0E-6	NA	NA	2.80E+7	Solid	206.27
Aldicarb sulfone	NR	NR	3.37E-9	0.08	8.0E-6	NA	NA	7.80E+6	Solid	222.27
Aldrin	NR	NR	1.70E-4	0.0132	4 86E-6	NA	NA	180	Solid	364 9
Aluminum (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	26 982
Ammonia	NR	NR	3.20E-4	0.08	8 0E-6	0.15	NA	5.30E+8	Liquid	17 04
t-Amyl methyl ether (TAME)	NR	NR	2.68E-3	0.08	8.0E-6	NA	NA	2.64E+6	Liquid	102.18
Aniline	NR	NR	2.30E-6	0.07	8.3E-6	0.013	158	3.60E+7	Liquid	93 13
Anthracene	NR	NR	6 50E-5	0.0324	7.74E-6	NA	NA	43.4	Solid	178.24
Antimony	NR	45	NR	NR	NR	NA	NA	NA	Inorganic	121.760
Arsenic	NR	29	NR	NR	NR	NA	NA	NA	Inorganic	74.922
Asbestos (BB)	NR	NA	NR	NR	NR	NR	NR	NA	Inorganic	NA
Atrazine	NR	NR	2.63E-9	0.08	8.0E-6	NA	NA	70,000	Solid	215.72
Azobenzene	NR	NR	1 35E-5	0.08	8.0E-6	NA	NA	6,400	Solid	182.23

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Barium (B)	7440393	7 0E-2	NA	5 0E+0	NA	NA	1.0	0 5	0 01	1 0	NR	NR
Benzene (I)	71432	NA	2.9E-2	NA	8.3E-6	8.0E+3	0.2	1 0	0.1	1 0	2 13	58.2
Benzidine	92875	2.7E-3	2.3E+2	NA	6 7E-2	NA	0 2	1 0	0 1	1 0	1.66	42 9
Benzo(a)anthracene (Q)	56553	NA	4 1E-1	NA	NA	NA	0.2	0.5	0 13	1 0	5 7	4 01E+5
Benzo(b)fluoranthene (Q)	205992	NA	4.1E-1	NA	NA	NA	0.2	0 5	0.13	1.0	6 2	1.24E+6
Benzo(k)fluoranthene (Q)	207089	NA	4.1E-2	NA	NA	NA	0 2	0 5	0.13	1 0	6 2	1 24E+6
Benzo(g,h,i)perylene	191242	7.1E-3	NA	1.2E+1	NA	NA	0.2	0.5	0.13	1.0	6 7	3.86E+6
Benzo(a)pyrene (Q)	50328	NA	4.1E+0	NA	2.1E-3	NA	0.2	0 5	0.13	1.0	6 11	1 01E+6
Benzoic acid	65850	4.4E+0	NA	NA	NA	NA	0.2	1 0	0.1	1.0	1.86	0 6
Benzyl alcohol	100516	1.4E+0	NA	5 0E+3	NA	NA	0.2	1.0	0.1	1 0	1 11	12.3
Benzyl chloride	100447	NA	1.1E-1	NA	5.0E-5	NA	0.2	1 0	0.1	1.0	2.30	182
Beryllium	7440417	1.5E-3	NA	2.0E-2	2 4E-3	1.0E+1	0.2	1.0	0	1.0	NR	NR
bis(2-Chloroethoxy)ethane	112265	NA	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1.28	18.1
bis(2-Chloroethyl)ether (I)	111444	NA	4.2E-1	NA	3 3E-4	5.8E+4	0.2	1.0	0.1	1.0	1.21	10.9
bis(2-Ethylhexyl)phthalate	117817	1.9E-2	3.2E-3	NA	4 43E-6	1.0E+4	0.2	0 5	0.1	1.0	7.3	1.50E+7
Boron (B)	7440428	3 2E-1	NA	NA	NA	NA	0.2	0.5	0 01	1 0	NR	NR
Bromate	15541454	4.0E-3	7.0E-1	NA	NA	NA	0 2	0 5	0.01	1 0	0 63	NR
Bromobenzene (I)	108861	2 4E-3	NA	8 0E+0	NA	NA	0.2	1 0	0 1	1 0	2.99	870
Bromodichloromethane	75274	1 8E-2	5.0E-2	NA	3.7E-5	NA	0.2	1.0	0 1	1.0	2.1	55 1
Bromoform	75252	1.8E-2	6.4E-3	NA	1 1E-6	NA	0 2	1.0	0 1	1 0	2 35	87 0
Bromomethane	74839	1 4E-3	NA	5 0E+0	NA	NA	0.2	1.0	0 1	1.0	1.18	14.5
n-Butanol (I)	71363	1.3E-1	NA	3.5E+2	NA	1.52E+5	0.2	1 0	0.1	1.0	0 851	5 65
2-Butanone (MEK) (I)	78933	1.8E+0	NA	1 0E+3	NA	8.85E+5	0.2	1.0	0 1	1.0	0.279	1 99
n-Butyl acetate	123864	7.6E-2	NA	7.1E+3	NA	9.5E+5	0.2	1.0	0.1	1.0	1.78	30.8
t-Butyl alcohol	75650	5.4E-1	NA	1.89E+3	NA	NA	0.2	1 0	0.1	1.0	0.35	2.27
Butyl benzyl phthalate	85687	1.6E-1	NA	7.0E+2	NA	NA	0 2	1.0	0.1	1 0	4.84	57,300
n-Butylbenzene	104518	1.1E-2	NA	NA	NA	NA	0.2	1 0	0 1	1.0	4 38	20,200
sec-Butylbenzene	135988	1.1E-2	NA	NA	NA	NA	0.2	1 0	0 1	1.0	4.57	31,100
tert-Butylbenzene (I)	98066	1.1E-2	NA	NA	NA	NA	0.2	1.0	0 1	1.0	4 11	11,000
Cadmium (B)	7440439	1 0E-3	NA	NA	1.8E-3	NA	0.2	0.5	0 001	1 0	NR	NR
Camphene (I)	79925	NA	NA	NA	NA	NA	0.2	1.0	0 1	1.0	3 53	2,950
Caprolactam	105602	8.0E-1	NA	1 0E+1	NA	4.6E+4	0.2	1 0	0 1	1 0	-0.19	0 65
Carbaryl	63252	9.6E-2	NA	NA	NA	NA	0.2	1.0	0 1	1.0	2 4	229
Carbazole	86748	NA	1.0E-2	NA	NA	NA	0.2	1.0	0.1	1.0	3.59	3,380

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{eff})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^0F	ug/L		g/mol
Barium (B)	NR	41	NR	NR	NR	NA	NA	NA	Inorganic	137 327
Benzene (I)	NR	NR	5.55E-3	0.088	9.8E-6	0 012	12	1.75E+6	Liquid	78 11
Benzidine	NR	NR	3.90E-11	0.08	1.5E-5	NA	NA	5.20E+5	Solid	184 24
Benzo(a)anthracene (Q)	NR	NR	3.35E-6	0 051	9 0E-6	NA	NA	9.4	Solid	228 3
Benzo(b)fluoranthene (Q)	NR	NR	1.11E-4	0.0226	5 56E-6	NA	NA	1.5	Solid	252.32
Benzo(k)fluoranthene (Q)	NR	NR	8 29E-7	0 0226	5.56E-6	NA	NA	0.8	Solid	252.32
Benzo(g,h,i)perylene	NR	NR	5.34E-8	0.08	8 0E-6	NA	NA	0 26	Solid	276.34
Benzo(a)pyrene (Q)	NR	NR	1.13E-6	0.043	9.0E-6	NA	NA	1.62	Solid	252.32
Benzoic acid	0 6	NR	1.54E-6	0 0536	7 97E-6	NA	NA	3.50E+6	Solid	122.1
Benzyl alcohol	NR	NR	3.90E-7	0.08	8.0E-6	NA	NA	4.40E+7	Liquid	108.13
Benzyl chloride	NR	NR	4.00E-4	0.075	7.8E-6	0.011	153	4 90E+5	Liquid	126.58
Beryllium	NR	790	NR	NR	NR	NA	NA	NA	Inorganic	9.012
bis(2-Chloroethoxy)ethane	NR	NR	7.81E-7	0.08	8.0E-6	NA	NA	1 89E+7	Liquid	187.07
bis(2-Chloroethyl)ether (I)	NR	NR	1 80E-5	0.0692	7.53E-6	0.027	131	1.72E+7	Liquid	143.01
bis(2-Ethylhexyl)phthalate	NR	NR	1.02E-7	0.0351	3 66E-6	NA	420	340	Liquid	390.57
Boron (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	10.811
Bromate	NR	NA	1.00E+0	NR	NR	NA	NA	3.80E-4	Solid	79 9
Bromobenzene (I)	NR	NR	4.74E-4	0 08	8.0E-6	NA	NA	4.13E+5	Liquid	157.015
Bromodichloromethane	NR	NR	1 60E-3	0.0298	1 06E-5	NA	NA	6.74E+6	Liquid	163 8
Bromoform	NR	NR	5 35E-4	0 0149	1 03E-5	NA	NA	3.10E+6	Liquid	252.8
Bromomethane	NR	NR	1.42E-2	0.08	8.0E-6	0 1	NA	1.45E+7	Liquid	94.94
n-Butanol (I)	NR	NR	8 81E-6	0 08	9.6E-6	0 014	84	7.40E+7	Liquid	74 14
2-Butanone (MEK) (I)	NR	NR	3 60E-5	0 081	9.8E-6	NA	16	2.40E+8	Liquid	72.1
n-Butyl acetate	NR	NR	3.20E-4	0.08	8.0E-6	0.017	72	6.70E+6	Liquid	116.16
t-Butyl alcohol	NR	NR	1.17E-5	0 08	8.0E-6	0 024	52	1.0E+9	Liquid	74 12
Butyl benzyl phthalate	NR	NR	1.26E-6	0.0174	4 83E-6	NA	NA	2.690	Liquid	312.37
n-Butylbenzene	NR	NR	NA	0 08	8.0E-6	NA	NA	NA	Liquid	134.22
sec-Butylbenzene	NR	NR	NA	0 08	8.0E-6	NA	NA	NA	Liquid	134.22
tert-Butylbenzene (I)	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	134.22
Cadmium (B)	NR	75	NR	NR	NR	NA	NA	NA	Inorganic	112.411
Camphene (I)	NR	NR	2.05E+0	0.08	8.0E-6	NA	NA	33.400	Solid	136.26
Caprolactam	NR	NR	2.53E-8	0.08	8.0E-6	0.014	282	5.25E+9	Solid	113.2
Carbaryl	NR	NR	6.80E-4	0.08	8.0E-6	NA	NA	1.26E+5	Solid	201.24
Carbazole	NR	NR	1 53E-8	0.039	7.03E-6	NA	NA	7.480	Solid	167.21

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Carbofuran	1563662	5.0E-3	NA	NA	NA	NA	0.2	1 0	0.1	1 0	1.6	37.4
Carbon disulfide (I R)	75150	1.1E-1	NA	7.0E+2	NA	NA	0.2	1.0	0 1	1.0	2	45 9
Carbon tetrachloride	56235	7.1E-4	5 5E-2	NA	2 36E-5	6.3E+4	0.2	1.0	0 1	1.0	2.73	174
Chlordane (J)	57749	1 5E-3	3.5E-1	7.0E-1	1.0E-4	NA	0.2	0.5	0 04	1.0	6.32	1.21E+5
Chloride	16887006	NA	NA	NA	NA	NA	0.2	0 5	0 01	1 0	NR	NR
Chlorobenzene (I)	108907	1.9E-2	NA	7.0E+1	NA	NA	0.2	1.0	0.1	1.0	2 86	220
para-Chlorobenzenesulfonic acid	98668	1.0E+0	NA	NA	NA	NA	0.2	1 0	0.1	1.0	-0 52	4.64E-01
1-Chloro-1,1-difluoroethane	75683	2.1E+0	NA	5.0E+4	NA	NA	0.2	1 0	0 1	1.0	1.81	32 5
Chloroethane	75003	1.8E+1	2.0E-3	1.0E+4	NA	NA	0.2	1 0	0.1	1.0	1.4	23.8
2-Chloroethyl vinyl ether	110758	NA	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1.07	8 43
Chloroform	67663	1.3E-2	4 4E-3	NA	2.4E-6	NA	0.2	1.0	0 1	1 0	1 92	39.7
Chloromethane (I)	74873	NA	3.3E-3	9.0E+1	6 39E-7	2 07E+5	0.2	1 0	0.1	1 0	0.91	6.30
4-Chloro-3-methylphenol	59507	2.0E-2	NA	NA	NA	NA	0.2	1 0	0.1	1 0	3.1	1,120
beta-Chloronaphthalene	91587	2 5E-1	NA	NA	NA	NA	0.2	1.0	0 1	1.0	4.1	10,700
2-Chlorophenol	95578	6 2E-3	NA	NA	NA	NA	0.2	1 0	0.1	1.0	2.15	388
o-Chlorotoluene (I)	95498	2.0E-2	NA	7.0E+1	NA	NA	0.2	1.0	0 1	1.0	3.42	612
Chlorpyrifos	2921882	3 0E-2	NA	2.0E+0	NA	NA	0.2	0.5	0.1	1 0	5 3	18,900
Chromium (III) (B H)	16065831	1 5E+0	NA	5 0E+0	NA	NA	0 7	0.5	0.01	1 0	NR	NR
Chromium (VI)	18540299	4.8E-3	NA	8.0E-3	1.2E-2	NA	0.7	0 5	0 01	1 0	NR	NR
Chrysene (Q)	218019	NA	4.1E-3	NA	NA	NA	0.2	0.5	0 13	1 0	5.7	4.01E+5
Cobalt	7440484	5 0E-3	NA	2.0E-1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Copper (B)	7440508	3.8E-2	NA	2.0E+0	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Cyanazine	21725462	3.0E-3	3.7E-1	NA	NA	NA	0.2	1.0	0.1	1.0	2.2	146
Cyanide (P R)	57125	5.4E-3*	NA	5.0E+1	NA	NA	0 2	1 0	0	1.0	NA	NA
Cyclohexanone	108941	4.5E+0	NA	1.0E+3	NA	NA	0.2	1.0	0.1	1.0	0.81	6.26
Dacthal	1861321	1.0E-2	NA	NA	NA	NA	0 2	1.0	0 1	1 0	4.4	21,200
Dalapon	75990	8.5E-2	NA	NA	NA	NA	0.2	1 0	0.1	1 0	0 77	5 72
4-4'-DDD	72548	3 0E-3	9 4E-2	NA	7.0E-5	NA	0.2	0.5	0 1	1 0	6 1	81,100
4-4'-DDE	72559	7 0E-4	2.0E-1	NA	9.7E-5	NA	0.2	0 5	0.1	1.0	6 76	2.70E+5
4-4'-DDT	50293	5 0E-4	2.0E-1	NA	9 7E-5	NA	0.2	0.5	0 03	1.0	6 53	1.78E+5
Decabromodiphenyl ether	1163195	1.0E-2	NA	3.5E+1	4.0E-7	NA	0.2	0 5	0.1	1.0	5.24	1.42E+5
Di-n-butyl phthalate	84742	1.2E-1	NA	5.0E+1	NA	NA	0.2	1.0	0.1	1.0	4.61	34,000
Di(2-ethylhexyl) adipate	103231	1.7E+0	5.9E-4	NA	3.4E-7	NA	0.2	0 5	0.1	1.0	6.11	1.01E+6
Di-n-octyl phthalate	117840	1.8E-2	NA	NA	NA	NA	0.2	0 5	0.1	1.0	7.51	2.41E+7

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Carbofuran	NR	NR	3.90E-10	0.08	8.0E-6	NA	NA	7.00E+5	Solid	221.3
Carbon disulfide (I R)	NR	NR	3.03E-2	0.104	1.0E-5	0.013	-22	1.19E+6	Liquid	76.14
Carbon tetrachloride	NR	NR	3.04E-2	0.078	8.8E-6	NA	NA	7.93E+5	Liquid	153.92
Chlordane (J)	NR	NR	4.86E-5	0.0118	4.37E-6	NA	NA	56	Solid	409.8
Chloride	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	35.453
Chlorobenzene (I)	NR	NR	3.70E-3	0.073	8.7E-6	0 013	82	4.72E+5	Liquid	112 56
para-Chlorobenzenesulfonic acid	NR	NA	NA	NA	NA	NA	226	NA	Solid	192 62
1-Chloro-1,1-difluoroethane	NR	NR	6 16E-2	0.08	8.0E-6	0 06	NA	3.9E+06	Gas	100 5
Chloroethane	NR	NR	8.80E-3	0.08	8.0E-6	0 038	-58	5.74E+6	Liquid	64.52
2-Chloroethyl vinyl ether	NR	NR	6.25E-4	0.08	8.0E-6	NA	NA	1.50E+7	Liquid	106.55
Chloroform	NR	NR	3.67E-3	0.104	1 0E-5	NA	NA	7.92E+6	Liquid	119.38
Chloromethane (I)	NR	NR	4.52E-2	0.13	6.5E-6	0.081	-60.8	6.34E+6	Liquid	50.49
4-Chloro-3-methylphenol	NR	NR	4.00E-7	0 08	8 0E-6	NA	NA	3.90E+6	Solid	142.6
beta-Chloronaphthalene	NR	NR	3.10E-4	0.08	8.0E-6	NA	NA	6,740	Solid	162.62
2-Chlorophenol	388	NR	3 91E-4	0.0501	9.46E-6	NA	NA	2.20E+7	Liquid	128.56
o-Chlorotoluene (I)	NR	NR	3.57E-3	0.08	8.0E-6	NA	96	3.73E+5	Liquid	126.58
Chlorpyrifos	NR	NR	7 80E+0	0.08	8.0E-6	NA	NA	1,120	Solid	350 59
Chromium (III) (B H)	NR	1.8E+6	NR	NR	NR	NA	NA	NA	Inorganic	51.996
Chromium (VI)	NR	19	NR	NR	NR	NA	NA	NA	Inorganic	51 996
Chrysene (Q)	NR	NR	9 46E-5	0 0248	6 21E-6	NA	NA	1.6	Solid	228.3
Cobalt	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	58.933
Copper (B)	NR	360	NR	NR	NR	NA	NA	NA	Inorganic	63 546
Cyanazine	NR	NR	1.00E-10	0.08	8.0E-6	NA	NA	1.70E+5	Solid	241
Cyanide (P,R)	NR	NR	NR	0 08	8.0E-6	NA	NA	NA	Inorganic	26 02
Cyclohexanone	NR	NR	7.80E+0	0.08	8.0E-6	NA	146	2.30E+7	Liquid	98.14
Dacthal	NR	NR	2.18E-6	0.08	8.0E-6	NA	NA	500	Solid	331
Dalapon	NR	NR	6.43E-8	0.08	8.0E-6	NA	NA	5.02E+8	Liquid	142 97
4-4'-DDD	NR	NR	4.00E-6	0.0169	4.76E-6	NA	NA	90	Solid	320 05
4-4'-DDE	NR	NR	2.10E-5	0.0144	5.87E-6	NA	NA	120	Solid	518 03
4-4'-DDT	NR	NR	8.10E-6	0.0137	4 95E-6	NA	162	25	Solid	354.49
Decabromodiphenyl ether	NR	NR	4.02E-5	0.08	8.0E-6	NA	NA	30	Solid	959.22
Di-n-butyl phthalate	NR	NR	9.38E-10	0.0438	7 86E-6	NA	315	11,200	Liquid	278.34
Di(2-ethylhexyl) adipate	NR	NR	4.34E-7	0.08	8.0E-6	NA	NA	471	Liquid	370
Di-n-octyl phthalate	NR	NR	7.66E-7	0.0151	3.58E-6	NA	NA	3,000	Liquid	390.62

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Diacetone alcohol (I)	123422	NA	NA	2.4E+3	NA	NA	0.2	1.0	0.1	1 0	-0.34	0.464
Diazinon	333415	1.8E-4	NA	NA	NA	NA	0.2	1 0	0.1	1.0	3 4	2,200
Dibenzo(a.h)anthracene (Q)	53703	NA	4 1E+0	NA	NA	NA	0.2	0.5	0.13	1.0	6.69	3.77E+6
Dibenzofuran	132649	NA	NA	NA	NA	NA	0 2	1.0	0 1	1 0	4.2	13,500
Dibromochloromethane	124481	2 1E-2	4.9E-2	NA	2.45E-5	NA	0.2	1 0	0.1	1.0	2.17	62 6
Dibromochloropropane	96128	NA	1 2E+0	2.0E-1	NA	NA	0 2	1 0	0 1	1.0	2.68	431
Dibromomethane	74953	1 1E-2	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1.62	39.2
Dicamba	1918009	3.00E-02	NA	NA	NA	NA	0 2	0 5	0.1	1	2.4	95 3
1.2-Dichlorobenzene	95501	8 6E-2	NA	1.5E+3	NA	3 01E+5	0.2	1.0	0 1	1 0	3 43	623
1 3-Dichlorobenzene	541731	9.0E-4	NA	NA	NA	NA	0.2	1.0	0.1	1 0	3 5	708
1.4-Dichlorobenzene	106467	NA	1 3E-2	NA	6 9E-6	NA	0.2	1.0	0 1	1 0	3.42	612
3.3'-Dichlorobenzidine	91941	NA	8 0E-1	NA	4.8E-4	NA	0.2	1 0	0.1	1.0	3 51	721
Dichlorodifluoromethane	75718	2.3E-1	NA	4.95E+4	NA	NA	0.2	1.0	0 1	1.0	2 15	60 4
1,1-Dichloroethane	75343	1 2E-1	NA	5.0E+2	NA	NA	0.2	1.0	0.1	1.0	1.79	31.3
1.2-Dichloroethane (I)	107062	NA	5.8E-2	NA	2.6E-5	NA	0.2	1.0	0.1	1.0	1.47	17 5
1,1-Dichloroethylene (I)	75354	9.0E-4	NA	NA	5E-5	7.9E+4	0.2	1 0	0 1	1 0	2.13	58.2
cis-1.2-Dichloroethylene	156592	1 1E-2	NA	3.4E+1	NA	NA	0.2	1.0	0 1	1 0	1.86	35.6
trans-1.2-Dichloroethylene	156605	1.7E-2	NA	7.0E+1	NA	NA	0 2	1.0	0.1	1 0	2.07	52.2
2.6-Dichloro-4-nitroaniline	99309	3 0E-1	NA	NA	NA	NA	0.2	1.0	0 1	1 0	2.76	517
2 4-Dichlorophenol	120832	1 0E-2	NA	7.7E+1	NA	NA	0.2	1.0	0 1	1 0	3 08	147
2.4-Dichlorophenoxyacetic acid	94757	1 0E-2	NA	1 0E+2	NA	NA	0.2	1.0	0.05	1 0	2.7	451
1.2-Dichloropropane (I)	78875	4.4E-1	3.7E-2	4 0E+0	NA	5.08E+5	0 2	1 0	0 1	1.0	1 97	43.5
1.3-Dichloropropene	542756	3 4E-2	1E-1	2.0E+1	4.0E-6	NA	0.2	1.0	0 1	1 0	2.0	45 9
Dichlorovos	62737	4 0E-4	5.2E-1	5.0E-1	NA	NA	0.2	1.0	0 1	1.0	1.4	15.4
Dicyclohexyl phthalate	84617	NA	NA	NA	NA	NA	0 2	0 5	0 1	1.0	6.2	1.24E+6
Dieldrin	60571	7 6E-5	8 0E+0	NA	4.6E-3	NA	0.2	0 5	0 1	1.0	5.37	21,400
Diethyl ether	60297	5 0E-1	NA	1.2E+4	NA	1.52E+6	0 2	1 0	0.1	1 0	0.83	6.55
Diethyl phthalate	84662	7.5E-1	NA	5.0E+1	NA	NA	0 2	1 0	0 1	1.0	2.5	287
Diethylene glycol monobutyl ether	112345	1.2E-2	NA	2.0E+1	NA	NA	0.2	1 0	0.1	1 0	0.32	2.06
Diisopropyl ether	108203	4.1E-3	NA	3.58E+2	NA	NA	0 2	1.0	0.1	1.0	1.67	25.2
Diisopropylamine (I)	108189	7.7E-4	NA	NA	NA	NA	0.2	1 0	0 1	1 0	1.6	37.4
Dimethyl phthalate	131113	1 0E+1	NA	5 0E+1	NA	NA	0.2	1.0	0.1	1.0	1.64	41.0
N,N-Dimethylacetamide	127195	2 5E-2	NA	NA	NA	NA	0 2	1.0	0.1	1.0	-0.77	0.175
N,N-Dimethylaniline	121697	2.2E-3	NA	NA	1 18E-5	5 0E+4	0.2	1 0	0 1	1.0	2.46	262

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{**})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Diacetone alcohol (l)	NR	NR	2.61E-7	0.08	8.0E-6	0.018	125	1.0E+9	Liquid	116.2
Diazinon	NR	NR	1.13E-7	0.08	8.0E-6	NA	180	68,800	Liquid	304.3
Dibenzo(a,h)anthracene (Q)	NR	NR	1.47E-8	0.0202	5.18E-6	NA	NA	2.49	Solid	278.36
Dibenzofuran	NR	NR	1.30E-5	0.08	8.0E-6	NA	NA	10,000	Solid	168.21
Dibromochloromethane	NR	NR	7.83E-4	0.0229	1.05E-5	NA	NA	2.60E+6	Liquid	208.29
Dibromochloropropane	NR	NR	1.90E-4	0.08	8.0E-6	NA	170	1,230	Liquid	236.34
Dibromomethane	NR	NR	9.00E-4	0.08	8.6E-6	NA	NA	1.10E+7	Liquid	173.85
Dicamba	NR	NA	7.90E-09	0.08	8.00E-06	NA	NA	4.50E+06	Solid	221.04
1,2-Dichlorobenzene	NR	NR	1.9E-3	0.069	7.9E-6	0.022	151	1.56E+5	Liquid	147.01
1,3-Dichlorobenzene	NR	NR	1.8E-3	0.08	8.0E-6	NA	NA	1.11E+5	Liquid	147.01
1,4-Dichlorobenzene	NR	NR	2.43E-3	0.069	7.9E-6	0.025	150	73,800	Solid	147
3,3'-Dichlorobenzidine	NR	NR	4.00E-9	0.0194	6.74E-6	NA	NA	3,110	Solid	253.1
Dichlorodifluoromethane	NR	NR	2.6E+0	0.08	8.0E-6	NA	NA	3.00E+5	Liquid	120.91
1,1-Dichloroethane	NR	NR	5.62E-3	0.0742	1.05E-5	0.054	2.0	5.06E+6	Liquid	98.96
1,2-Dichloroethane (I)	NR	NR	9.79E-4	0.104	9.9E-6	0.062	56	8.52E+6	Liquid	98.97
1,1-Dichloroethylene (I)	NR	NR	2.61E-2	0.09	1.04E-5	0.065	-2	2.25E+6	Liquid	96.94
cis-1,2-Dichloroethylene	NR	NR	4.08E-3	0.0736	1.13E-5	0.056	36	3.50E+6	Liquid	96.94
trans-1,2-Dichloroethylene	NR	NR	9.38E-3	0.0707	1.19E-5	0.056	36	6.30E+6	Liquid	96.94
2,6-Dichloro-4-nitroaniline	NR	NR	4.67E-8	0.08	8.0E-6	NA	NA	7,000	Solid	207.02
2,4-Dichlorophenol	147	NR	3.16E-6	0.0346	8.77E-6	NA	NA	4.50E+6	Liquid	163
2,4-Dichlorophenoxyacetic acid	NR	NR	4.50E-6	0.059	6.5E-6	NA	NA	6.80E+5	Solid	221.04
1,2-Dichloropropane (I)	NR	NR	2.80E-3	0.0782	8.73E-6	0.034	60	2.80E+6	Liquid	112.99
1,3-Dichloropropene	NR	NR	1.77E-2	0.0626	1.0E-5	0.053	77	2.80E+6	Liquid	110.97
Dichlorovos	NR	NR	9.58E-7	0.08	8.0E-6	NA	175	1.60E+7	Liquid	220.98
Dicyclohexyl phthalate	NR	NR	7.61E-5	0.08	8.0E-6	NA	NA	4,000	Solid	330.43
Dieldrin	NR	NR	1.51E-5	0.0125	4.74E-6	NA	NA	195	Solid	380.9
Diethyl ether	NR	NR	8.70E-4	0.074	9.3E-6	0.019	-49	6.10E+7	Liquid	74.12
Diethyl phthalate	NR	NR	4.50E-7	0.0256	6.35E-6	NA	322	1.08E+6	Liquid	222.23
Diethylene glycol monobutyl ether	NR	NR	1.52E-9	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	162.23
Diisopropyl ether	NR	NR	1.3E-3	0.08	8.0E-6	0.014	-18	8,041	Liquid	102.18
Diisopropylamine (I)	NR	NR	9.60E-5	0.08	8.0E-6	0.011	20	3.69E+7	Liquid	101.22
Dimethyl phthalate	NR	NR	5.78E-7	0.067	6.3E-6	NA	295	4.19E+6	Liquid	194.19
N,N-Dimethylacetamide	NR	NR	1.31E-8	0.08	8.0E-6	NA	158	1.0E+9	Liquid	87.14
N,N-Dimethylaniline	NR	NR	8.12E-5	0.08	8.0E-6	NA	142	1.27E+6	Liquid	121.18

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	(mg/Kg-day)$^{-1}$	ug/m^3	(ug/m^3)$^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Dimethylformamide (I)	68122	9.6E-2	NA	3.0E+1	NA	NA	0 2	1.0	0.1	1 0	-1.01	0.102
2,4-Dimethylphenol	105679	5.0E-2	NA	7.0E+1	NA	NA	0.2	1.0	0 1	1 0	2.36	209
2,6-Dimethylphenol	576261	6.0E-4	NA	NA	NA	NA	0.2	1.0	0 1	1.0	2.36	209
3,4-Dimethylphenol	95658	1.4E-3	NA	NA	NA	NA	0 2	1.0	0 1	1.0	2.23	156
Dimethylsulfoxide	67685	3 0E+1	NA	NA	NA	NA	0.2	1 0	0.1	1 0	-1.66	0.0234
2,4-Dinitrotoluene	121142	2.0E-3	1 1E-1	2.0E+0	2.0E-4	NA	0 2	1.0	0.1	1 0	2.01	94 6
Dinoseb	88857	1.0E-3	NA	NA	NA	NA	0 2	1.0	0.1	1 0	3 15	1,250
1,4-Dioxane (I)	123911	NA	1 0E-2	NA	5.5E-6	NA	0.2	1.0	0 1	1 0	-0.39	0 588
Diquat	85007	2.2E-3	NA	NA	NA	NA	0 2	1.0	0.1	1.0	-2.82	0.00169
Diuron	330541	4.3E-3	NA	7.0E+0	NA	NA	0.2	1.0	0.1	1.0	2.77	187
Endosulfan (J)	115297	6.0E-3	NA	NA	NA	NA	0.2	1.0	0 1	1 0	4.1	2,110
Endothall	145733	1.7E-2	NA	3.5E+1	NA	NA	0.2	1 0	0.1	1.0	-0 55	0.288
Endrin	72208	1.7E-4	NA	NA	NA	NA	0.2	0.5	0.1	1 0	5 06	12,200
Epichlorohydrin (I)	106898	1.0E-3	5.9E-1	1.0E+0	1.2E-6	NA	0 2	1.0	0 1	1 0	0 26	1.92
Ethanol (I)	64175	6.2E+1	NA	1 9E+4	NA	NA	1.0	1.0	0.1	1 0	-0.31	0.496
Ethyl acetate (I)	141786	9 0E-1	NA	3.2E+3	NA	NA	0.2	1 0	0 1	1 0	0 69	4.77
Ethyl-tert-butyl ether (ETBE)	637923	NA	NA	373	NA	NA		1.0	0 1	1.0	1.92	3.97
Ethylbenzene (I)	100414	9.7E-2	NA	1 0E+3	3.1E-7	5.43E+5	0.2	1.0	0.1	1 0	3.14	367
Ethylene dibromide	106934	NA	5 7E+1	NA	2.2E-4	NA	0 2	1 0	0.1	1.0	1.75	52.5
Ethylene glycol	107211	2 0E+0	NA	1 0E+3	NA	1 0E+5	0 2	1.0	0 1	1 0	-1.4	0.0421
Ethylene glycol monobutyl ether	111762	5 0E-1	NA	1 3E+4	NA	NA	0.2	1.0	0.1	1 0	0 83	6 55
Fluoranthene	206440	1.2E-1	NA	1.4E+2	NA	NA	0.2	0 5	0 1	1.0	5.12	1.08E+5
Fluorene	86737	1 2E-1	NA	1.4E+2	NA	NA	0 2	1.0	0.1	1.0	4.21	13,800
Fluorine (soluble fluoride) (B)	7782414	6.0E-2	NA	NA	NA	3.1E+3	1 0	0 5	0.01	1 0	NR	NR
Formaldehyde	50000	1 8E-1	NA	NA	1.3E-5	3.7E+2	0 2	1.0	0.1	1.0	-0 051	1.09
Formic acid (I,U)	64186	1.4E+0	NA	2.0E+0	NA	1.9E+4	0.2	1.0	0.1	1.0	-0 538	0.449
1-Formylpiperidine	2591868	1.1E-2	NA	NA	NA	NA	0 2	1 0	0.1	1.0	NA	NA
Gentian violet	548629	1.4E-1	5 5E-2	NA	NA	NA	0.2	1.0	0 1	1 0	0 51	3 17
Glyphosate	1071836	1.0E-1	NA	NA	NA	NA	0.2	0 5	0.1	1.0	-4.47	4.04E-5
Heptachlor	76448	2.3E-3	1 6E+0	NA	1 3E-3	NA	0.2	0.5	0 1	1.0	6 26	1.43E+6
Heptachlor epoxide	1024573	8 5E-6	2.9E+0	NA	2.6E-3	NA	0 2	0 5	0 1	1.0	5 0	82,300
n-Heptane	142825	4.4E+0	NA	3.5E+3	NA	2.05E+6	0.2	1 0	0 1	1.0	4 72	43,700
Hexabromobenzene	87821	2.8E-3	NA	NA	NA	NA	0.2	0.5	0.1	1.0	6 1	9.92E+5
Hexachlorobenzene (C-66)	118741	8 0E-4	1.0E+0	NA	4.6E-4	NA	0 2	0 5	0.1	1.0	5.89	55,300

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{**})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Dimethylformamide (I)	NR	NR	7.39E-8	0.08	8.0E-6	NA	136	1.0E+9	Liquid	73.1
2,4-Dimethylphenol	NR	NR	2.0E-6	0.0584	8.69E-6	NA	NA	7.87E+6	Solid	122.16
2,6-Dimethylphenol	NR	NR	5.02E-6	0.08	8.0E-6	NA	NA	6.14E+6	Solid	122.16
3,4-Dimethylphenol	NR	NR	3.78E-7	0.08	8.0E-6	NA	NA	4.93E+6	Solid	122.16
Dimethylsulfoxide	NR	NR	5.80E-8	0.08	8.0E-6	NA	NA	1.66E+8	Liquid	78.14
2,4-Dinitrotoluene	NR	NR	9.26E-8	0.203	7.06E-6	NA	NA	2.70E+5	Solid	183.15
Dinoseb	NR	NR	4.60E-7	0.08	8.0E-6	NA	NA	52,000	Liquid	240.2
1,4-Dioxane (I)	NR	NR	4.90E-6	0.23	1.0E-5	0.02	55	9.00E+8	Liquid	88.11
Diquat	NR	NR	1.42E-13	0.08	8.0E-6	NA	NA	7.00E+5	Solid	344.08
Diuron	NR	NR	2.70E-6	0.08	8.0E-6	NA	NA	37,300	Solid	233.1
Endosulfan (J)	NR	NR	1.12E-5	0.0115	4.55E-6	NA	NA	510	Solid	406.9
Endothall	NR	NR	2.60E-10	0.08	8.0E-6	NA	NA	1.00E+8	Solid	186.18
Endrin	NR	NR	7.52E-6	0.0125	4.74E-6	NA	NA	250	Solid	380.9
Epichlorohydrin (I)	NR	NR	3.00E-5	0.086	9.8E-6	0.038	93	6.60E+7	Liquid	92.53
Ethanol (I)	NR	NR	6.29E-6	0.08	8.0E-6	0.033	55	1.0E+9	Liquid	46.07
Ethyl acetate (I)	NR	NR	1.70E-4	0.073	9.7E-6	0.02	24	6.40E+7	Liquid	88.12
Ethyl-tert-butyl ether (ETBE)	NR	NR	1.389E-3	0.08	8.0E-6	NA	NA	5.63E+6	Liquid	102.18
Ethylbenzene (I)	NR	NR	7.88E-3	0.075	7.8E-6	0.008	55	1.69E+5	Liquid	106.17
Ethylene dibromide	NR	NR	4.60E-4	0.08	8.0E-6	NA	NA	4.20E+6	Liquid	187.9
Ethylene glycol	NR	NR	6.00E-8	0.08	8.0E-6	0.032	232	1.0E+9	Liquid	62.07
Ethylene glycol monobutyl ether	NR	NR	5.13E-2	0.08	8.0E-6	NA	143	2.24E+8	Liquid	118.2
Fluoranthene	NR	NR	1.61E-5	0.0302	6.35E-6	NA	NA	206	Solid	202.24
Fluorene	NR	NR	6.36E-5	0.0363	7.88E-6	NA	NA	1,980	Solid	166.23
Fluorine (soluble fluoride) (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	38
Formaldehyde	NR	NR	2.80E-4	0.18	2.0E-5	0.07	NA	5.50E+8	Liquid	30.03
Formic acid (I,U)	NR	NR	2.50E-6	0.079	1.4E-6	0.18	122	1.0E+9	Liquid	46.03
1-Formylpiperidine	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	113.2
Gentian violet	NR	NR	3.06E-16	0.08	8.0E-6	NA	NA	1.00E+6	Solid	408
Glyphosate	NR	NR	1.50E-9	0.08	8.0E-6	NA	NA	1.16E+7	Solid	169.09
Heptachlor	NR	NR	1.48E-3	0.0112	5.69E-6	NA	NA	180	Solid	373.4
Heptachlor epoxide	NR	NR	9.50E-6	0.0132	4.23E-6	NA	NA	200	Solid	389.32
n-Heptane	NR	NR	2.11E+0	0.08	8.0E-6	0.0105	25	2,690	Liquid	100.2
Hexabromobenzene	NR	NR	1.30E-5	0.08	8.0E-6	NA	NA	0.17	Solid	551
Hexachlorobenzene (C-66)	NR	NR	1.32E-3	0.0542	5.91E-6	NA	NA	6,200	Solid	284.78

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Hexachlorobutadiene (C-46)	87683	2.0E-3	5.2E-2	NA	2.2E-5	NA	0.2	1.0	0.1	1 0	4.81	53,500
alpha-Hexachlorocyclohexane	319846	NA	2.0E+0	NA	1 83E-3	NA	0.2	1.0	0.1	1.0	3.8	1,220
beta-Hexachlorocyclohexane	319857	NA	9.7E-1	NA	5.3E-4	NA	0.2	1 0	0.1	1.0	3.81	1,250
Hexachlorocyclopentadiene (C-56)	77474	6 0E-3	NA	0 2	NA	NA	0.2	0.5	0.1	1 0	5.39	1.99E+5
Hexachloroethane	67721	1.0E-3	8.5E-3	3.5E+0	4.0E-6	NA	0.2	1 0	0.1	1 0	4 0	1,760
n-Hexane	110543	4.1E-1	NA	2.0E+2	NA	NA	0.2	1.0	0.1	1.0	4.0	1,760
2-Hexanone	591786	1.4E-1	NA	4.0E+1	NA	NA	0.2	1 0	0.1	1 0	1 4	23.8
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	4.1E-1	NA	NA	NA	0 2	0.5	0.13	1.0	6.65	3.45E+6
Iron (B)	7439896	3.0E-1	NA	NA	NA	NA	0.2	0 5	0.01	1.0	NR	NR
Isobutyl alcohol (I)	78831	3.2E-1	NA	1.5E+3	NA	NA	0.2	1 0	0.1	1.0	0 75	5.46
Isophorone	78591	1 5E-1	1.1E-3	2.8E+2	2 7E-7	2.8E+4	0.2	1 0	0.1	1 0	1 699	46.8
Isopropyl alcohol (I)	67630	6.4E-2	NA	2.2E+2	NA	1.23E+6	0.2	1.0	0.1	1 0	0 05	1.31
Isopropyl benzene	98828	1.1E-1	NA	8.7E+1	NA	NA	0.2	1 0	0.1	1 0	3.6	3,460
Lead (B)	7439921	NA	NA	1.5E+0	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Lindane	58899	3.3E-4	7.1E-1	NA	NA	NA	0.2	1.0	0.04	1.0	3.73	1,080
Lithium (B)	7439932	2 8E-2	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Magnesium (B)	7439954	1.1E+1	NA	1 0E+2	NA	NA	1 0	0 5	0.01	1.0	NR	NR
Manganese (B)	7439965	4.7E-2	NA	5 0E-2	NA	NA	0 5	0.5	0 01	1.0	NR	NR
Mercury (Total) (B,Z)	Varies	3.0E-4	NA	0.3	NA	NA	0 2	0 5	0 01	1.0	5 95	NR
Methane (K)	74828	NA	NA	NA	NA	NA	0 2	1 0	0.1	1.0	1.09	11 8
Methanol	67561	5.0E-1	NA	3.25E+3	NA	3.28E+6	0.2	1 0	0.1	1 0	-0.72	0 196
Methoxychlor	72435	5.0E-3	NA	NA	NA	NA	0.2	0.5	0.1	1.0	5.08	12,600
2-Methoxyethanol (I)	109864	1.0E-3	NA	2 0E+1	NA	NA	0 2	1 0	0.1	1.0	-0 77	0 175
2-Methyl-4-chlorophenoxyacetic acid	94746	1.0E-3	NA	NA	NA	NA	0 2	1.0	0.1	1 0	3 25	1,570
2-Methyl-4,6-dinitrophenol	534521	3.5E-4	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.1	116
N-Methyl-morpholine (I)	109024	2 7E-3	NA	NA	NA	NA	0.2	1.0	0 1	1.0	-0 33	0.474
Methyl parathion	298000	2 5E-4	NA	NA	NA	NA	0.2	1 0	0 1	1 0	2.9	710
4-Methyl-2-pentanone (MIBK) (I)	108101	2.5E-1	NA	2.05E+3	NA	3.07E+6	0 2	1 0	0.1	1.0	1.18	14.5
Methyl-tert-butyl ether (MTBE)	1634044	3.3E-2	3 4E-3	3.0E+3	NA	NA	0.2	1 0	0.1	1.0	0 99	9.41
Methylcyclopentane (I)	96377	NA	NA	NA	NA	NA	0 2	1.0	0 1	1.0	3 37	2,060
(MBOCA)	101144	7.3E-4	7.7E-1	NA	3.7E-5	NA	0.2	1 0	0.1	1.0	3.92	7,140
Methylene chloride	75092	5.8E-2	4.2E-3	NA	4.7E-7	NA	0.2	1.0	0.1	1.0	1.26	11.9
2-Methylnaphthalene	91576	3.6E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	3 9	6,820
Methylphenols (J)	1319773	5.0E-2	NA	1.0E+2	NA	NA	0.2	1.0	0 1	1 0	1.99	45 1

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{23})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^0F	ug/L		g/mol
Hexachlorobutadiene (C-46)	NR	NR	8.15E-3	0.0561	6 16E-6	NA	NA	3.230	Liquid	260.76
alpha-Hexachlorocyclohexane	NR	NR	1.06E-5	0.0142	7 34E-6	NA	NA	2.000	Solid	290 82
beta-Hexachlorocyclohexane	NR	NR	7.43E-7	0.0142	7.34E-6	NA	NA	240	Solid	290.82
Hexachlorocyclopentadiene (C-56)	NR	NR	2.70E-2	0.0161	7.21E-6	NA	NA	1 800	Liquid	272.77
Hexachloroethane	NR	NR	3.89E-3	0.0025	6.8E-6	NA	NA	50,000	Solid	236.74
n-Hexane	NR	NR	1.40E-2	0.08	8.0E-6	0 011	-7	12.000	Liquid	86.18
2-Hexanone	NR	NR	9 57E-5	0.08	8 0E-6	NA	77	1.60E+7	Liquid	100 16
Indeno(1,2,3-cd)pyrene (Q)	NR	NR	1.60E-6	0.019	5 66E-6	NA	NA	0 022	Solid	276.34
Iron (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	55.845
Isobutyl alcohol (I)	NR	NR	1.30E-5	0 08	8.0E-6	NA	82	7 60E+7	Liquid	74.14
Isophorone	NR	NR	6.20E-6	0.0623	6.76E-6	0.008	184	1.20E+7	Liquid	138.23
Isopropyl alcohol (I)	NR	NR	8.07E-6	0.08	8.0E-6	0.02	53	1.0E+9	Liquid	60.09
Isopropyl benzene	NR	NR	1.50E-2	0.086	7.1E-6	0.009	96	56.000	Liquid	122.16
Lead (B)	NR	11,000	NR	NR	NR	NA	NA	NA	Inorganic	207.2
Lindane	NR	NR	1.40E-5	0.0176	7 34E-6	NA	NA	6.800	Solid	290.9
Lithium (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	6.941
Magnesium (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	24.305
Manganese (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	54.938
Mercury (Total) (B Z)	NR	52	7.10E-10	0.037	6 3E-6	NA	NA	56	Inorganic	200 59
Methane (K)	NR	NR	6 58E-1	0 08	8.0E-6	0 053	-306	NA	Gas	16 04
Methanol	NR	NR	1 70E-4	0 15	1 3E-5	0 06	52	2.90E+7	Liquid	32 05
Methoxychlor	NR	NR	1.58E-5	0.0156	4 46E-6	NA	NA	45	Solid	345 7
2-Methoxyethanol (I)	NR	NR	9 51E-7	0.08	8.0E-6	NA	NA	1 0E+9	Liquid	76.1
2-Methyl-4-chlorophenoxyacetic acid	NR	NR	1.33E-9	0 08	8.0E-6	NA	NA	9.24E+5	Solid	305.79
2-Methyl-4,6-dinitrophenol	NR	NR	4.30E-7	0.08	8.0E-6	NA	NA	2.00E+5	Solid	198.13
N-Methyl-morpholine (I)	NR	NR	2.50E-7	0.08	8.0E-6	NA	NA	1 0E+9	Liquid	101.17
Methyl parathion	NR	NR	1.10E-7	0.08	8.0E-6	NA	NA	50,000	Solid	263 23
4-Methyl-2-pentanone (MIBK) (I)	NR	NR	1.20E-4	0.075	7.8E-6	NA	64	2.00E+7	Liquid	100.2
Methyl-tert-butyl ether (MTBE)	NR	NR	6 39E-4	0.08	8.0E-6	NA	NA	4.68E+7	Liquid	88.15
Methylcyclopentane (I)	NR	NR	3.63E-1	0.08	8.0E-6	NA	NA	73,890	Liquid	84.16
(MBOCA)	NR	NR	4.10E-11	0.08	8.0E-6	NA	NA	14.000	Solid	267.17
Methylene chloride	NR	NR	2.40E-3	0.101	1.17E-5	0.13	NA	1.70E+7	Liquid	50.5
2-Methylnaphthalene	NR	NR	4.99E-4	0.08	8.0E-6	NA	NA	24,600	Solid	142.2
Methylphenols (J)	NR	NR	1.60E-6	0.074	8 3E-6	NA	178	2.80E+7	Solid	108.13

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Metolachlor	51218452	2.3E-1	3 5E-3	NA	NA	NA	0.2	1.0	0 1	1 0	3.13	361
Metribuzin	21087649	2.50E-02	NA	NA	NA	NA	0.2	0.5	0 1	1	1 7	46.9
Mirex	2385855	2 3E-4	9.3E-1	NA	NA	NA	0.2	0.5	0.1	1 0	6.70	3 86E+6
Molybdenum (B)	7439987	5.0E-3	NA	NA	NA	NA	0 4	0.5	0.01	1.0	NR	NR
Naphthalene	91203	7.1E-2	NA	3.0E+0	3 1E-6	7.9E+4	0.2	1.0	0.1	1 0	3 36	2.010
Nickel (B)	7440020	7 6E-2	NA	NA	2 4E-4	NA	0.2	0 5	0.01	1.0	NR	NR
Nitrate (B,N)	14797558	1.6E+0	NA	NA	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Nitrite (B,N)	14797650	1.0E-1	NA	NA	NA	NA	1.0	0.5	0 01	1.0	NR	NR
Nitrobenzene (I)	98953	4.6E-4	NA	0.7	2.0E-5	NA	0.2	1 0	0 1	1.0	1.84	64.4
2-Nitrophenol	88755	2.8E-3	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1.8	58.8
n-Nitroso-di-n-propylamine	621647	2.5E-1	4.5	NA	2.0E-3	NA	0.2	1.0	0 1	1.0	1.4	23.8
N-Nitrosodiphenylamine	86306	2.5E-1	3 1E-3	NA	NA	NA	0.2	1.0	0.1	1 0	3 16	381
Oxamyl	23135220	3 8E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.47	0 508
Oxo-hexyl acetate	88230357	1.0E-2	NA	3.1E+1	NA	NA	0.2	1 0	0 1	1.0	NA	NA
Pendimethalin	40487421	1 2E-1	NA	NA	NA	NA	0.2	0.5	0.1	1 0	5 18	1.24E+5
Pentachlorobenzene	608935	8.3E-4	NA	NA	NA	NA	0.2	0 5	0 1	1.0	5 26	1.48E+5
Pentachloronitrobenzene	82688	7.5E-3	NA	5.0E+0	NA	NA	0 2	1.0	0.1	1 0	4 64	36,400
Pentachlorophenol	87865	3.0E-2	6 8E-2	1.0E+2	3 0E-5	NA	0 2	0 5	0 25	1 0	5 09	592
Pentane	109660	NA	NA	1.8E+4	NA	2.21E+6	0 2	1.0	0.1	1.0	3.42	2,300
2-Pentene (I)	109682	NA	NA	NA	NA	NA	0.2	1.0	0 1	1 0	2 58	344
Phenanthrene	85018	7.1E-3	NA	1 0E-1	NA	NA	0 2	1 0	0.1	1 0	4 6	33.300
Phenol	108952	6.0E-1	NA	6.0E+2	NA	NA	0.2	1 0	0 1	1 0	1.48	17 8
Phosphorus (Total)	7723140	1 1E+1*	NA	NA	NA	NA	0.2	0 5	0 1	1.0	NR	NA
Phthalic acid	88993	1 9E+0	NA	NA	NA	NA	0.2	1.0	0.1	1 0	0 73	5.22
Phthalic anhydride	85449	2 1E+0	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1 6	37.4
Picloram	1918021	7.0E-2	NA	NA	NA	NA	0.2	1 0	0 1	1 0	0.3	1 97
Piperidine	110894	4 4E-4	NA	1.4E+2	NA	NA	0 2	1 0	0 1	1 0	0.84	6.7
Polybrominated biphenyls (J)	67774327	4.3E-6	7.2E+0	NA	NA	NA	0.2	0.5	0.1	1.0	7 07	8 91E+6
Polychlorinated biphenyls (PCBs) (J,T)	1336363	2E-5	2 0E+0	NA	6.0E-4	NA	0.2	0.5	0.14	1 0	5 58	3.06E+5
Prometon	1610180	2 2E-2	NA	NA	NA	NA	0.2	1.0	0.1	1 0	2 99	870
Propachlor	1918167	1.3E-2	NA	NA	NA	NA	0.2	1.0	0 1	1.0	2 01	94.6
Propazine	139402	2.7E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.75	505
Propionic acid	79094	1.7E+0	NA	3 0E+2	NA	NA	0 2	1 0	0.1	1 0	0 28	1.89
Propyl alcohol (I)	71238	1 9E-1	NA	7 3E+2	NA	6.14E+5	0.2	1 0	0.1	1 0	0.25	1.89

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Metolachlor	NR	NR	9.90E-9	0.08	8 0E-6	NA	NA	5.30E+5	Liquid	283 83
Metribuzin	NR	NA	8.80E-02	0.08	8.00E-06	NA	NA	1.20E+06	Solid	214.29
Mirex	NR	NR	5 16E-4	0.08	8.0E-6	NA	NA	6.8E-6	Solid	545.54
Molybdenum (B)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	95.94
Naphthalene	NR	NR	4 83E-4	0.059	7.5E-6	0 009	174	31,000	Solid	128 17
Nickel (B)	NR	65	NR	NR	NR	NA	NA	NA	Inorganic	58.7
Nitrate (B,N)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	62
Nitrite (B,N)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	46
Nitrobenzene (I)	NR	NR	2.40E-5	0.076	8.6E-6	NA	190	2.09E+6	Liquid	123.11
2-Nitrophenol	NR	NR	3 50E-6	0.08	8 0E-6	NA	NA	2.50E+6	Solid	139 11
n-Nitroso-di-n-propylamine	NR	NR	2.25E-6	0.0545	8.17E-6	NA	NA	9.89E+6	Liquid	130 22
N-Nitrosodiphenylamine	NR	NR	5 00E-6	0.0312	6 35E-6	NA	NA	35,100	Solid	198 22
Oxamyl	NR	NR	2 37E-10	0.08	8.0E-6	NA	NA	2.80E+8	Solid	219.29
Oxo-hexyl acetate	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	144.2
Pendimethalin	NR	NR	8 56E-7	0.08	8.0E-6	NA	NA	275	Solid	281 31
Pentachlorobenzene	NR	NR	8.40E-4	0.067	6.3E-6	NA	NA	650	Liquid	250 3
Pentachloronitrobenzene	NR	NR	2.90E-2	0.08	8.0E-6	NA	NA	32	Solid	295.32
Pentachlorophenol	592	NR	2.44E-8	0 056	6 1E-6	NA	NA	1.85E+6	Solid	266 32
Pentane	NR	NR	1.26E+0	0.08	8.0E-6	0 015	-57	38,200	Liquid	72 15
2-Pentene (I)	NR	NR	2 3E-1	0.08	8 0E-6	NA	NA	2.03E+5	Liquid	70 13
Phenanthrene	NR	NR	2.3E-5	0.08	8.0E-6	NA	NA	1,000	Solid	178 24
Phenol	NR	NR	3 97E-7	0.082	9.1E-6	0 018	175	8.28E+7	Liquid	147.01
Phosphorus (Total)	NR	NR	NR	0.08	8 0E-6	NA	NA	NA	Solid	30 974
Phthalic acid	NR	NR	2 18E-12	0 08	8 0E-6	NA	NA	1.42E+7	Liquid	166 13
Phthalic anhydride	NR	NR	1.63E-8	0.08	8 0E-6	1 7E+7	305	6.2E+6	Liquid	148.1
Picloram	NR	NR	4.05E-11	0.08	8.0E-6	NA	NA	4.30E+5	Solid	241 48
Piperidine	NR	NR	4.45E-6	0.08	8 0E-6	NA	NA	1 0E+9	Liquid	85.15
Polybrominated biphenyls (J)	NR	NR	3.90E-6	0.08	8.0E-6	NA	NA	1.66E+7	Solid	NA
Polychlorinated biphenyls (PCBs) (J,T)	NR	NR	4.20E-4	0.08	8.0E-6	NA	NA	44.7	Solid	268.4
Prometon	NR	NR	1.98E-9	0.08	8.0E-6	NA	NA	7.50E+5	Solid	225.29
Propachlor	NR	NR	1.09E-7	0.08	8.0E-6	NA	NA	6.55E+5	Solid	211.69
Propazine	NR	NR	4.60E-9	0 08	8.0E-6	NA	NA	8,600	Solid	229.75
Propionic acid	NR	NR	4.45E-7	0.08	8.0E-6	0.029	126	1 0E+9	Liquid	74.09
Propyl alcohol (I)	NR	NR	7.41E-6	0.08	8.0E-6	0 022	72	1 0E+9	Liquid	60.11

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
n-Propylbenzene (I)	103651	1 1E-2	NA	2.0E+1	NA	NA	0 2	1.0	0.1	1.0	3.69	4,240
Propylene glycol	57556	2.0E+1	NA	6.0E+3	NA	NA	0.2	1.0	0 1	1 0	-0.92	0 125
Pyrene	129000	7 5E-2	NA	1.0E+2	NA	NA	0.2	0.5	0 1	1.0	5.11	1.06E+5
Pyridine (I)	110861	1.0E-3	NA	3.5E+0	NA	NA	0.2	1 0	0 1	1 0	0.67	4.56
Selenium (B)	7782492	5.0E-3	NA	2.0E+0	NA	NA	0.2	0.5	0 01	1 0	NR	NR
Silver (B)	7440224	4 7E-3	NA	1.0E-1	NA	NA	0.2	0 5	0 01	1 0	NR	NR
Silvex (2,4 5-TP)	93721	7 5E-3	NA	NA	NA	NA	0.2	1 0	0 1	1.0	3.4	2,200

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^0F	ug/L		g/mol
n-Propylbenzene (I)	NR	NR	NA	0.08	8 0E-6	NA	NA	NA	Liquid	120.19
Propylene glycol	NR	NR	1 24E-8	0 08	8.0E-6	NA	NA	1.0E+9	Liquid	76.1
Pyrene	NR	NR	1.10E-5	0 0272	7 24E-6	NA	NA	135	Solid	202 26
Pyridine (I)	NR	NR	7.00E-3	0 091	7.6E-6	0 018	68	3.00E+5	Liquid	79 11
Selenium (B)	NR	5	NR	NR	NR	NA	NA	NA	Inorganic	78.96
Silver (B)	NR	8 3	NR	NR	NR	NA	NA	NA	Inorganic	107.868
Silvex (2,4,5-TP)	NR	NR	1.30E-8	0 08	8 0E-6	NA	NA	1 40E+5	Solid	269 51

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Simazine	122349	5.2E-3	NA	NA	NA	NA	0.2	1.0	0 1	1.0	1 93	79.0
Sodium	17341252	3.4E+1	NA	NA	NA	NA	0.1	0 5	0 01	1.0	NR	NR
Sodium azide	26628228	1.20E-02	NA	NA	NA	NA	0.2	1	0.1	1	NA	NA
Strontium (B)	7440246	6 3E-1	NA	NA	NA	NA	0.2	0.5	0.01	1 0	NR	NR
Styrene	100425	2.0E-1	1 3E-2	1.0E+3	5.7E-7	1.7E+5	0 2	1.0	0.1	1.0	2 94	777
Sulfate	14808798	NA	NA	NA	NA	NA	NA	0.5	0 1	1 0	NR	NR
Tebuthiuron	34014181	7.0E-2	NA	NA	NA	NA	0.2	1 0	0.1	1 0	1.78	56 2
2 3 7 8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	7 5E+4	NA	NA	NA	0.2	0.5	0.03	1.0	7.24	1 31E+7
1.2.4 5-Tetrachlorobenzene	95943	3.4E-1	NA	NA	NA	NA	0.2	1.0	0 1	1.0	4.64	36,400
2.3 7.8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	7.5E+4	NA	4.4E+1	NA	0.2	0.5	0.03	1 0	7.04	8.33E+6
1.1.1.2-Tetrachloroethane	630206	8.9E-2	1.1E-2	NA	7.4E-6	NA	0.2	1 0	0.1	1.0	2.63	145
1.1.2.2-Tetrachloroethane	79345	NA	1.0E-1	NA	5.8E-5	NA	0.2	1.0	0.1	1.0	2.39	93.5
Tetrachloroethylene	127184	1 0E-2	2.6E-2	NA	5 8E-7	6.85E+5	0.2	1 0	0.1	1 0	2.67	156
Tetrahydrofuran	109999	1.3E-2	NA	5.9E+3	NA	7 37E+5	0.2	1 0	0.1	1 0	0 46	2.83
Tetranitromethane	509148	NA	NA	NA	1.5E-2	NA	0.2				-2 05	9 66E-3
Thallium (B)	7440280	6 7E-5	NA	NA	NA	NA	0.2	0.5	0 01	1 0	NR	NR
Toluene (I)	108883	2.2E-1	NA	4.0E+2	NA	NA	0.2	1 0	0.1	1 0	2 75	180
p-Toluidine	106490	NA	5.6E-2	NA	3.1E-5	NA	0.2	1.0	0.1	1 0	1 39	23 3
Toxaphene	8001352	NA	4 4E-1	NA	3.2E-4	1.0E+3	0.2	0 5	0.1	1 0	5.5	2.55E+5
Triallate	2303175	1.3E-2	NA	NA	NA	NA	0.2	1 0	0 1	1 0	4 57	31,100
Tributylamine	102829	3 5E-3	NA	7.0E+0	NA	NA	0.2	1 0	0 1	1.0	4.46	24,200
1.2.4-Trichlorobenzene	120821	1.5E-2	NA	3 7E+2	NA	3 7E+4	0.2	1 0	0 1	1 0	4 01	1,790
1 1.1-Trichloroethane	71556	2.2E+0	NA	1.0E+3	NA	2.46E+6	0.2	1.0	0.1	1.0	2 48	110
1.1.2-Trichloroethane	79005	3.9E-3	2.9E-2	NA	1.6E-5	NA	0.2	1.0	0.1	1.0	2.05	50 3
Trichloroethylene	79016	1 7E-3*	1 0E-2	NA	1.7E-6	5 37E+5	0.2	1.0	0 1	1.0	2.71	168
Trichlorofluoromethane	75694	3 5E-1	NA	5.62E+4	NA	5 62E+6	0.2	1.0	0 1	1.0	2 53	121
2 4.5-Trichlorophenol	95954	1 0E-1	NA	3.5E+2	NA	NA	0.2	1 0	0.1	1 0	3 9	1597
2.4.6-Trichlorophenol	88062	NA	7.4E-3	NA	3 1E-6	NA	0.2	1 0	0 1	1.0	3 7	381
1.2.3-Trichloropropane	96184	5.7E-3	NA	NA	NA	NA	0.2	1.0	0.1	1 0	2 26	167
1.1.2-Trichloro-1.2 2-trifluoroethane	76131	2.7E+1	NA	7.67E+4	NA	9 59E+6	0 2	1 0	0 1	1 0	3.15	1,250
Triethanolamine	102716	5.0E-1	NA	5.0E+1	NA	NA	0.2	1.0	0 1	1.0	-1.38	0.0440
Triethylene glycol	112276	5 9E-1	NA	NA	NA	NA	0.2	1.0	0 1	1 0	-1 69	0 0218
3-Trifluoromethyl-4-nitrophenol	88302	6.2E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.87	663
Trifluralin	1582098	5.1E-3	4.5E-3	NA	NA	NA	0 2	0.5	0.1	1.0	5 3	1 62E+5

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L		g/mol
Simazine	NR	NR	3.37E-9	0.08	8 0E-6	NA	NA	4,470	Solid	201 67
Sodium	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	23
Sodium azide	NR	NA	NA	0.08	8.00E-06	NA	NA	NA	Solid	65 01
Strontium (B)	NR	NA	NR	NA	NA	NA	NA	NA	Inorganic	87 62
Styrene	NR	NR	2.75E-3	0.071	8 0E-6	0 009	88	3.10E+5	Liquid	104.15
Sulfate	NR	NA	NR	0.08	8 0E-6	NA	NA	NA	Inorganic	96 066
Tebuthiuron	NR	NR	2.40E-10	0.08	8.0E-6	NA	NA	2 50E+6	Solid	228 31
2 3,7,8-Tetrabromodibenzo-p-dioxin (O)	NR	NR	2.95E-7	0.08	8 0E-6	NA	NA	0.00996	Solid	499.6
1,2,4,5-Tetrachlorobenzene	NR	NR	1.20E-3	0.08	8 0E-6	NA	NA	1.300	Solid	215.28
2 3,7,8-Tetrachlorodibenzo-p-dioxin (O)	NR	NR	9.20E-6	0.047	8.0E-6	NA	NA	0.019	Solid	322
1,1,1,2-Tetrachloroethane	NR	NR	2.40E-3	0.071	7.9E-6	NA	NA	1.10E+6	Liquid	167 85
1,1,2,2-Tetrachloroethane	NR	NR	3 45E-4	0 071	7.9E-6	NA	NA	2.97E+6	Liquid	167.85
Tetrachloroethylene	NR	NR	1.84E-2	0.072	8 2E-6	NA	NA	2.0E+5	Liquid	165.83
Tetrahydrofuran	NR	NR	9.63E-3	0.08	8.0E-6	0.02	6 0	1.0E+9	Liquid	72.12
Tetranitromethane	NR	NR	2.6E-05	0 08	8.0E-6	NA	NA	85,000	Liquid	196 03
Thallium (B)	NR	71	NR	NR	NR	NA	NA	NA	Inorganic	204.383
Toluene (I)	NR	NR	6.64E-3	0.087	8 6E-6	0.011	40	5.26E+5	Liquid	92.14
p-Toluidine	NR	NR	6.10E-6	0 08	8 0E-6	NA	188	7.60E+6	Liquid	107.17
Toxaphene	NR	NR	6 00E-6	0.0116	4 34E-6	NA	NA	740	Solid	414
Triallate	NR	NR	1 93E-5	0.08	8 0E-6	NA	NA	4,000	Liquid	304.66
Tributylamine	NR	NR	5 60E-3	0.08	8 0E-6	NA	NA	75,400	Liquid	185.4
1,2,4-Trichlorobenzene	NR	NR	1.42E-3	0.03	8.23E-6	NA	222	3 00E+5	Liquid	181.45
1,1,1-Trichloroethane	NR	NR	1.72E-2	0.078	8 8E-6	0.075	NA	1.33E+6	Liquid	133.4
1,1,2-Trichloroethane	NR	NR	9 13E-4	0.078	8.8E-6	0.06	NA	4.42E+6	Liquid	133.4
Trichloroethylene	NR	NR	1 03E-2	0.079	9.1E-6	0 08	NA	1.10E+6	Liquid	131 39
Trichlorofluoromethane	NR	NR	1.3E-1	0 087	9 7E-6	NA	NA	1.10E+6	Liquid	137.38
2 4,5-Trichlorophenol	1,597	NR	4.33E-6	0 0291	7 03E-6	NA	NA	1 20E+6	Solid	197 5
2,4,6-Trichlorophenol	381	NR	7.79E-6	0.0318	6 25E-6	NA	NA	8.00E+5	Solid	197.5
1 2,3-Trichloropropane	NR	NR	3.80E-4	0 071	7.9E-6	NA	160	1.90E+6	Liquid	147.43
1,1,2-Trichloro-1,2,2-trifluoroethane	NR	NR	5.3E-1	0.078	8 2E-6	NA	NA	1.70E+5	Liquid	187.38
Triethanolamine	NR	NR	3.38E-19	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	149.19
Triethylene glycol	NR	NR	2.61E-10	0.0427	8.06E-6	NA	NA	1.00E+6	Liquid	150.17
3-Trifluoromethyl-4-nitrophenol	NR	NR	1.92E-8	0.08	8.0E-6	NA	NA	5.00E+6	Solid	207
Trifluralin	NR	NR	2.60E-5	0.08	8.0E-6	NA	NA	8,100	Solid	335.29

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
2,2,4-Trimethyl pentane	540841	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.09	2,080

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{25})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^0F	ug/L		g/mol
2 2,4-Trimethyl pentane	NR	NR	3.13E+0	0.08	8 0E-6	0.011	10	2,330	Liquid	114 23

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Chemical Abstract Service Number (CAS#)	Oral Reference Dose (RfD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
2,4,4-Trimethyl-2-pentene (I)	107404	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.0	1,760
1,2,4-Trimethylbenzene (I)	95636	1.4E-1	NA	1.23E+3	NA	NA	0.2	1.0	0.1	1.0	3.67	965
1,3,5-Trimethylbenzene (I)	108678	1.4E-1	NA	1.23E+3	NA	NA	0.2	1.0	0.1	1.0	3.5	708
Triphenyl phosphate	115866	1.6E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.67	39,000
tris(2,3-Dibromopropyl)phosphate	126727	NA	1.2E+0	NA	5.3E-4	NA	0.2	1.0	0.1	1.0	3.51	2,820
Urea	57136	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-2.11	0.0256
Vanadium	7440622	5.0E-3	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Vinyl acetate (I)	108054	8.8E-2	NA	2.0E+2	NA	5.3E+4	0.2	1.0	0.1	1.0	0.73	5.22
Vinyl chloride	75014	3.0E-3	1.4E+0*	100	8.8E-6*	NA	0.2	1.0	0.1	1.0	1.5	18.5
White phosphorus (R)	12185103	1.5E-5	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Xylenes (I)	1330207	1.8E+0	NA	4.4E+3	NA	6.51E+5	0.2	1.0	0.1	1.0	3.11	348
Zinc (B)	7440666	3.3E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA FOR PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)

Hazardous Substance	Soil K_{oc} for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6 8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
	L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^0F	ug/L		g/mol
2,4,4-Trimethyl-2-pentene (l)	NR	NR	8 81E-1	0.08	8 0E-6	NA	NA	11.900	Liquid	112.2
1,2,4-Trimethylbenzene (l)	NR	NR	5.87E-3	0.08	8.0E-6	0.009	112	55.890	Liquid	120 2
1,3,5-Trimethylbenzene (l)	NR	NR	7.38E-3	0.08	8.0E-6	NA	122	61.150	Liquid	120 2
Triphenyl phosphate	NR	NR	3.60E-7	0.08	8.0E-6	NA	NA	1.430	Liquid	326 3
tris(2,3-Dibromopropyl)phosphate	NR	NR	3 00E-5	0.08	8 0E-6	NA	NA	4.700	Liquid	697 67
Urea	NR	NR	NR	0.08	8.0E-6	NA	NA	NA	Solid	60.07
Vanadium	NR	1000	NR	NR	NR	NA	NA	NA	Inorganic	50.942
Vinyl acetate (l)	NR	NR	5 11E-4	0.085	9.2E-6	0.026	18	2.00E+7	Liquid	86.09
Vinyl chloride	NR	NR	2.70E-2	0.106	1 23E-5	0.036	NA	2.76E+6	Liquid	62.5
White phosphorus (R)	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	123 9
Xylenes (l)	NR	NR	6.04E-3	0.078	3 21E-5	NA	NA	1.86E+5	Liquid	106.17
Zinc (B)	NR	62	NR	NR	NR	NA	NA	NA	Inorganic	65.39

NA = Data are not available for this parameter
NR = Parameter is not relevant for this compound.

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Acetaldehyde (I)	75070	GSI	500 (M)	130	TDL lowered from 500 to 100 (R 299.5103(I))
Acetate	71501	All	None	See Attachment 1	New Hazardous Substance (R 299.5706a(10))
Acetic acid	64197	Res DWC	18,000 (M)	4,200	TDL lowered from 18,000 to 1,000 (R 299.5103(I))
		Ind/Com DWC	18,000 (M)	12,000	TDL lowered from 18,000 to 1,000 (R 299.5103(I))
		GSI	18,000 (M)	1000 (M)	TDL lowered from 18,000 to 1,000 (R 299.5103(I) and R 299.5707)
		Res DWPC	9.05E+5 (M)	84,000	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(I))
		Ind/Com DWPC	9.0E+5 (M)	2.4E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(I))
		GSI PC	9.0E+5 (M)	3.6E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(I))
Acrylonitrile (I)	107131	Res DWPC	52	100 (M)	TDL changed from 10 to 100 (R 299.5103(I) and R 299.5707)
		GSI PC	98	100 (M, X)	TDL changed from 10 to 100 (R 299.5103(I) and R 299.5707)
		Footnote (X) surface water HDV	0.87	2.0 (M)	TDL changed from 1.0 to 2.0 (R 299.5103(I) and R 299.5707)
		Footnote (X) GSI PC for HDV	17	100 (M)	TDL was 10 and is now 100 (R 299.5103(I) and R 299.5707)
Aldicarb sulfone	1646884	Res DWPC	50 (M)	200 (M)	TDL changed from 50 to 200 (R 299.5103(I) and R 299.5707)
		Ind/Com DWPC	50 (M)	200 (M)	TDL changed from 50 to 200 (R 299.5103(I) and R 299.5707)

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Aldicarb sulfoxide	1646873	Res DWPC	80	200 (M)	TDL changed from 50 to 200 (R 299.5103(l) and R 299.5707)
		Ind/Com DWPC	80	200 (M)	TDL changed from 50 to 200 (R 299.5103(l) and R 299.5707)
Aniline	62533	GSI	20 (M)	4	TDL lowered from 20 to 4 (R 299.5103(l))
		Res DWPC	1,700 (M)	1,100	TDL lowered from 1,700 to 330 (R 299.5103(l))
		GSI PC	1,700 (M)	330 (M)	TDL lowered from 1,700 to 330 (R 299.5103(l) and R 299.5707)
Antimony	7440360	Res DWPC	500 (M)	4,300	TDL lowered from 500 to 300 (R 299.5103(l))
Benzo(b)fluoranthene (Q)	205992	Res DWC	2.0 (M)	1.5 (S,AA)	TDL lowered from 2.0 to 1.0 (R 299.5103(l) and R 299.5708)
		Ind/Com DWC	2.0 (M)	1.5 (S,AA)	TDL lowered from 2.0 to 1.0 (R 299.5103(l) and R 299.5708)
		GCC	2.0 (M,AA)	1.5 (S,AA)	TDL lowered from 2.0 to 1.0 (R 299.5103(l) and R 299.5708)
Benzo(k)fluoranthene (Q)	207089	Res DWC	5.0 (M)	1.0 (M)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5707)
		Ind/Com DWC	5.0 (M)	1.0 (M)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5707)
		GCC	5.0 (M,AA)	1.0 (M,AA)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5708)
Benzo(g,h,i)perylene	191242	Res DWC	5.0 (M)	1.0 (M)	TDL was lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5707)
		Ind/Com DWC	5.0 (M)	1.0 (M)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5707)
		GCC	5.0 (M,AA)	1.0 (M,AA)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5707)

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Benzo(a)pyrene (Q)	50328	GCC	2.0 (M,AA)	1.0 (M,AA)	TDL lowered from 2.0 to 1.0 (R 299.5103(l) and R 299.5707)
Benzyl chloride	100447	Res DWPC	200 (M)	150	TDL lowered from 200 to 150 (R 299.5103(l))
bis(2-Chloroethyl)ether (I)	111444	Res DWPC	330 (M)	100	TDL lowered from 330 to 100 (R 299.5103(l))
		Ind/Com DWPC	330 (M)	170	TDL lowered from 330 to 100 (R 299.5103(l))
		GSI PC	330 (M)	300	TDL lowered from 330 to 100 (R 299.5103(l))
Bromodichloromethane	75274	Res DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Res DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
Bromoform	75252	Res DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Res DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
Chloroform	67663	Res DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Res DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Chloroform (cont.)	67663	Ind/Com DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
4-Chloro-3-methylphenol	59507	GSI PC	330 (M)	280	TDL changed from 330 to 280 (R 299.5103(l))
Chlorpyrifos	2921882	GSI	NA	2.0 (M)	New R 57 value (R 299.5706a(11) and R 299.5707)
		GSI PC	NA	1,500	New GSI value (R 299.5706a(11))
Chrysene (Q)	218019	Res DWC	5.0 (M)	1.6 (S)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5708)
		Ind/Com DWC	5.0 (M)	1.6 (S)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5708)
		GCC	5.0 (M)	1.6 (S, AA)	TDL lowered from 5.0 to 1.0 (R 299.5103(l) and R 299.5708)
Cyanazine	21725462	Res DWC	10 (M)	2.3	TDL lowered from 10 to 2.0 (R 299.5103(l))
		Ind/Com DWC	10 (M)	9.4	TDL lowered from 10 to 2.0 (R 299.5103(l))
		Res DWPC	500 (M)	200	TDL lowered from 500 to 200 (R 299.5103(l))
		Ind/Com DWPC	500 (M)	200	TDL lowered from 500 to 200 (R 299.5103(l))
		Footnote (X) surface water HDV	0.93	2.0 (M)	TDL lowered from 10 to 2 (R 299.5103(l) and R 299.5707)
		Footnote (X) GSI PC HDV	500 (M)	200 (M)	TDL lowered from 500 to 200 (R 299.5103(l) and R 299.5707)
Cyanide (P,R)	57125	GSI PC	200 (M)	100	TDL lowered from 200 to 100 (R 299.5103(l))
Dibenzofuran	132649	GSI	5.0 (M)	4.0	TDL lowered from 5 to 4 100 (R 299.5103(l))
Dibromochloromethane	124481	Res DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWC	100 (A,W)	80 (A,W)	New State Drinking Water Standard (R 299.5706a(12))

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Dibromochloromethane (cont.)	124481	Res DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
		Ind/Com DWPC	2,000 (W)	1,600 (W)	New State Drinking Water Standard (R 299.5706a(12))
Dibromochloropropane	96128	Res DWPC	4.0	10 (M)	TDL changed from 4 to 10 (R 299.5103(l) and R 299.5707)
		Ind/Com DWPC	4.0 (M)	10 (M)	TDL changed from 4 to 10 (R 299.5103(l) and R 299.5707)
Dicamba	1918009	All	None	See Attachment 1	New Hazardous Substance (R 99.5706a(10))
Dinoseb	88857	GSI PC	20	200 (M)	TDL changed from 20 to 200 (R 299.5103(l) and R 299.5707)
Epichlorohydrin (I)	106898	Res DWPC	40	100	TDL changed from 10 to 100 (R 299.5103(l))
		Ind/Com DWPC	40	100	DWC used to calculate DWPC changed due to TDL change (R 299.5103(l))
Ethylene dibromide	106934	Res DWC	1.0 (M)	0.05 (A)	TDL lowered from 1.0 to 0.05 (R 299.5103(l))
		Ind/Com DWC	1.0 (M)	0.05 (A)	TDL lowered from 1.0 to 0.05 (R 299.5103(l))
		GSI	1.0 (M)	0.2 (X)	TDL lowered from 1.0 to 0.05 (R 299.5103(l))
		Footnote (X) surface water HDV	Not listed in (X) footnote	0.05 (M)	TDL lowered from 1.0 to 0.05 which resulted in GSIDW being lower than GSI (R 299.5103(l))
		Res DWPC	250 (M)	20 (M)	TDL lowered from 250 to 20 (R 299.5103(l) and R 299.5707)
		Ind/Com DWPC	250 (M)	20 (M)	TDL lowered from 250 to 20 (R 299.5103(l) and R 299.5707)
		GSI PC	250 (M)	20 (M)	TDL lowered from 250 to 20 (R 299.5103(l) and R 299.5707)

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Ethylene dibromide (cont.)	106934	Res DCC	250 (M)	92	TDL lowered from 250 to 20 (R 299.5103(l))
Fluoranthene	206440	GSI	5.0 (M)	1.6	TDL lowered from 5.0 to 1.0 (R 299.5103(l))
Formic acid (I,U)	64186	Res DWC	18,000 (M)	10,000	TDL lowered from 18,000 to 1,000 (R 299.5103(l))
		Res DWPC	9.0E+5 (M)	2.0E+5	TDL lowered from 9.0E+5 from 20,000 (R 299.5103(l))
		Ind/Com DWPC	9.0E+5 (M)	5.8E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Res VSIC	9.0E+5 (M)	2.1E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Res VSIC 5M	9.0E+5 (M)	1.4E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Res VSIC 2M	9.0E+5 (M)	1.4E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Ind/Com Infinite VSIC	9.0E+5 (M)	2.6E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Ind/Com VSIC 5M	9.0E+5 (M)	1.6E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
		Ind/Com VSIC 2M	9.0E+5 (M)	1.6E+5	TDL lowered from 9.0E+5 to 20,000 (R 299.5103(l))
Hexabromobenzene	87821	Res DWC	10 (M)	0.17 (S)	TDL lowered from 10 to 0.02 (R 299.5103(l) and R 299.5708)
		Ind/Com DWC	10 (M)	0.17 (S)	TDL lowered from 10 to 0.02 (R 299.5103(l) and R 299.5708)
		GCC	10 (M)	0.17 (S)	TDL lowered from 10 to 0.02 (R 299.5103(l) and R 299.5708)
		Res DWPC	3.2E+5	5,400	Res DWC used to calculate DWPC lowered as a result of TDL change (R 299.5103(l))

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Hexabromobenzene (cont.)	87821	Ind/Com DWPC	3.2E+5	5,400	Ind/Com DWC used to calculate DWPC lowered as a result of TDL change (R 299.5103(l))
		GCC PC	3.2E+5	5,400	GCC used to calculate GCC PC lowered as a result of TDL change (R 299.5103(l))
Hexachlorobenzene (C-66)	118741	GSI	ID	0.2 (M)	Updated R 57 value (R 299.5706a(11) and R 299.5707)
		GSI PC	ID	350	Updated R 57 value (R 299.5706a(11)
Hexachlorobutadiene (C-46)	87683	GSI	5.0 (M)	0.05	TDL lowered from 5.0 to 0.05 (R 299.5103(l))
		GSI PC	330 (M)	91	TDL lowered from 330 to 50 (R 299.5103(l))
Mercury (Total) (B,Z)	Varies	GSI PC	100 (M)	50 (M)	TDL lowered from 100 to 50 (R 299.5103(l) and R 299.5707)
Methane	74828	Res and Ind/Com SVIIC	None	8.4E+6 ug/m3 (GG)	To address acute physical hazards, specifically explosivity (R 299.5728(1)(d)), where criteria were not previously available (R 299.5706a(11))
Methanol	67561	GSI	1,000 (M)	480	TDL lowered from 1,000 to 400 (R 299.5103(l))
2-Methyl-4,6-dinitrophenol	534521	Res DWPC	1,700 (M)	830 (M)	TDL lowered from 1,700 to 830 (R 299.5103(l) and R 299.5707)
		Ind/Com DWPC	1,700 (M)	830 (M)	TDL lowered from 1,700 to 830 (R 299.5103(l) and R 299.5707)
Metribuzin	21087649	All	None	See Attachment 1	New Hazardous Substance (R 299.5706a(10))
Nitrobenzene (I)	98953	Res DWPC	200 (M)	330 (M)	TDL changed from 200 to 330 (R 299.5103(l) and R 299.5707)
		Ind DWPC	200 (M)	330 (M)	TDL changed from 200 to 330 (R 299.5103(l) and R 299.5707)

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Nitrobenzene (I) (cont.)	98953	Footnote (X) GSIPC for HDV	200 (M)	330 (M)	TDL changed from 200 to 330 (R 299.5103(l) and R 299.5707)
		Ind/Com DWPC	1,700 (M)	830 (M)	TDL lowered from 1,700 to 830 (R 299.5103(l) and R 299.5707)
Pentachlorobenzene	608935	GSI	2.0 (M)	5.0 (M)	TDL changed from 2.0 to 5.0 (R 299.5103(l) and R 299.5707)
		GSI PC	NA	9,500	Updated R 57 value (R 299.5706a(11))
Phenanthrene	85018	GSI	5.0 (M)	2.4	TDL lowered from 5.0 to 2.0 (R 299.5103(l))
Picloram	1918021	GSI	NA	46	Updated R 57 value (R 299.5706a(11))
		GSI PC	NA	920	Updated R 57 value (R 299.5706a(11))
Pyridine (I)	110861	Res DWC	7.3	20 (M)	Default to TDL (R 299.5103(l) and R 299.5707)
		Res DWPC	330 (M)	400	DWC used to calculate DWPC changed as a result of TDL change (R 299.5103(l))
Silver {B}	7440224	GSI PC	500 (M)	100 (M)	TDL lowered fro 500 to 100 (R 299.5103(l))
Silvex (2,4,5-TP)	93721	GSI	NA	30	Updated R 57 value (R 299.5706a(11))
		GSI PC	NA	2,200	Updated R 57 value (R 299.5706a(11))
Sodium azide	26628228	All	None	See Attachment 1	New Hazardous Substance (R 99.5706a(10))
Tetranitromethane	509148	Res SVIIC	110	500 (M)	New TDL (R 299.5103(l) and R 299.5707)
		Res VSIC	51	500 (M)	New TDL (R 299.5103(l) and R 299.5707)
		Ind/Com VSIC	180	500 (M)	New TDL (R 299.5103(l) and R 299.5707)
Thallium (B)	7440280	Footnote (X) surface water HDV	1.2	2.0 (M)	Default to TDL (R 299.5103(l) and R 299.5707)

Attachment 2
LIST OF REVISIONS TO CRITERIA SINCE DECEMBER 2002

CHEMICAL	CAS #	PATHWAY	PREVIOUS CRITERIA	REVISED CRITERIA	REASON FOR CHANGE
Thallium (cont.)	7440280	Footnote (X) GSI PC for HDV	1,400	2,300	HDV used to calculate HDV PC was changed as a result of TDL change (R 299.5103(l) and R 299.5707)
2,4,6-Trichlorophenol	88062	GSI	5.0 (M)	4.4	TDL lowered from 5.0 to 4.0 (R 299.5103(l))
Triethylene glycol	112276	Res DWC	10,000 (M)	4,300	TDL lowered from 10,000 to 4,000 (R 299.5103(l))
tris(2,3-Dibromopropyl)phosphate	126727	Res DWC	0.71	10 (M)	New TDL (R 299.5103(l) and R 299.5707)
		Ind/Com DWC	2.9	10 (M)	New TDL (R 299.5103(l) and R 299.5707)
	126727	Res DWPC	66	930	DWC used to calculate DWPC changed as a result of TDL change (R 299.5103(l))
		Ind/Com DWPC	270	930	New TDL (R 299.5103(l) and R 299.5707)

ACRONYMS
DWC: Drinking water criteria
DWPC: Drinking water protection criteria
GCC: Ground water contact criteria
GSI: Ground water surface water interface criteria
GSI PC: Ground water surface water interface criteria protection criteria
HDV: surface water human drinking water value
Ind/Com: Industrial/Commercial
Res: Residential
R 57 value: R 323.1057, R 299.5716
SVIIC: Soil volatilization to indoor air inhalation criteria
TDL: Target detection limit
VSIC (5M or 2M): Volatile soil inhalation criteria (5M source thickness or 2M source thickness)

July 2006

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 4
PART 201 GROUNDWATER CONTACT CRITERIA
PART 213 TIER I GROUNDWATER CONTACT RISK-BASED SCREENING LEVELS

Developed under R 299.5712

Key definitions for terms used in this document:

NREPA:	**The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended**
Part 201:	**Part 201, Environmental Remediation, of NREPA**
Part 213:	**Part 213, Leaking Underground Storage Tanks, of NREPA**
MDEQ:	**Michigan Department of Environmental Quality**
RRD:	**Remediation and Redevelopment Division**
U.S. EPA:	**United States Environmental Protection Agency**
CAP/RAP:	**Corrective Action Plan pursuant to provisions of Part 213 of NREPA and Remedial Action Plans pursuant to provisions of Part 201 of NREPA**
Criteria or criterion:	**Includes the cleanup criteria for Part 201 of NREPA and Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)**
GCC:	**Groundwater contact criteria or criterion**
Facility:	**Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA**
TSD:	**Technical Support Document**

This TSD presents the methodology for development of the GCC. The GCC represent groundwater concentrations that are protective against adverse health effects due to long-term dermal exposure to hazardous substances in groundwater. The GCC were developed pursuant to Sections 20120a(1)(a), (b), and (d); 20120a(3); and 21304a(1)(2) of NREPA. The method and equations for the GCC are presented in R 299.5712. This TSD supercedes previous MDEQ documents regarding the GCC (Environmental Response Division Operational Memorandum No. 18, Technical Support Document – Generic Groundwater Contact Criteria, and Storage Tank Division Operational Memorandum No. 4 – Attachment 5, Utility Worker Groundwater Direct Contact).

The GCC are presented in the Part 201 Administrative Rules (R 299.5744) and Attachment 1 of the RRD Operational Memorandum (Op Memo) No. 1: Part 201 Generic Cleanup Criteria/

Part 213 Tier I Risk-Based Screening Levels. The GCC are presented in column 6 of the groundwater criteria table.

IMPLEMENTATION OF THE GROUNDWATER CONTACT CRITERIA

The GCC were derived to address human health risk from dermal (i.e., skin) exposure to hazardous substances in groundwater. Subsurface utility line repair, maintenance, and installation are the common types of activities that could result in periodic contact with hazardous substances in groundwater for any land use. Therefore, generic GCC have been developed using the utility worker as the target receptor. Utility worker exposure to groundwater contaminants at a facility is likely to occur throughout the duration of their employment, resulting in a higher frequency of contact with contaminants than a construction worker whose exposure is likely to occur over a few months for only one year at a facility.

The groundwater contact pathway is relevant for all land uses where contaminated groundwater is or will be encountered at a depth where construction or maintenance of utilities or other subsurface activities may reasonably be expected to result in persons coming into contact with the groundwater. If utilities are not currently present at a facility, then the location and elevation of contaminated groundwater relative to the location and elevation of surrounding utilities shall be considered in determining whether it is likely that dermal contact with groundwater related to utility construction and maintenance is reasonably likely to occur in the future (R 299.5712(1) and R 299.5532(7)(ii)).

If the pathway is relevant, the GCC are applicable for all land uses where soil excavations to conduct subsurface work can result in groundwater seepage and collection in the excavation. The GCC are applicable at facilities that have existing utilities and at facilities where utilities could be placed in the future. These criteria are not applicable if restrictions are placed on the property to prevent subsurface activities. The GCC are not applicable for ponds and other surface water. The groundwater surface water interface criteria established under R 299.5716(6) shall apply to such surface water bodies unless the MDEQ approves of alternative criteria under R 299.5716(8), R 299.5716(11), or R 299.5712(2). The RAPs/CAPs must identify if the pathway and risks due to hazardous substances in groundwater as a result of dermal contact with that groundwater are relevant (R 299.5532(7)). As a part of the evaluation, RAPs/CAPs must also identify existing utility corridors and their depth in relation to the saturated soils, describe the basis for conclusions regarding the potential depth of future utilities, and describe other subsurface activities that are anticipated to occur at the facility.

Since the GCC are based upon a specific set of exposure assumptions for a utility worker, it is essential that other groundwater exposure pathways be considered to assure that exposures different than the generic GCC exposure assumptions are evaluated. For example, consider a situation where the drinking water use of an aquifer is controlled by land use restrictions, but groundwater may be used for irrigation and recreational activities such as filling small backyard swimming pools. The generic GCC based on exposure assumptions for a utility worker will not protect for these other uses. Therefore, a criterion more restrictive than the GCC may be necessary to protect for the health and ecological risks posed by nondrinking uses of the groundwater.

Typically, the generic GCC address systemic human health effects (i.e., only those effects that occur as a result of absorption and distribution of the chemical to an

organ/tissue that is different than the site of contact) from long-term dermal exposure. Assessment of the potential for acute systemic and/or acute non-systemic (point-of-contact) effects may be necessary for some chemicals to determine criteria that are protective for the most sensitive effect (Section 20120a(4)). For example, acute systemic toxicity data were used to generate the soil direct contact criteria (DCC) and the GCC for cyanide. The acute toxicity assessment for cyanide is provided in Appendix A for reference.

For some contaminants and exposure settings, the inhalation exposure route may be significant. The potential for acute inhalation effects due to hazardous substances in groundwater in subsurface excavations must be evaluated using the Acute Inhalation Screening Levels (AISLs) or other information addressing acute inhalation concerns. In addition, excavations greater than 4 feet below ground surface are considered confined spaces under occupational safety regulations (MIOSHA Administrative Rule 6402).

The concentrations of hazardous substances in groundwater must also be evaluated for potential acute physical hazards such as flammability and explosivity. Flammability explosivity screening levels (FESLs) have been derived for this purpose.

The FESLs and AISLs, which have been developed for hazardous substances where sufficient chemical-specific information is available, are presented in columns 8 and 9 in Op Memo No. 1, Attachment 1 (Groundwater Criteria Table). Information related to the FESLs and AISLs are presented in the Part 201 Cleanup Criteria Training Material Guidesheet D (R 299.5728(1)(d) and (e)).

If the risk-based GCC is greater than the solubility limit for that specific hazardous substance, then the solubility limit is the cleanup criterion (R 299.5708(2)). Criteria that are based on the solubility limit are identified by the (S) footnote in Op Memo No. 1, Attachment 1 (Groundwater Criteria Table) (R 299.5750(S)).

The generic GCC have been developed to protect workers exposed to contamination in subsurface excavations for less than 20 days/year. Facilities with a dedicated work force for these activities would likely experience higher exposure rates and would need to develop site-specific criteria using appropriate exposure rates.

The GCC algorithm estimates a criterion protective against adverse health effects resulting from dermal exposure to hazardous substances dissolved in groundwater. The presence of dissolved phase contaminant is a key assumption for the GCC methodology. Some hazardous substances strongly adsorb to soil particles and their dissolution in groundwater may be minimal. These contaminants are identified in the criteria tables with the (AA) footnote (R 299.5750). When the groundwater contact pathway is a driver for remediation activities and hazardous substances notated with footnote (AA) exceed the GCC using totals analysis, groundwater samples may be filtered with a 0.45 micron filter for demonstrating compliance with the GCC. This allows for comparison of data representing dissolved phase contaminant to criteria based on dissolved phase contaminant. See RRD Operational Memorandum No. 2, Attachment 5 (page 5) for further details.

GROUNDWATER CONTACT ALGORITHMS The GCC are derived from the algorithms presented below except as provided in R 299.5734. The exposure assumptions for calculation

of GCC apply for all land use categories. The series of generic equations presented below are consistent with the U.S. EPA's guidance for dermal risk assessment (U.S. EPA, 2004). Some modifications of the equations are necessary for converting the calculation procedures from one of calculating risk from dermal exposure to a contaminant concentration in water, to that of back-calculating the contaminant concentration in water assuming a fixed "target" risk and acceptable dose. As a result, the *dose absorbed per exposure event* term has been modified to calculate the extent of *skin penetration* (SP) per exposure event. Since only one exposure event is assumed to occur per day under the generic scenario, the SP values are expressed in units of cm/day. Lastly, the *dermal absorbed dose* from forward calculation of risk becomes the acceptable (exposure) dose (i.e., oral cancer slope factor (SF) or oral reference dose (RfD)) for back-calculation of generic GCC.

The algebraically rearranged equations for back-calculating acceptable hazardous substance concentrations in groundwater for dermal contact (i.e., GCC) are shown in equations 1 (carcinogenic) and 2 (non-carcinogenic). Further details regarding the common parameters within the GCC algorithms are presented following the "Derivation of Skin Penetration" section.

EQUATION FOR CARCINOGENIC EFFECTS:

$$GCC = \frac{BW \times AT \times TR \times CF_1}{SF \times SA \times SP \times EV \times EF \times ED \times CF_2} \quad (1)$$

where,

GCC	(Groundwater contact criterion)	= chemical-specific (ug/L or ppb)
BW	(Body weight)	= 70 kg
AT	(Averaging time)	= 25,550 days (70 years x 365 days/year)
TR	(Target risk level)	= 10^{-5}
SF	(Oral cancer slope factor)	= chemical-specific $(mg/kg\text{-}day)^{-1}$
SA	(Skin surface area – adult)	= 3,300 cm^2
SP	(Skin penetration per event)	= chemical-specific (cm/event)
EV	(Event frequency)	= 1 event/day
EF	(Exposure frequency)	= 20 days/year
ED	(Exposure duration)	= 21 years
CF_1	(Conversion factor 1)	= 1E+3 ug/mg
CF_2	(Conversion factor 2)	= 1E-3 L/cm^3

EQUATION FOR NON-CARCINOGENIC EFFECTS:

$$GCC = \frac{THQ \times RfD \times BW \times AT \times CF_1}{SA \times SP \times EV \times EF \times ED \times CF_2} \quad (2)$$

where,

GCC	(Groundwater contact criterion)	= chemical-specific (ug/L or ppb)
THQ	(Target hazard quotient)	= 1
RfD	(Oral reference dose)	= chemical-specific (mg/kg-day)
BW	(Body weight)	= 70 kg
AT	(Averaging time)	= 7,665 days (21 years x 365 days/year)
SA	(Skin surface area – adult)	= 3,300 cm^2
SP	(Skin penetration per event)	= chemical-specific (cm/event)
EV	(Event frequency)	= 1 event/day
EF	(Exposure frequency)	= 20 days/year
ED	(Exposure duration)	= 21 years
CF_1	(Conversion factor 1)	= 1E+3 ug/mg
CF_2	(Conversion factor 2)	= 1E-3 L/cm^3

DERIVATION OF SKIN PENETRATION

Chemical-specific SP values are a function of the chemical's permeability coefficient (K_p) and the exposure time (ET). The K_p is a flux parameter, normalized for concentration, that represents the rate at which the chemical penetrates the skin (cm/hour) (U.S. EPA, 1992). Derivation of chemical-specific SP values is performed differently for inorganic and organic hazardous substances. The traditional steady-state method is used to estimate skin penetration for inorganic hazardous substances (SP_i) as shown in the following equation:

$$SP_i = K_p \times ET \quad (3)$$

where,

SP_i	(Skin penetration per event for inorganic substances)	= chemical-specific (cm/event)
K_p	(Permeability coefficient)	= chemical-specific (cm/hour), or default specified by the MDEQ
ET	(Exposure time)	= 2 hours/event for subsurface worker (hours/event)

If the MDEQ does not specify a K_p for a particular inorganic hazardous substance, a default value of 0.001 cm/hour shall be used.

A nonsteady-state method is used to calculate skin penetration values for organic hazardous substances (SP_o) to account for absorption that can occur after the exposure event due to storage of the hazardous substance within skin lipids (U.S. EPA, 1992). Factors such as the tendency for the chemical to partition between lipid and water phases, estimated by the octanol-

water partition coefficient (K_{ow}) influence the amount of contaminant absorbed after exposure has ceased.

Chemical-specific K_p values for organic hazardous substances are estimated using a refined Potts and Guy (1992) correlation equation (U.S. EPA, 2004). The correlation equation is a function of the K_{ow} and molecular weight (MW) and is based on an experimental database from Flynn (1990) for approximately 90 chemicals. The K_p values derived from this equation, presented below, were found to correlate reasonably well with experimentally determined K_p values.

$$\log K_p = -2.80 + (0.67 \times \log K_{ow}) - (0.0056 \times MW) \qquad (4)$$

where,

K_p	(Permeability coefficient)	= chemical-specific (cm/hour)
K_{ow}	(Octanol-water partition coefficient)	= chemical-specific (unitless)
MW	(Molecular weight)	= chemical-specific (g/mole)

Chemical-specific values for K_{ow} and MW are specified by the MDEQ and are presented in Op Memo No. 1, Attachment 1, Table 4: Toxicological and Chemical-Physical Data.

Derivation of K_p values using equation 4 is recommended over experimentally determined values as it provides a consistent methodology across chemicals, including chemicals that do not have an experimental measurement of K_p. Additionally, replicated experimental measurements have been shown to vary by one to two orders of magnitude (Vecchia, 1997).

An analysis using the Flynn (1990) database was conducted to determine the range of K_{ow} and MW where equation 4 would be valid for extrapolation to other chemicals. Using Mandel's analysis (Mandel, 1985), the following boundaries of K_{ow} and MW for equation 4 were determined and are referred to as the effective predictive domain (EPD):

$$-0.06876 \leq 0.5088 \times 10^{-4} MW + 0.056466 \log K_{ow} \leq 0.5586 \qquad (5)$$

$$-0.30118 \leq 0.5088 \times 10^{-4} MW + 0.056466 \log K_{ow} \leq 0.1453 \qquad (6)$$

This analysis indicates that equation 4 would not apply to chemicals with $\log K_{ow} < -1$ and $MW < 60$, and those with $\log K_{ow} > 4$ and $150 < MW < 350$, and $MW > 600$. Generally, chemicals with very large and very small K_{ow} values are outside the EPD of equation 4. There are 38 hazardous substances in the Part 201 criteria tables that lie within these boundaries. Nonetheless, equation 4 was used to develop conservative K_p values for the purpose of deriving generic GCC. The equations used to estimate SP_o are as follows:

$$\text{If } ET \leq t^*, \text{ then: } SP_o = 2 \times K_p \times \sqrt{\frac{6 \times \tau \times ET}{\pi}} \qquad (7)$$

$$\text{If } ET > t^{*}\text{, then: } SP_o = K_p \times \left[\frac{ET}{1+B} + 2\tau \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \qquad (8)$$

where,

SP_o	(Skin penetration per event for organic substances)	= chemical-specific (cm/event)
t^{*}	(Time to reach steady-state)	= chemical-specific (hours)
τ	(Lag time)	= chemical-specific (hours)
ET	(Exposure time)	= 2 hours
π	(pi)	= 3.141592654
B	(Ratio of the K_p of the stratum corneum to the K_p of the viable epidermis)	= chemical-specific (dimensionless)

Derivation of B, τ and t^{*}

Chemical-specific values for B, τ and t^{*} are calculated from the following steps:

Step 1: Calculate B

$$B = K_p \times \left(\frac{\sqrt{MW}}{2.6} \right) \qquad (9)$$

where,

B	(Ratio of the K_p of the stratum corneum to the K_p of the viable epidermis)	= chemical-specific (dimensionless)
K_p	(Permeability coefficient)	= chemical-specific (cm/hour)
MW	(Molecular weight)	= chemical-specific (g/mole)

Step 2: Calculate the chemical-specific diffusivity across the stratum corneum (D_{sc})

$$D_{sc} = 10^{(-2.80-0.0056MW)} \times l_{sc} \qquad (10)$$

where,

D_{sc}	(Effective diffusivity across stratum corneum)	= chemical-specific (cm^2/hour)
l_{sc}	(Thickness of stratum corneum)	= 0.001 cm

Step 3: Calculate lag time (τ) in hours

$$\tau = \frac{l_{sc}^2}{6 \times D_{sc}} \qquad (11)$$

Step 4: Calculate t^*

$$\text{If } B \le 0.6, \text{then } t^* = 2.4 \times \tau \quad (12)$$

$$\text{If } B > 0.6, \text{then } t^* = \left(b - \sqrt{b^2 - c^2}\right)\left(\frac{I_{sc}^2}{D_{sc}}\right) \quad (13)$$

where,

$$b = \frac{2(1+B)^2}{\pi} - c \quad (14)$$

$$c = \frac{1+3B+3B^2}{3(1+B)} \quad (15)$$

TARGET RISK LEVEL AND TARGET HAZARD QUOTIENT

The GCC are calculated using a TR for carcinogens or a THQ for non-carcinogens. The TR represents the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogenic hazardous substance. The required level of protection is no greater than 1 additional cancer above the background cancer rate per 100,000 individuals (written as $1X10^{-5}$ or 10^{-5} or 1E-5; 10^{-5} is preferentially used in this document). (Section 20120a(4)). A THQ is the ratio of the chronic daily dose of a hazardous substance (reasonable maximum exposure) divided by the chronic reference dose for that substance. The GCC are calculated using a TR of 1 in 100,000 (10^{-5}) (Section 20120a(4) and Section 21304a(3) of NREPA) and a THQ of 1 (Section 20120a(4) of NREPA).

EXPOSURE ASSUMPTIONS

The generic GCC exposure assumptions were developed to characterize a reasonable maximum exposure (RME). The RME represents a "high end" exposure estimate defined as the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures (U.S. EPA, 1989). Dermal contact with groundwater by the RME individual (RMEI) is unlikely to be continuous over an 8-hour workday. It is reasonable to assume that a RMEI will be in contact with groundwater for 25 percent of the 8-hour workday or 2 hours/day (i.e., ET = 2 hours/day). The ET is one of the parameters used to derive the SP. The SP in combination with the other exposure assumptions (including the EF) is incorporated into the GCC equation. In developing the EF default value, consideration was given to the likelihood of multiple utilities being present and the variability in days required for repair and installation of the various utility types. Accidents or natural events (e.g., frost heaving) necessitating utility repairs were also considered in developing the default EF value. Based on this general knowledge, an EF of 20 days/year is used, which represents both the uncertainty and variability in utility work events that can occur across varying types of land uses. The MDEQ recognizes that in practice this value could overestimate or underestimate exposure. The default value of 20 days/year was selected for generic application to all land use categories statewide. Facilities with a dedicated work force for these activities would likely experience higher exposure rates and would need to have site-specific criteria developed with appropriate exposure rates.

An ED default value of 21 years is used since a utility worker is considered to spend as many years on the job as an industrial worker characterized in the generic soil DCC calculations. The SA is not considered to be equivalent to the SA of the industrial worker. It is more probable that half the lower legs, feet, and hands (i.e., SA=3,300 cm^2; U.S. EPA, 1997) will be the areas of the body routinely in contact with groundwater contaminants for this scenario. The conventional adult BW of 70 kg is used for the RMEI.

TOXICITY VALUES

Toxicity values specific to dermal contact exposure are not currently available. Ideally, a dermal toxicity factor would consider point-of-contact toxicity as well as dosimetry information on the dose-response relationship for systemic effects via dermal absorption. Toxic responses elicited from oral doses may differ significantly from responses associated with dermal exposure because of differences in the toxicokinetics between the two routes. Given the absence of dermal exposure information, toxicity factors based on *oral* dose-response relationships, such as the RfD for noncancer assessment and SF for cancer assessment, must be used to calculate the GCC. Oral toxicity factors, without adjustment for absorption efficiency, are used in the development of the GCC. A detailed discussion of the basis for the dermal toxicity factor is presented in Appendix B.

This memorandum is intended to provide guidance to foster consistent application of Part 201 and Part 213 of NREPA and the associated Administrative Rules. This document is not intended to convey any rights to any person nor itself create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

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Appendix A

EXAMPLE ASSESSMENT FOR ACUTE TOXIC EFFECTS

A toxicological evaluation of the acute systemic effects of cyanide (CN) was completed (MDEQ, 1999) and is summarized here. This evaluation is performed pursuant to Section 20120a(4) of the NREPA, which requires that generic cleanup criteria be protective of the most sensitive effect. The evaluation determined that the acute toxicity of CN is the most sensitive effect; therefore, the acute endpoint was used to generate the generic soil DCC and GCC for CN.

The following acute toxicity data are based on CN poisoning in humans (ATSDR, 1995). Estimation of the lethal dose in humans is difficult since most lethal events occur under either accidental or suicidal conditions. Gettler and Baine (1938) applied an analytical methodology first developed under experimental conditions to 4 human suicide cases to estimate both an average and a lowest human lethal dose. Under controlled experimental conditions, lethal doses of CN were administered to dogs through inhalation and stomach intubation and organ tissues were then analyzed to determine the CN content relative to the lethal dose. Expressed per unit of organ weight, CN content was shown to be consistent throughout several organs with slightly higher concentrations in the blood. Since tissue samples are frequently available for only a limited number of organs from human autopsies, the brain and liver were selected to be representative of the CN present in the total body. Experimental results, confirmed by whole body human autopsies, indicate that the absorbed CN dose is approximately 7 times the total concentration of CN in the liver and brain combined. Based on these findings, absorbed CN lethal doses were calculated for 4 suicide victims and an average human lethal dose for CN was estimated at 1.4 mg/kg of body weight. The lowest human lethal absorbed CN dose of 0.54 mg/kg of body weight is selected as the lowest observed adverse effect level (LOAEL) for the lethal endpoint.

An uncertainty factor (UF) of 10 is applied to the LOAEL to account for human differences in sensitivity to the effects of CN. A full value of 10 is justified in part because no data are available for children, one of the subpopulations of interest in this assessment. An additional UF of 10 is applied to account for extrapolation from a LOAEL to a no-observed adverse effect level. A full 10-fold UF is consistent with MDEQ policy and is justified by the significance of the lethal endpoint used for this analysis. Since the LOAEL is based on a lethal dose in a human subject, no UF is necessary to account for interspecies differences.

Application of the total UF of 100 (10 X 10) to the LOAEL of 0.54 mg/kg results in an acute RfD of 5.4E-3 mg/kg for the lethal effects of CN in human subjects. A comparison of the RfD for lethal effects in humans to that of 2.0E-2 mg/kg-day for chronic effects derived from the Howard and Hanzel (1955) study in rats indicates that lethality is the more sensitive effect in human subjects. Therefore, the RfD of 5.4E-3 mg/kg is used to derive Part 201 soil DCC.

Incorporating this oral acute-based RfD into the GCC equation for non-carcinogens along with setting AT, EF, and ED parameters to a value of one for acute calculations, and using a default K_p of 10^{-3} for inorganics (see main body of TSD for equations) yields a GCC of 57,000 ug/L (ppb).

The GCC for CN is based on an RfD and may not be protective of other routes of exposure. Other toxic effects that need to be evaluated are contact site toxicity and the inhalation of hydrogen cyanide (HCN) gas. Most CN compounds in water will form HCN and then evaporate. Therefore, it is possible that the emission of HCN gas will be significant at concentrations equal to the acute GCC potentially causing adverse health effects through the inhalation route of exposure. These routes of exposure warrant further evaluation. In addition, CN may be more readily absorbed through the skin than indicated by the generic default SP of 0.001 for inorganic chemicals and should be evaluated further.

Although this toxicological assessment may not result in development of a criterion that is protective of all exposure routes and health endpoints, it does emphasize the importance of considering all toxic effects and relevant exposure pathways in establishing final groundwater cleanup criteria. It also demonstrates that in many cases the scientific database is insufficient to address all effects clearly and quantitatively. For some chemicals, it will be necessary to use a limited database, a qualitative approach, and professional judgment to ensure that all effects are addressed in developing a generic GCC.

REFERENCES

ATSDR (Agency for Toxic Substances and Disease Registry). 1995. Toxicological Profile for Cyanide. U.S. Department of Health & Human Services, Atlanta, Georgia.

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Appendix B

DERMAL TOXICITY FACTOR

Toxicity values specific to dermal contact exposure are not currently available. Ideally, a dermal toxicity factor would consider point-of-contact toxicity as well as dosimetry information on the dose-response relationship for systemic effects via dermal absorption. Toxic responses elicited from oral doses may differ significantly from responses associated with dermal exposure because of differences in the toxicokinetics (absorption, metabolism, distribution, and elimination) between the two routes. Given the absence of this information, toxicity factors based on *oral* dose-response relationships, such as the RfD for noncancer assessment and SF for cancer assessment, must be used to calculate the GCC.

Oral toxicity factors are typically based on *administered dose* whereas exposure estimates for the dermal route yield an *absorbed dose*. To characterize risk for the dermal exposure pathway, an adjustment of the oral toxicity values to represent an absorbed rather than an administered dose is necessary. The U.S. EPA (1989) general risk assessment guidance and dermal risk assessment guidance (U.S. EPA, 2004) recommend that the toxicity adjustment be based on the gastrointestinal (GI) absorption efficiency of the "critical study" that forms the basis of the RfD or SF. This is not significant to the many organic hazardous substances whose oral absorption in the critical study was complete (i.e., 100 percent; the absorbed dose is equal to the administered dose) and would not require an adjustment to the toxicity value. Toxicity factor adjustments are significant for hazardous substances whose GI absorption is significantly less than 100 percent (i.e., 50 percent). In these cases, the absorbed dose, which is more representative of the systemic dose causing the toxic effect, is much smaller than the administered dose.

The U.S. EPA (2004) proposes that an adjustment to the oral toxicity factor should be made when the following conditions are met: (1) the toxicity value derived from the critical study is based on administered dose (e.g., delivery in diet or by gavage) in the study design; (2) a scientifically defensible database demonstrates that the GI absorption of the chemical from a medium (e.g., water, feed) similar to the one used in the critical study is significantly less than 100 percent (i.e., 50 percent). A cutoff of 50 percent absorption is recommended to represent the intrinsic variability in the analysis of the absorption studies. Applying this cutoff level eliminates the need to make relatively small adjustments in the toxicity value that would otherwise imply a level of accuracy not supported by the scientific literature (U.S. EPA, 2004). In the absence of the chemical-specific data on absorption efficiency, the U.S. EPA recommends 100 percent absorption for organic and inorganic substances.

Concomitant with this recommendation, the U.S. EPA acknowledges that adjusting toxicity values from administered to absorbed doses based on absorption efficiency introduces some uncertainty. A portion of this uncertainty involves important distinctions between "absorption" and "bioavailability." Absorption refers to the disappearance of a chemical from the GI lumen, while bioavailability is the rate and amount of a chemical that reaches the systemic circulation unchanged. Bioavailability represents both absorption and pre-systemic metabolism. Pre-systemic metabolism includes both gut wall and liver metabolism, with liver metabolism referred to as the "first pass effect," playing the major role. First pass liver metabolism may be an

activating or detoxifying process, further complicating the route-to-route extrapolation. Ultimately, toxicity is a function of the contaminant concentration at the site of action.

At present, oral toxicity factors, without adjustment for absorption efficiency, are used as the dermal toxicity factor in development of the GCC.

REFERENCES

U.S. EPA. 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation. Manual (Part A). Interim Final. EPA/540/1-89/002. December 1989.

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Remediation and
Redevelopment Division

Michigan Department of Environmental Quality

April 2005

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 6
PART 201 SOIL DIRECT CONTACT CRITERIA
PART 213 TIER I SOIL DIRECT CONTACT RISK-BASED SCREENING LEVELS

Developed under R 299.5720

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
CAP/RAP:	**Corrective Action Plan pursuant to provisions of Part 213 of NREPA and Remedial Action Plans pursuant to provisions of Part 201 of NREPA**
Criteria or criterion:	**Includes the cleanup criteria for Part 201 of NREPA and Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)**
DCC:	**Direct contact criteria or criterion**
Facility:	**Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA**
TSD:	**Technical Support Document**
U.S. EPA:	United States Environmental Protection Agency

This TSD presents the methodology for development of the soil DCC. The soil DCC represents a soil concentration that is protective against adverse health effects due to long-term ingestion of and dermal contact with contaminated soil. The DCC were developed pursuant to Sections 20120a(1)(a), (b), and (d); 20120(a)(3); and 21304a(1)(2) of NREPA. The method and equations for the soil DCC are presented in R 299.5720. This TSD supercedes previous MDEQ documents regarding the DCC.

In addition to the Part 201 Administrative Rules (R 299.5746 and R 299.5748), the soil DCC are presented in Attachment 1 of the RRD Operational Memorandum No. 1: Part 201 Generic Cleanup Criteria/Part 213 Tier I Risk-Based Screening Levels. The residential and commercial I DCC are presented in column 19 of the Soil: Residential and Commercial I Table. The industrial and commercial II, commercial III, and commercial IV DCC are presented in columns 27, 28, and 29, respectively, of the Soil: Industrial and Commercial II, III, and IV Table.

micrograms per kilogram (ug/kg) or parts per billion (ppb) unless otherwise noted. To convert to units of milligrams per kilogram (mg/kg) or parts per million (ppm) in soil, divide by 1,000. A discussion of the parameters used in the algorithms follows the equations.

Generic Residential and Commercial I Algorithms:

CARCINOGENS:

$$DCC = \frac{TR \times AT \times CF}{SF \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

where,

DCC	(Direct contact criterion)	= chemical-specific, ug/kg (ppb)
TR	(Target risk level)	= 10^{-5}
AT	(Averaging time)	= 25,550 days (70 years x 365 days/year)
CF	(Conversion factor)	= 1E+9 ug/kg
SF	(Oral cancer slope factor)	= chemical-specific $(mg/kg\text{-}day)^{-1}$
EF_i	(Ingestion exposure frequency)	= 350 days/year
IF	(Age-adjusted soil ingestion factor)	= 114 mg-year/kg-day*
AE_i	(Ingestion absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)
EF_d	(Dermal exposure frequency)	= 245 days/year
DF	(Age-adjusted soil dermal factor)	= 353 mg-year/kg-day**
AE_d	(Dermal absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)

NONCARCINOGENS:

$$DCC = \frac{THQ \times RfD \times AT \times CF \times RSC}{[(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

where,

DCC	(Direct contact criterion)	= chemical-specific, ug/kg (ppb)
THQ	(Target hazard quotient)	= 1
RfD	(Oral reference dose)	= chemical-specific, mg/kg-day
AT	(Averaging time)	= 10,950 days (30 years x 365 days/year)
CF	(Conversion factor)	= 1E+9 ug/kg
RSC	(Relative source contribution)	= 1
EF_i	(Ingestion exposure frequency)	= 350 days/year
IF	(Age-adjusted soil ingestion factor)	= 114 mg-year/kg-day*
AE_i	(Ingestion absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)
EF_d	(Dermal exposure frequency)	= 245 days/year
DF	(Age-adjusted soil dermal factor)	= 353 mg-year/kg-day**
AE_d	(Dermal absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)

and,

AF	(Soil adherence factor)	= 0.2 mg/cm^2 (industrial and commercial II) = 0.01 mg/cm^2 (commercial III) = 0.1 mg/cm^2 (commercial IV)
AE_d	(Dermal absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)

NONCARCINOGENS:

$$DCC = \frac{THQ \times RfD \times BW \times AT \times CF \times RSC}{ED \times \left[(EF_i \times IR_s \times AE_i) + (EF_d \times SA \times EV \times AF \times AE_d)\right]}$$

where,

DCC	(Direct contact criterion)	= chemical-specific, ug/kg (ppb)
THQ	(Target hazard quotient)	= 1
RfD	(Oral reference dose)	= chemical-specific, mg/kg-day
BW	(Body weight)	= 70 kg
AT	(Averaging time)	= 7,665 days (21 years x 365 days/year)
CF	(Conversion factor)	= 1E+9 ug/kg
RSC	(Relative source contribution)	= 1
ED	(Exposure duration)	= 21 years
EF_i	(Ingestion exposure frequency)	= 245 days/year
IR_s	(Soil ingestion rate)	= 100 mg/day
AE_i	(Ingestion absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)
EF_d	(Dermal exposure frequency)	= 160 days/year
SA	(Skin surface area)	= 3,300 cm^2/event
EV	(Event frequency)	= 1 event/day
AF	(Soil adherence factor)	= 0.2 mg/cm^2 (industrial and commercial II) = 0.01 mg/cm^2 (commercial III) = 0.1 mg/cm^2 (commercial IV)
AE_d	(Dermal absorption efficiency)	= chemical-specific or default specified at R 299.5720(3) (see text)

Toxicity Values

The oral reference dose (RfD) is defined in R 299.5703(c) as a conservative estimate of the daily intake of the human population, including sensitive subgroups, that is likely to be without appreciable risk of deleterious effect during a lifetime. The RfD is expressed in units of mg/kg body weight per day. The RfD is used to evaluate noncarcinogenic effects. Because the soil DCC represents a soil concentration that is protective against adverse health effects due to long-term ingestion of and dermal contact with contaminated soil, a chronic RfD is generally used to calculate the DCC. The RfDs were obtained from the U.S. EPA Integrated Risk Information System (IRIS) or developed by the MDEQ. The RfDs used to develop the generic DCC are presented in RRD Operational Memorandum No. 1, Attachment 1, Table 4 (MDEQ, 2004b).

The cancer slope factor (SF) is defined in R 299.5701(d) as a plausible upper bound estimate of the probability of a response per unit dose of a hazardous substance over a lifetime. The SF is

(21 years x 365 days/year) is used to calculate the generic industrial and commercial II, III, and IV DCC.

Developmental Toxicants: The timing of exposure to developmental toxicants may affect both the type and severity of effect on the developing organism. Some compounds may exert these effects after only a single exposure, particularly during the more susceptible periods of development such as organogenesis, while others may require a longer period of exposure before effects are manifested. In the absence of information concerning the critical period of time in which a developmental toxicant may exert its effects and given the vulnerability of the potentially affected population (i.e., human infants), it is reasonable to assume that any exposure may result in undesirable effects. The U.S. EPA guidance (U.S. EPA, 1991b; 1989) indicates that assessment of the risks of exposure to developmental toxicants should be based on a daily dose that is not adjusted for duration or pattern of exposure. Therefore, the acceptable daily dose is not averaged over the ED (R 299.5734(3)(a) and R 299.5750(1)(DD)). For developmental toxicants, AT and the exposure parameters (exposure frequency and ED) are each equal to 1.

Exposure Frequency

The ingestion exposure frequency (EF_i) value for exposures to soil/dust is 350 days per year for residential exposures and 245 days per year for industrial/commercial exposures. The residential EF_i of 350 days per year represents the number of days per year that a resident is exposed to soil at their home; it assumes that people spend approximately 15 days per year away from their homes for vacations or other reasons. The U.S. EPA recommends an EF_i of 250 days per year for industrial/commercial scenarios. An additional 5 days as sick leave or vacation time away from the work place was used by the MDEQ to give an EF_i of 245 days. The EF_i is linked to the soil ingestion rate. The recommended soil ingestion rates account for ingestion of both outdoor soil and indoor dust (U.S. EPA, 1991a).

The exposure frequency for dermal contact, dermal exposure frequency (EF_d) is 245 days per year for the residential scenario and represents outdoor soil exposure. The residential EF_d takes into account the U.S. EPA's recommendation to consider local weather conditions (e.g., snow cover, frozen soil). It is assumed that Michigan winters last 4 months (120 days) making soil unavailable for contact. The EF_d for the industrial/commercial scenario is 160 days per year. The industrial/commercial EF_d takes into account 120 days of winter, 3 weeks off for vacations and sick leave, and an adjustment for a standard 5-day work week. The calculation for the EF_d is shown below:

$$(365 - 120 - 21) \times 5/7 = 160$$

Relative Source Contribution (RSC)

The RSC is the portion of a person's total daily intake of a noncarcinogen that comes from the medium being addressed by the cleanup criterion (R 299.5703(d)). The RSC for the soil DCC is assumed to be 1, i.e., 100 percent of the exposure to the hazardous substance comes from contaminated soil. A site-specific RSC may be developed in accordance with R 299.5706a(9)(a)(iv).

Ingestion and Dermal Contact Rates

Ingestion and dermal contact rates used in the residential soil direct contact algorithm are adjusted to account for differences between children and adults. It is assumed that during the 30-year exposure period, 6 years are spent as a child (U.S. EPA, 1991a). The child receptor is assumed to ingest more soil per day than an adult based on behavior (U.S. EPA, 1991a).

For soil ingestion, the MDEQ utilizes the U.S. EPA's recommended intake rates of 200 mg/day for children aged 1-6 years of age and 100 mg/day for industrial/commercial workers (U.S. EPA, 1997; 2002a). This daily intake rate reflects the increased ingestion exposures that occur to outdoor workers during landscaping or other activities that disturb the soil. These soil ingestion rates account for ingestion of both outdoor soils and indoor dust. Data suggests that up to 80 percent of indoor dust consists of outdoor soils that have been brought into a residence by air deposition and foot traffic. Therefore, it cannot be assumed that ingestion of contaminated soil is entirely precluded by climatic conditions such as snow cover. The soil intake values are derived primarily from fecal tracer studies that estimate the amount of soil ingested throughout a day's activities. As such, the intake rates are not event-specific (i.e., the rates do not represent the amount of soil ingested only during outdoor activities).

Skin Surface Area (SA)

The SA for children and residential adult receptors is equal to the 50th percentile values of body part-specific SAs for the respective age group (U.S. EPA, 1997). Dermal exposure to soil is expected to occur on the head, hands, forearms, and lower legs of an adult and the head, hands, forearms, lower legs, and feet of a child. The SA for a child aged 0-6 is 2,670 cm^2/event.

The SA for industrial/commercial workers is 3,300 cm^2/event. The SA is strongly correlated with body weight. Since the assumed body weight represents an average value, the SA is also represented as an average value. The amount of exposed SA identified below represents a typical scenario, realizing that at times a worker could have more or less skin exposed. For example, there may be times when a worker is working without a shirt and times when a worker may be working in a long-sleeved shirt and/or a coat. The typical scenario assumes that a worker is working in a short-sleeved shirt, long pants, and shoes.

SA head	1,200
SA hands	900
SA forearms	1,200
Skin surface area (cm^2/event) =	3,300

Table 2 summarizes the exposure assumptions associated with each land use category or subcategory. Additional information on the commercial land use subcategory can be found in RRD Operational Memorandum No. 1 (MDEQ, 2004b).

This memorandum is intended to provide guidance to foster consistent application of Part 201 and Part 213 of NREPA and the associated Administrative Rules. This document is not intended to convey any rights to any person nor itself create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

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April 2006 Revision

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 8
PART 201 C_{sat} CONCENTRATIONS
PART 213 TIER I C_{sat} CONCENTRATIONS

Developed pursuant to R 299.5718(2)

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
Criteria or criterion:	Includes the cleanup criteria for Part 201 of NREPA and the Risk-Based Screening Levels as defined in Part 213 of NREPA and R 299.5706a(4)
C_{sat} value:	The concentration in soil at which the solubility limits of the soil pore water, the vapor phase limits of the soil pore air, and the absorptive limits of the soil particles have been reached. C_{sat} is a theoretical threshold above which a free-phase liquid hazardous substance may exist.
Facility:	Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA
Facility-specific value or criterion:	Means "facility-specific" for Part 201 of NREPA or "site-specific" for Part 213 of NREPA
Free-Phase Liquid:	A substance that is liquid in its natural state, that is not dissolved in water and is at a concentration sufficient to allow it to flow and migrate in the environment separate from the influence of water. Includes free product as defined in Parts 201 and 213.
Response actions:	Includes "response activities" as defined by Part 201 of NREPA and "corrective action" as defined by Part 213 of NREPA
TSD:	Technical Support Document

The objective of this TSD is to describe the technical basis and purpose for developing the generic C_{sat} concentrations. The equation and parameter assumptions used to calculate the C_{sat} concentrations along with guidance for their application are provided in Part 201 and Part 213. This TSD supersedes other MDEQ documents regarding C_{sat}.

R 299.5718(2) states that if a generic soil criterion developed under R 299.5720 to R 299.5726 is greater than the C_{sat} concentration, the C_{sat} concentration becomes the generic criterion for that pathway, unless a facility-specific C_{sat} concentration is established using facility-specific soil characteristics. R 299.5706a(2)(a) states that if a criterion is greater than C_{sat}, documentation must be provided to the MDEQ addressing whether additional response activity is required to

control free-phase liquids or to protect against hazards associated with free-phase liquids that are not accounted for in the development of the generic criteria. The generic C_{sat} concentrations are presented in the RRD Operational Memorandum No. 1, Attachment 1: Part 201 Cleanup Criteria; Part 213 Risk-Based Screening Levels. They are located in column 20 of the soil criteria table. C_{sat} concentrations have been substituted for those criteria which exceed C_{sat} in the criteria tables except for the volatile and particulate soil inhalation criteria (VSIC and PSIC) for ambient air. The actual calculated VSIC and PSIC are presented in the criteria tables even if C_{sat} has been exceeded to allow for source size modifications. An underlying assumption of the generic soil inhalation criteria (SIC) is that the area of soil contamination is equal to a half-acre. In order to adapt the generic SIC for a half-acre source to larger and smaller source sizes, air dispersion modeling was used to provide a set of modifiers to adjust the criteria presented in the criteria tables (see RRD Operational Memorandum No. 1, Attachment 7).

C_{sat} is an estimate of the concentration at which the soil pore water, pore air, and surface sorption sites are saturated with a particular hazardous substance, based upon the properties of the soil and hazardous substances. Above this theoretical threshold concentration, the hazardous substance may be present in free-phase within the soil matrix - as nonaqueous phase liquids (NAPLs) for substances that are liquid at ambient soil temperatures, and pure solid phases for compounds that are solids at ambient soil temperatures (EPA, 1996). Because C_{sat} is a theoretical value, concentrations greater than C_{sat} are not definitive evidence of a saturated soil condition or the presence of free-phase liquids. Instead, they are conservative estimates of when saturation conditions may occur. Concentrations at or near saturation may require response actions as a matter of source control or to address unacceptable risks not accounted for in the development of generic criteria.

C_{sat} concentrations are not risk-based values. The purpose of a C_{sat} value is to identify an upper limit to the applicability of generic risk-based soil criteria since certain assumptions and models used in the generic algorithms are not applicable when free-phase contamination is present in soil. In addition, soil concentrations greater than C_{sat} raise concerns relative to physical hazards, such as corrosivity and flammability, contact-site toxicity, aesthetic impacts, and/or ecological impacts which are not incorporated into the development of generic soil criteria. These factors must be considered in determining final soil criteria at a facility.

Soil saturation is not equivalent to free-phase liquid conditions. The term saturation refers to the soil pore water, soil pore air, and soil sorption sites that are ***saturated*** or contain the maximum amount of hazardous substance within each of these soil compartments. It is not a visible condition. Concentrations greater than C_{sat} may exhibit the characteristics of free-phase liquids or NAPL. The absence of free-phase liquids should not be construed to mean that C_{sat} conditions do not exist.

C_{sat} concentrations do not account for the effects of multiple contaminants and their interactions in soil. The presence of multiple contaminants is common at many facilities. It is probable that chemical-specific C_{sat} concentrations would be lower when present with other organic liquid contaminants in the soil. Since soil organic carbon water partition coefficient (K_{oc}) are determined for a contaminant in the presence of one solvent (i.e., water), multiple contaminants at a facility may cause free-phase contamination even when single chemical C_{sat} values are not exceeded.

An explanation of the importance for using C_{sat} as a limit for certain exposure pathway-specific soil criteria is discussed below:

Direct Contact Criteria for Soil

The result of human exposure to free-phase contaminants in soil is expected to be significantly different than that characterized by the generic soil direct contact equation. This is because certain exposure parameters in the generic soil direct contact equation, such as ingestion and dermal absorption efficiencies and soil adherence, characterize desorption and absorption (i.e., bioavailability) of a contaminant that is sorbed or "bound" to soil particles. The default values for these parameters are not applicable for a contaminant that is "unbound" to soil, as would be the case with free-phase contamination in soil. Pure substances, particularly those existing as liquids (i.e., NAPLs), unbound to a solid, may be completely absorbed through skin (EPA, 1992a) and absorbed to a greater extent across the gastrointestinal tract. The bioavailability of NAPL in soil may significantly exceed that represented in the soil direct contact equation.

Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC)

The Johnson and Ettinger (1991) model (JEM) is used for the development of generic soil criteria protective of indoor air inhalation health risks from vapor migration into buildings. The initial step in the JEM involves vapor equilibrium modeling to determine the vapor concentration ratio in the soil to the initial unit mass concentration in the source. Vapor equilibrium modeling is only applicable at concentrations less than free-phase, where the chemical is sorbed to organic carbon in the soil, dissolved in soil moisture, and present as a gas in the air-filled pore spaces of the soil.

Ambient Air SIC

At C_{sat}, the emission flux of volatile contaminants from soil to ambient air reaches a plateau. Volatile emissions will not increase above C_{sat}, given the soil porosity assumptions inherent to the C_{sat} and volatilization factor equations, even if more chemical is added to the soil. C_{sat} concentrations, therefore, correspond to maximum volatile emissions from soil. Under C_{sat} conditions, the Jury model (RRD Operational Memorandum No. 1, Attachment 5) cannot be used to calculate an accurate SIC because the Henry's Law Constant (HLC), which predicts partitioning of chemical between the soil pore water (liquid) and pore air (gas), is not applicable when free-phase contamination is present (see discussion in the section titled "Equation Assumptions" for more information on the application of HLC). Air concentrations for chemicals with generic VSIC greater than C_{sat} do not exceed target risk levels (i.e., 1E-5, or hazard quotient = 1) since maximum volatile emissions are theoretically occurring at the C_{sat} concentration. This indicates that the inhalation pathway is not likely to be a human health concern for those chemicals with calculated VSIC greater than C_{sat}. Consequently, generic VSIC less than C_{sat} are applicable soil criteria, whereas VSIC exceeding C_{sat} are not valid criteria. The VSIC for the latter condition, however, are provided in the criteria tables to allow for calculations of criteria based on different source area sizes.

Soil Criteria for Groundwater Protection (all pathways)

When C_{sat} concentrations are exceeded at facilities, there is an increased potential for contaminant migration from soil to groundwater. Generally, the mobility of liquid phase contaminants will increase as soil concentrations approach and exceed the C_{sat} concentration; contaminants will migrate downward more rapidly simply by advection and gravity. Modeling soil contaminant migration to groundwater using the EPA (1996) soil-water partition (SWP) equation is invalid when C_{sat} conditions are present (for more information on the SWP equation, see the SWP criteria TSD (RRD Operational Memorandum No. 1, Attachment 9). The concept of three-phase chemical equilibrium partitioning, a fundamental component of the SWP

equation, is invalid under C_{sat} conditions because once the three phases reach capacity (i.e., C_{sat}), multiphase (NAPL and dissolved) flow of contaminants to groundwater is possible (see the discussion in the section titled "Equation Assumptions" for more information on three-phase equilibrium partitioning). Therefore, if a chemical-specific C_{sat} value is less than the calculated groundwater protection value, the C_{sat} value becomes the criterion unless a facility-specific C_{sat} concentration is established using facility-specific soil characteristics (R 299.5722). If a facility-specific C_{sat} is calculated, it is necessary to evaluate if additional response activity is necessary to protect against hazards unaccounted for in the development of that facility-specific criterion.

EQUATION ASSUMPTIONS

The C_{sat} equation illustrates that soil saturation is a function of several soil- and chemical-specific factors. The equation is presented below:

SOIL SATURATION (C_{sat}) CONCENTRATION EQUATION:

$$Csat = \frac{S}{\rho_b}\left[(K_d \times \rho_b) + \theta_w + (H' \times TAF \times \theta_a)\right]$$

where,

$Csat$	Soil saturation concentration	= ug/kg (ppb), chemical-specific
S	Chemical-specific solubility in water	= ug/L
ρ_b	Dry soil bulk density	= 1.5 kg/L
K_d	Soil-water distribution coefficient, where, $K_d = K_{oc} \times f_{oc}$	= L/kg, chemical-specific
K_{oc}	Soil organic carbon water partition coefficient	= L/kg, chemical-specific
f_{oc}	Fraction organic carbon in soil	= 0.002 (i.e., 0.2% - subsurface soil)
θ_w	Soil water-filled porosity	= 0.16 L_{water}/L_{air}
HLC	HLC	= atm-m^3/mol, chemical-specific
H'	Dimensionless HLC, where $H' = HLC \times 41$	= unitless, chemical-specific
TAF	Temperature adjustment factor	= 0.5 (H') adjusted to Michigan annual average soil temperature of 10° Celsius
θ_a	Soil air-filled porosity	= 0.09 L_{air}/L_{soil}

The C_{sat} equation models a contaminant's equilibrium partitioning into three phases in soil - the amount dissolved in the soil pore water, the amount in the vapor phase of the soil pore air, and the amount sorbed to soil particles. These three phases are represented by the chemical-specific properties, water solubility (S), the HLC, and the soil-water distribution coefficient (K_d), respectively. For example, at C_{sat} the concentration of a hazardous substance in the soil pore water is equal to the chemical's S, the concentration in the pore air space is equal to its saturated vapor concentration estimated by the chemical's HLC, and the concentration of the substance sorbed to organic carbon in the soil is at its maximum based on the chemical's K_d. Therefore, C_{sat} corresponds to the soil concentration at which the solubility limits of the soil pore water, the vapor phase limits of the soil pore air, and the adsorptive limits of the soil particles

have been reached. Free-phase liquid or solid may occur above C_{sat}, depending on the contaminant's physical state at ambient soil temperature. The conceptual application of C_{sat} has been modified to represent subsurface soil characteristics instead of surface soil assumptions as used by the EPA. This was necessary to establish consistency with default soil assumptions used to develop SWP criteria and SVIIC. As a result, the fraction of organic carbon default value was reduced from 0.6 to 0.2 percent. Similarly, the water- and air-filled soil porosity default values in the equation, θ_w and θ_a, respectively, were modified to account for "effective porosity" instead of total porosity. Effective porosity is defined as the portion of the total soil porosity that is actively involved in the flow and exchange processes. Therefore, use of effective porosity will better reflect that portion of the total soil pore volume that could become saturated with a hazardous substance.

Effective porosity values of 25 to 33 percent are common for sand and silty sand. However, Michigan soils are composed of more than sand and silty sand, and there are also several areas throughout the state where clay soil predominates. Effective porosities for clay soil can be lower than 25 percent. Therefore, a default effective porosity value of 25 percent was chosen as a low-end estimate for applicability statewide. The recommended default values for the water- and air-filled soil porosity are 0.16 L_{water}/L_{air} and 0.09 L_{air}/L_{soil}, respectively, which equate to an effective porosity of 25 percent. Further guidance for estimation of effective porosity in various soil types can be obtained from Russell (1977).

The chemical-specific dimensionless H' are multiplied by one-half (0.5) to account for reduced volatility of the chemical under lower annual average soil temperatures of 10° Celsius in Michigan, relative to the measured HLC reported at 25° Celsius. Justification for this application is available in Howe et al., (1987). The EPA (1996) provides background information for the remaining parameters and their default assumptions used in the C_{sat} equation. Facility-specific soil parameter data may be used in place of the default values and are discussed later in the application and implementation section of this document.

Development of chemical-specific C_{sat} concentrations is limited since the equation requires data on each chemical's soil organic carbon water partition coefficient (K_{oc} for calculation of K_d), S, and HLC. C_{sat} concentrations are presented in the cleanup criteria tables for substances that are liquid at standard temperature and pressure. Interpretation and implementation of the C_{sat} concentrations for solids is more complex. The average C_{sat} concentration for chemical liquids presented in the cleanup criteria tables is 2.8E+7 parts per billion (ppb) which equals 2.8 percent. Based on these results, 1.0E+7 ppb, or 1.0 percent is chosen as a reasonable default C_{sat} concentration for chemical liquids that have insufficient data for calculating their C_{sat} value. Qualitatively, soil concentrations greater than 1 percent or 10,000 mg/kg (ppm) are generally considered to indicate the likely presence of NAPL (Feenstra et al., 1991).

APPLICATION AND IMPLEMENTATION

Since free-phase liquids may be present at concentrations greater than C_{sat}, consideration should be given to whether Section 20114(1)(f) or Section 21307(2) of NREPA is applicable. This section describes obligations to address free-phase liquids and free product.

Soil sampling locations with concentrations at or above C_{sat} may represent contaminant source areas and/or hot spots as defined in the Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria (S3TM). The S3TM states:

> "It is not appropriate to combine samples from Hot Spot areas with samples from other areas of a property for statistical analysis. This is necessary to avoid averaging or diluting the samples that represent Hot Spots. Hot Spots must be addressed separately."

This is particularly important when conducting a statistical evaluation of soil data for comparison to C_{sat} concentrations. Care must be exercised not to mask potential source areas. Hot spots and/or potential source areas must be evaluated separately. This assures identification of soils that may serve as continuing sources of contamination to groundwater and air.

Facility-Specific

A person conducting the evaluation has the option to develop facility-specific C_{sat} concentrations by modifying either dry soil bulk density (ρ_b) or fraction organic carbon in soil (f_{oc}) (R299.5718(2)). Methods for determining dry soil bulk density and fraction organic carbon in soil are specified in the RRD Operational Memorandum No. 2.

Properly calculated facility-specific C_{sat} concentrations allow for a generic or unrestricted closure if the generic or calculated facility-specific criteria are not exceeded. The facility-specific parameters must be based upon representative sampling. A single measurement is not an acceptable representation given the variability of these soil parameters for different soil conditions. Adequate site characterization is necessary to establish appropriate soil types and uncontaminated areas. General guidelines for conducting representative sampling for this option are presented below (S3TM, RRD Operational Memorandum No. 4, Site Characterization and Remediation Verification).

- Soil samples must be taken from uncontaminated areas; the samples need to represent native soil conditions unaffected by any release.
- Soil samples must be collected from the same soil type associated with the contamination but not from the contaminated area.
- Soil samples must include a chemical analysis to assure that the sample area is not contaminated.
- The appropriate analytical method must be used as described above.
- A minimum of 4 samples from each soil type must be analyzed.
    - If fewer than 9 samples are collected for f_{oc}, the lowest value from each soil type should be used in calculating the facility/site-specific f_{oc}. If a minimum of 9 samples from each soil type is analyzed, a 95 percent lower confidence limit (LCL) for the mean may be used to determine the facility/site-specific f_{oc}. If an LCL for the mean is calculated, a random sampling strategy should be used to collect the samples from the appropriate soil type (i.e., the same soil type as that associated with the release) from uncontaminated areas. Methods for calculating LCLs for the mean will be provided as an addendum to the S3TM document.
    - If fewer than 9 samples are collected for soil dry bulk density analysis, the highest value from each soil type should be used in calculating the facility/site-specific soil dry bulk density. If a minimum of 9 samples from each soil type is analyzed, a 95 percent upper confidence limit (UCL) may be used to determine

the facility/site-specific soil dry bulk density. If a UCL for the mean is calculated, a random sampling strategy should be used to collect the samples from the appropriate soil type (i.e., the same soil type as that associated with the release) from uncontaminated areas. Tabbed section 7 of the S3TM should be referred to for guidance on calculating the 95 percent UCL for the mean concentration.

Prior to relying upon an appropriately calculated facility-specific C_{sat} concentration as a criterion, it must be compared to the risk-based value. Appendix 1 consists of a table of generic risk-based soil values for the various exposure pathways that are greater than the generic C_{sat} concentrations. The lower of the appropriately calculated facility-specific C_{sat} concentration and the risk-based value is the applicable facility-specific criterion. If facility-specific, risk-based values are calculated for any pathway, the same soil parameter values must be used as are used for the facility-specific C_{sat} calculations.

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RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
Acetaldehyde (I)	1.1E+08			8.4E+08					1.3E+08	
Acetic acid	6.5E+08			3.6E+09						
Acetone (I)	1.1E+08			6.2E+08	2.9E+08	5.4E+08				
Acetonitrile	2.2E+07			1.1E+08						
Acetophenone	1.1E+06			1.2E+08	1.2E+08	2.1E+08	4.7E+07	1.5E+08	2.1E+08	1.8E+08
Acrolein (I)	2.3E+07			6.8E+07						
t-Amyl methyl ether (TAME)	4.4E+05			6.0E+07			2.9E+07	9.5E+07	1.3E+08	1.1E+08
Benzene (I)	4.0E+05							8.4E+05	1.2E+06	9.9E+05
Benzyl alcohol	5 8E+06			8.8E+08			3.2E+08	1.0E+09	1.4E+09	1.2E+09
Benzyl chloride	2.3E+05								3.1E+05	2.6E+05
bis(2-Ethylhexyl)phthalate	1.0E+07							1.2E+07	2.1E+07	1.5E+07
Bromobenzene (I)	7.6E+05							1.7E+06	2.5E+06	2.1E+06
Bromoform	8.7E+05			2.8E+06				3.8E+06	5.3E+06	4.5E+06
n-Butanol (I)	8.7E+06			1.8E+08			2.9E+07	9.5E+07	1.3E+08	1.1E+08
2-Butanone (MEK) (I)	2.7E+07			4.8E+09	5.4E+07	9.9E+07	1.2E+08	7.0E+08	1.1E+09	8.6E+08
n-Butyl acetate	1.1E+06			3.6E+07	5.6E+07	1.0E+08	1.7E+07	5.5E+07	7.8E+07	6.5E+07
t-Butyl alcohol	1.1E+08			1.6E+09	3.1E+08	5.7E+08	1.2E+08	3.9E+08	5.5E+08	4.6E+08
Butyl benzyl phthalate	3.1E+05	2.2E+06	5.0E+06	5.0E+06			3.6E+07	1.2E+08	1.6E+08	1.4E+08

RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
n-Butylbenzene	1.0E+07								1.1E+07	
sec-Butylbenzene	1.0E+07								1.1E+07	
tert-Butylbenzene (I)	1.0E+07								1.1E+07	
Carbon disulfide (I,R)	2.8E+05			2.4E+07			7.2E+06	4.3E+07	6.6E+07	5.3E+07
Carbon tetrachloride	3.9E+05							4.4E+05	6.2E+05	5.2E+05
Chlorobenzene (I)	2.6E+05			1.7E+06			4.3E+06	1.4E+07	1.9E+07	1.6E+07
1-Chloro-1,1-difluoroethane	9.6E+05			7.8E+07	2.9E+06	5.4E+06	4.7E+08	1.5E+09	2.1E+09	1.8E+09
Chloroethane	9.5E+05			8.8E+06	2.9E+06	5.3E+06	2.6E+06	1.2E+07	1.7E+07	1.4E+07
Chloroform	1.5E+06			3.0E+06				5.5E+06	7.7E+06	6.5E+06
Chloromethane (I)	1.1E+06			9.8E+06			1.6E+06	7.4E+06	1.0E+07	8.7E+06
o-Chlorotoluene (I)	5.0E+05			9.8E+05		5.0E+05	4.5E+06	1.5E+07	2.0E+07	1.7E+07
Cyclohexanone	2.2E+08			3.6E+09			1.0E+09	3.3E+09	4.6E+09	3.9E+09
Dalapon	5.9E+07			2.4E+08				6.2E+07	8.7E+07	7.3E+07
Di-n-butyl phthalate	7.6E+05	9.6E+05	2.7E+06	1.2E+07			2.7E+07	8.7E+07	1.2E+08	1.0E+08
Di(2-ethylhexyl) adipate	9.6E+05	1.3E+07	1.3E+07	1.5E+07			1.5E+07	6.3E+07	1.1E+08	8.2E+07
Di-n-octyl phthalate	1.4E+08		2.9E+08	3.1E+08						
Dibromochloromethane	6.1E+05								6.9E+05	
Dibromochloropropane	1,200			7,800	11,000	20,000	4,400	20,000	28,000	24,000

RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
Dibromomethane	2.0E+06			1.1E+07			2.5E+06	8.0E+06	1.1E+07	9.4E+06
1,2-Dichlorobenzene	2.1E+05			3.6E+06	1.1E+07	2.0E+07	1.9E+07	6.3E+07	8.8E+07	7.4E+07
1,3-Dichlorobenzene	1.7E+05						2.0E+05	6.6E+05	9.2E+05	7.7E+05
Dichlorodifluoromethane	1.0E+06			1.7E+07			5.2E+07	1.7E+08	2.3E+08	2.0E+08
1,1-Dichloroethane	8.9E+05			4.8E+07			2.7E+07	8.7E+07	1.2E+08	1.0E+08
1,1-Dichloroethylene (I)	5.7E+05							6.6E+05	9.2E+05	7.7E+05
cis-1,2-Dichloroethylene	6.4E+05			4.0E+06			2.5E+06	8.0E+06	1.1E+07	9.4E+06
trans-1,2-Dichloroethylene	1.4E+06			4.4E+06			3.8E+06	1.2E+07	1.7E+07	1.5E+07
2,4-Dichlorophenol	1.8E+06							3.9E+06	6.0E+06	4.8E+06
1,2-Dichloropropane (I)	5.5E+05							6.6E+05	9.2E+05	7.7E+05
Diethyl ether	7.4E+06			7.0E+08	2.8E+07	5.2E+07	1.1E+08	3.6E+08	5.1E+08	4.3E+08
Diethyl phthalate	7.4E+05			2.2E+07			1.7E+08	5.5E+08	7.7E+08	6.4E+08
Diisopropyl ether	1,300		1,700	1.6E+05	6.7E+05	1.2E+06	9.2E+05	3.0E+06	4.2E+06	3.5E+06
Dimethyl phthalate	7.9E+05	1.5E+06	4.2E+06	8.4E+07			2.3E+09	7.3E+09	1.0E+10	8.6E+09
Dinoseb	1.4E+05			3.0E+05				3.9E+05	6.0E+05	4.8E+05
Ethanol (I)	1.1E+08			2.0E+10			4.1E+09	2.4E+10	3.7E+10	3.0E+10
Ethyl-tert-butyl ether (ETBE)	6.5E+05					1.0E+06				
Ethylbenzene (I)	1.4E+05			3.4E+06		4.6E+05	2.2E+07	7.1E+07	9.9E+07	8.3E+07
Ethylene glycol	1.1E+08			2.0E+10			4.5E+08	1.5E+09	2.0E+09	1.7E+09

RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
Formaldehyde	6.0E+07			6.0E+08				1.3E+08	1.8E+08	1.5E+08
Formic acid (I,U)	1.1E+08			1.2E+10			3.2E+08	1.0E+09	1.4E+09	1.2E+09
Hexachlorobutadiene (C-46)	3.5E+05			6.9E+05		7.1E+05		4.7E+05	6.5E+05	5.5E+05
Hexachlorocyclopentadiene (C-56)	7.2E+05			1.0E+07			2.3E+06	6.7E+06	1.2E+07	8.7E+06
2-Hexanone	2.5E+06			1.0E+08			3.2E+07	1.0E+08	1.4E+08	1.2E+08
Isobutyl alcohol (I)	8.9E+06			5.0E+08	2.3E+08	4.3E+08	7.2E+07	2.3E+08	3.3E+08	2.7E+08
Isophorone	2.4E+06			2.0E+07			4.8E+06	2.2E+07	3.1E+07	2.6E+07
Isopropyl alcohol (I)	1.1E+08			2.6E+08						
Isopropyl benzene	3.9E+05			6.4E+06	4.0E+05	7.3E+05	2.5E+07	8.0E+07	1.1E+08	9.4E+07
Methanol	3.1E+06			5.8E+08	3.6E+07	6.7E+07	1.1E+08	3.6E+08	5.1E+08	4.3E+08
4-Methyl-2-pentanone (MIBK) (I)	2.7E+06			2.6E+08	3.7E+07	6.9E+07	5.6E+07	1.8E+08	2.6E+08	2.1E+08
Methyl-tert-butyl ether (MTBE)	5.9E+06			1.2E+07	9.9E+06	1.8E+07		7.1E+06	1.0E+07	8.4E+06
Methylene chloride	2.3E+06			4.4E+06				5.8E+06	8.1E+06	6.8E+06
Metolachlor	4.4E+05			1.8E+06			1.5E+06	6.9E+06	9.7E+06	8.2E+06
Pentachlorobenzene	1.9E+05			1.1E+06			3.2E+05	9.3E+05	1.7E+06	1.2E+06
Pentane	2.4E+05				9.5E+05					
Phenol	1.2E+07			5.8E+08			4.0E+07	2.3E+08	3.6E+08	2.9E+08
Phthalic anhydride	1.1E+06			1.2E+08			4.7E+08	1.5E+09	2.1E+09	1.8E+09

RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
Propionic acid	1.1E+08			5.6E+09			3.8E+08	1.2E+09	1.7E+09	1.5E+09
n-Propylbenzene (I)	1.0E+07								1.1E+07	
Propylene glycol	1.1E+08			2.0E+10			4.5E+09	1.5E+10	2.0E+10	1.7E+10
Pyridine (I)	37,000			1.9E+06			2.3E+05	7.3E+05	1.0E+06	8.6E+05
Styrene	5.2E+05					1.3E+06		1.9E+06	2.6E+06	2.2E+06
1,1,1,2-Tetrachloroethane	4.4E+05			6.0E+05			4.8E+05	2.2E+06	3.1E+06	2.6E+06
Tetrachloroethylene	88,000			2.4E+05			2.0E+05	9.3E+05	1.3E+06	1.1E+06
Toluene (I)	2.5E+05			1.1E+07	3.3E+05	6.1E+05	5.0E+07	1.6E+08	2.2E+08	1.9E+08
Triallate	2.5E+05		2.7E+05	4.0E+06			2.9E+06	9.5E+06	1.3E+07	1.1E+07
1,2,4-Trichlorobenzene	1.1E+06				9.6E+06	1.8E+07		5.8E+06	9.0E+06	7.2E+06
1,1,1-Trichloroethane	4.6E+05			2.6E+07			5.0E+08	1.6E+09	2.2E+09	1.9E+09
1,1,2-Trichloroethane	9.2E+05								1.2E+06	9.9E+05
Trichloroethylene	5.0E+05						5.3E+05	6.6E+05	1.0E+06	8.1E+05
Trichlorofluoromethane	5.6E+05			2.2E+07	2.8E+06	5.2E+06	7.9E+07	2.6E+08	3.6E+08	3.0E+08
1,2,3-Trichloropropane	8.3E+05			1.7E+06			1.3E+06	4.2E+06	5.8E+06	4.9E+06
1,1,2-Trichloro-1,2,2-trifluoroethane	5.5E+05	9.0E+06	9.0E+06	9.0E+06	5.1E+06	9.3E+06	6.1E+09	2.0E+10	2.8E+10	2.3E+10
Triethylene glycol	1.1E+05	2.0E+05	2.4E+05	2.0E+07			3.9E+07	2.3E+08	3.6E+08	2.8E+08
1,2,4-Trimethylbenzene (I)	1.1E+05			1.9E+06	4.3E+06	7.9E+06	3.2E+07	1.0E+08	1.4E+08	1.2E+08
1,3,5-Trimethylbenzene (I)	94,000			1.5E+06	2.6E+06	4.8E+06	3.2E+07	1.0E+08	1.4E+08	1.2E+08

RRD Operational Memorandum No. 1, Attachment 8, Appendix 1:

Generic Soil Saturation Concentrations (C_{sat}) and Calculated Risk-based Soil Values Greater than the Generic C_{sat}

Hazardous Substance	Generic C_{sat} Concentration (ug/kg)	Risk-based Values Greater than C_{sat} (ug/kg or ppb)								
		Residential Drinking Water Protection	Industrial and Commercial Drinking Water Protection	Ground-water Contact Protection	Residential & Commercial I Soil Volatilization to Indoor Air Inhalation	Industrial & Commercial II III IV Soil Volatilization to Indoor Air Inhalation	Residential & Commercial I Direct Contact	Industrial & Commercial II Direct Contact	Commercial III Direct Contact	Commercial IV Direct Contact
Triphenyl phosphate	1.1E+05	1.5E+06	1.8E+06	1.8E+06			3.6E+07	1.2E+08	1.6E+08	1.4E+08
tris(2,3-Dibromopropyl)phosphate	27,000			1.9E+05	81,000	4.3E+05			28,000	
Vinyl acetate (I)	2.4E+06			1.6E+08			5.8E+06	3.4E+07	5.3E+07	4.2E+07
Xylenes (I)	1.5E+05			3.8E+06	6.3E+06	1.2E+07	4.1E+08	1.3E+09	1.8E+09	1.5E+09

Remediation and
Redevelopment Division

Michigan Department of Environmental Quality

March 2005

RRD OPERATIONAL MEMORANDUM NO. 1

SUBJECT: TECHNICAL SUPPORT DOCUMENT - ATTACHMENT 9
PART 201 GROUNDWATER PROTECTION CRITERIA
PART 213 TIER I RISK-BASED SCREENING LEVELS
PART 213 TIER I GROUNDWATER PROTECTION RISK-BASED SCREENING LEVELS

Developed under R 299.5722

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
Criteria or criterion:	**Includes the cleanup criteria for Part 201 of NREPA and the Risk-Based Screening Levels, as defined in Part 213 of NREPA and R 299.5706a(4)**
Facility:	**Includes "facility" as defined by Part 201 of NREPA and "site" as defined by Part 213 of NREPA**
DWC:	**Drinking water criteria or criterion**
GCC:	**Groundwater contact criteria or criterion**
GSI:	**Groundwater surface water interface criteria or criterion**
GWPC:	**Groundwater protection criteria or criterion**
SWP:	**Soil-water partition**
SWPV:	**Soil-water partition value or values**
TSD:	**Technical Support Document**

This TSD presents the methodology for the development of the generic Part 201 soil cleanup criteria and Part 213 Tier I Risk-Based Screening Levels protective of groundwater, or the GWPC. This methodology is used to assess the potential for hazardous substances in soil to leach and impact groundwater at concentrations greater than the applicable generic drinking water, groundwater surface water interface, and groundwater contact criteria. This TSD replaces the Environmental Response Division, Operational Memorandum No. 18, TSD, Part 201 Generic Soil/Water Partitioning Criteria, dated August 23, 1999 and the Storage Tank Division, Operational Memorandum No. 4, Attachment 7, Part 213 Risk-Based Screening Levels for Soil/Water Partitioning, dated April 1999.

To assure that soils do not pose a threat of aquifer contamination, the concentration of a hazardous substance in soil leachate must be below the applicable Part 201 groundwater criterion for that hazardous substance, considering all relevant pathways (R 299.5722(1)). Leach testing is not required to make this demonstration if the total concentration of a hazardous substance in soil does not exceed the generic soil GWPC (R 299.5722(2)). For each soil leaching pathway evaluated, the highest of 20 times (20X) the lowest applicable generic groundwater criterion and the SWPV, if available, becomes the GWPC for a given hazardous substance (R 299.5722(1)). If a SWPV is not available for a hazardous substance, then the 20X value becomes the GWPC. For hazardous substances with soil protection criteria greater than their respective soil saturation (C_{sat}) concentration, the C_{sat} becomes the criterion unless a facility-specific C_{sat} concentration is established using facility-specific soil characteristics (R 299.5718(2)).

The GWPC were developed pursuant to Sections 20120a(1)(a), (b), and (d); 20120a(3) and (9); and Sections 21304a(1) and (2) of NREPA; and R 299.5722. In addition to the Part 201 Administrative Rules (R 299.5746 and R 299.5748), the GWPC are presented in Attachment 1 of Operational Memorandum No. 1: Part 201 Generic Cleanup Criteria/Part 213 Risk-Based Screening Levels. These criteria are presented in columns 11, 12, and 13 of the residential and commercial I soil criteria table and in columns 12, 13, and 21 of the industrial and commercial II, III, and IV soil criteria table. The GWPC represent soil concentrations of contaminants in units of micrograms per kilogram (µg/kg) or parts per billion (ppb), unless otherwise noted.

THE SWP METHODOLOGY

The SWP methodology is based on assumptions related to the fate and transport of contaminants migrating from subsurface soil to groundwater. Generally, the migration of contaminants from soil to groundwater can be broken down into two stages:

1. Contaminant release from soil into the soil pore water and pore air (i.e., contaminant release into soil leachate).

2. Contaminant transport through the soil and groundwater to a receptor point (e.g., a drinking water well).

The United States Environmental Protection Agency (U.S. EPA) Soil Screening Guidance (SSG; U.S. EPA, 1996) provides a generic equation that accounts for both of these processes. The same equations are used in the risk-based corrective action screening methodology applied at petroleum release sites (American Society for Testing and Materials (ASTM), 1995). The SWP methodology is considered suitable for generic statewide application because it utilizes simple conservative assumptions about the release and transport of contaminants in the subsurface and also has the flexibility to allow for facility-specific adjustments if adequate data are available.

The SWP methodology presented in the SSG incorporates a linear equilibrium SWP equation to estimate hazardous substance release from soil into soil leachate by relating the concentration of hazardous substance adsorbed to soil organic carbon (f_{oc}) to the concentration in the soil leachate. As hazardous substances in soil leachate move through soil and groundwater, they are subjected to physical, chemical, and biological processes that can reduce the hazardous substance concentration at the receptor. The SWP methodology addresses only one of these attenuation processes which is contaminant dilution in groundwater. By incorporating a simple

water-balance equation, a dilution attenuation factor (DAF) is calculated to account for soil leachate dilution in groundwater. The DAF is expressed as the ratio of the soil leachate concentration to the acceptable groundwater concentration. This DAF is used to calculate the target soil leachate concentration (C_w), which is the product of the applicable groundwater cleanup criterion and the DAF. This concentration is based on the most restrictive of the relevant groundwater exposure pathways that requires protection (i.e., drinking water, groundwater surface water interface, or groundwater contact). For example, if the DWC for a particular hazardous substance is 0.05 mg/L and the DAF is 16, C_w would be 0.80 mg/L. Once established, C_w is used in the SWP equation to determine the hazardous substance concentration in soil protective of the relevant groundwater exposure pathway.

Several parameters within the U.S. EPA SWP equation have been modified by the MDEQ after consultation with soil and groundwater modeling experts within the MDEQ. The water- and air-filled soil porosity default values have been changed to 0.16 L_{water}/L_{air} and 0.09 L_{air}/L_{soil}, respectively, to reflect a percentage of the effective porosity (assumed to be 25%) rather than total porosity. More specifically, 65% of effective porosity is attributed to water-filled porosity and 35% of effective porosity is attributed to air-filled porosity. The basis for this modification is presented in MDEQ 1995 and 1996. The DAF utilized for the SWPV has been changed from 20 to 16 to more accurately reflect conditions at Michigan sites. The chemical-specific dimensionless Henry's Law Constant (H') are multiplied by a temperature adjustment factor (TAF) of one-half (0.5) to account for reduced volatility of a hazardous substance under lower annual average soil temperatures of 10° Celsius in Michigan (Howe *et al.*, 1987). Except for mercury, inorganic hazardous substances do not exhibit a significant vapor pressure. As a result, H' is assumed to be 0 when calculating a SWPV for inorganics. The U.S. EPA (1996) provides background information for the remaining parameters and the corresponding assumptions used in the SWP equation.

The SWP methodology was designed for use during the early stages of a site investigation when there may be limited information on soil and aquifer characteristics and the nature of contamination. Therefore, this methodology is based on conservative, simplifying assumptions about the release and transport of hazardous substances. These assumptions are implicit to the application of the SWP methodology. The assumptions are listed below (U.S. EPA, 1996).

1. The source is infinite (i.e., steady state concentrations will be maintained in groundwater over the exposure period of interest).

2. Contaminants (hazardous substances) are uniformly distributed throughout the zone of contamination.

3. Soil contamination extends from the ground surface to the water table (i.e., adsorption sites are filled in the unsaturated zone beneath the area of contamination).

4. There is no chemical or biological degradation in the unsaturated zone.

5. Equilibrium SWP is instantaneous and linear in the contaminated soil.

6. The receptor well (or GSI, or excavation) is at the edge of the source (i.e., there is no dilution from recharge downgradient of the site) and is screened within the plume (or intersects the plume).

7. The aquifer is unconsolidated and unconfined (surficial).
8. Aquifer properties are homogenous and isotropic.

9. There is no attenuation (i.e., adsorption or degradation) of contaminants (hazardous substances) in the aquifer.

10. Nonaqueous phase liquids are not present at the site.

The SWP Equation

The SWP equation is presented below. The SWP equation is the same for organic and inorganic hazardous substances. However, the soil-water distribution coefficient (K_d) values for organics and inorganics are derived differently. The K_d for organic compounds is largely influenced by the soil organic carbon. Unlike organic compounds, K_d values for metals (inorganics) are affected by a variety of soil conditions with the most significant being pH, oxidation-reduction conditions, iron oxide content, soil organic matter content, cation exchange capacity, and major ion chemistry (U.S. EPA, 1996).

There is a wide range of K_d values for metals reported in the literature. With the exception of lead and copper, the K_d values for metals were obtained from the SSG (U.S. EPA, 1996). The K_d values for lead and copper were not provided in the SSG and were developed by the MDEQ under contract with Research Triangle Institute (Truesdale, 1999).

The SWP equation follows:

$$SWPV = C_w \left[K_d + \left(\frac{\theta_w + (H' \times TAF \times \theta_a)}{\rho_b} \right) \right]$$

where,

SWPV	Soil-water partitioning value	= µg/kg (ppb), chemical-specific
C_w	Target soil leachate concentration; applicable Part 201 groundwater criterion x 16 (i.e., DAF)	= µg/L (ppb)
K_d	For inorganics: Soil-water distribution coefficient for inorganic compounds For organics: $K_d = K_{oc} \times f_{oc}$	= L/kg, chemical-specific
K_{oc}	Soil organic carbon-water partition coefficient for organic compounds	= L/kg, chemical-specific
f_{oc}	Fraction of organic carbon in soil	= 0.002 (i.e., 0.2% for subsurface soil)
θ_w	Soil water-filled porosity	= 0.16 L_{water}/L_{air}

θ_a	Soil air-filled porosity	= 0.09 L_{air}/L_{soil}
H'	Dimensionless Henry's Law Constant, where $H' = HLC \times 41$ where 41 is a conversion factor. (NOTE: For calculation of the SWPV for inorganic hazardous substances, H' equals 0)	= unitless, chemical-specific
HLC	Henry's Law Constant	= atm-m^3/mol, chemical-specific
TAF	Temperature adjustment factor	= 0.5 (H' adjusted to Michigan annual average soil temperature of 10° Celsius)
ρ_b	Dry soil bulk density	= 1.5 kg/L

20X VALUE

Both the 20X and the SWP approaches are used to predict soil leachate concentrations of hazardous substances. The 20X value for soil is derived by multiplying the applicable groundwater criterion (DWC, GSI, or GCC) by 20. Before the SWP methodology was adopted, a 20X approach was used to determine the level of hazardous substance in soil that was protective of groundwater. The multiplier of 20 comes from the dilution factor inherent to the toxicity characteristic leach procedure.

Chemical-specific information necessary to develop the SWPV is not available for all hazardous substances, resulting in the ability to generate only 20X values for some hazardous substances. When both a SWPV and a 20X value are available, the higher of the two becomes the GWPC.

APPLICATION AND IMPLEMENTATION

The GWPC are not calculated for hazardous substances designated with a footnote "NLL" (i.e., "not likely to leach") in the criteria tables. The generic GWPC are *not* applicable to hazardous substances present in non-soil matrices such as slag, tailings, wood, coal tar, and other solid or semi-solid material. In these instances, a site-specific evaluation such as leach testing is necessary. In addition, the generic GWPC are *not* applicable if the exposure pathway is not a relevant pathway at the facility or if the exposure it addresses (e.g., drinking water ingestion, dermal contact with groundwater, etc.) is reliably restricted by a restrictive covenant, or institutional control, or other mechanism allowed for under Part 201 and the associated Administrative Rules.

Drinking Water Protection Criteria

The migration of contaminants from soil to groundwater **is a relevant pathway** for any facility where groundwater is in an aquifer. This pathway is **also relevant** for groundwater that is not in an aquifer but may transport a hazardous substance into an aquifer at a concentration that exceeds the Part 201 generic residential and commercial I DWC (R 299.5710(1)(b)). The GWPC are not applicable if ingestion of the groundwater is, or will be, reliably restricted (Section 21310a and Sections 20120b(4) and (5) of NREPA; R 299.5710(1)(a) and (2)).

Restrictions on groundwater use for drinking at a facility do not preclude the need to comply with appropriate soil cleanup criteria to assure that groundwater will comply with the residential criteria at the property boundary. This is necessary to assure protection of off-property resource uses (e.g., drinking water, groundwater contact, surface water impacts), unless those off-property uses are also reliably restricted.

The soil criteria protective of commercial II, III, IV, and industrial DWC are applicable to property that is zoned or being used for purposes consistent with these land use categories provided that a notice of approved environmental remediation, notice of corrective action, or restrictive covenant limits the property use to industrial or commercial, as appropriate. It must be documented that the source property is not used for residential purposes or any other non-conforming use that presents greater potential for exposure than assumed in the development of the generic criteria. Both commercial/industrial and residential DWC are presented in the drinking water protection criteria column (column 21) of the industrial and commercial soil criteria table (Table 3) of Operational Memorandum No. 1.

GSI Protection Criteria

The soil leaching pathway for GSI protection (GSIP) **is relevant** for all land uses if an investigation or the application of best professional judgment leads to the conclusion that groundwater is reasonably expected to vent to surface waters in concentrations that exceed the generic GSI criteria (R 299.5716(1)).

If mixing zone criteria have been established for a specific hazardous substance pursuant to R 299.5716(7) and (8), then the SWPV for protection of the GSI can be determined by substituting the mixing zone-based GSI criterion as the applicable Part 201 groundwater criterion when calculating C_w in the SWP equation. The SWPV is then compared to 20X the mixing zone-based GSI criterion and the greater of the two becomes the GSIP criterion. The GSIP criteria calculated directly from generic or mixing zone-based GSI criteria do not need to be met at all points at the facility if a demonstration is made that an alternative soil concentration will not leach hazardous substances to the groundwater at levels that result in an exceedance of the generic or mixing zone-based criteria at the GSI. Predictions of any fate and transport modeling used as part of such a demonstration must be confirmed by field measurements.

For more information on the development and application of the Part 201 generic GSI or mixing zone-based criteria, please refer to MDEQ, 2004.

GCC Protection Criteria

The soil leaching pathway for GCC protection **is relevant** for all land uses unless the depth to groundwater exceeds the depth at which utilities exist or may be constructed or exceeds the depth at which subsurface work is likely to occur (R 299.5712).

Options for Part 201 Facility-Specific Generic Closure/Part 213 Tier II Site-Specific Unrestricted Closure

A party may modify the ρ_b, f_{oc}, and chemical-specific TAF for the Henry's Law Constant to develop a Part 201 facility-specific generic SWPV. A Tier II site-specific unrestricted closure is the Part 213 equivalent of a Part 201 facility-specific generic closure. Because these parameters do not vary significantly over time, options for Part 201 facility-specific generic closures and Part 213 Tier II site-specific unrestricted closures do not require land and resource use restrictions to address criteria modifications.

Refer to RRD Operational Memorandum No. 2 for methodologies to measure ρ_b, moisture content, and f_{oc}.

Additional alternatives that would allow for a facility or site-specific generic closure include:

1. Soil leach testing may be performed to determine site-specific leachate concentrations of hazardous substances for comparison to the applicable groundwater criteria. For further information on the requirements for leach testing and compliance with the GWPC, refer to R 299.5722(1), (2), and (3); and RRD Operational Memorandum No. 2, Attachment 2.

2. Saturated zone fate and transport models may be used to calculate a facility-specific DAF to account for source size and attenuation in the aquifer. Predictions from any fate and transport modeling must be confirmed by field measurements.

This memorandum is intended to provide guidance to foster consistent application of Part 201 and the associated Administrative Rules. This document is not intended to convey any rights to any person nor itself create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

REFERENCES

ASTM (American Society for Testing and Materials), 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Sites. E 1739-95.

Howe, G.B., Mullins, M.E., and Rogers, T.N, 1987. Evaluation and Prediction of Henry's Law Constants and Aqueous Solubilities for Solvents and Hydrocarbon Fuel Components, Volume I: Technical Discussion-Final Report. Research Triangle Institute.

MDEQ, 1995. Interoffice Communication from Dale Bridgford to Christine Flaga, dated August 31, 1995. Leaching Factor and C_{sat} – Effective Porosity and Total Porosity.

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MDEQ, 2004. RRD Operational Memorandum No. 5. Groundwater Surface Water Interface Criteria. September 30, 2004.

Siedlecki, M. and R. Truesdale, 1999. Development of MINTEQ-Based Soil-Water Partition Coefficients for Lead and Copper. Research Triangle Institute. February 16, 1999.

U.S. EPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response. EPA/540/R-95/128.

October 22, 2004

[Effective Date: February 1, 2005]

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Response Action:	Includes "response activities" as defined by Part 201 and "corrective action" as defined by Part 213

PURPOSE

This operational memorandum has been prepared to facilitate implementation of Part 201, Part 211, and Part 213. This operational memorandum supercedes all previous MDEQ Part 201, Part 211, and Part 213 sampling and analysis guidance.

Generic cleanup criteria for groundwater and soil have been developed pursuant to Sections 20120a(1) and 21304a of NREPA (see RRD Operational Memorandum No. 1). These criteria are the risk-based values the department has determined to be protective of the public health, safety, or welfare and the environment. The evaluation of sampling data to establish compliance with cleanup criteria under the provisions of Part 201, Part 211, and Part 213 requires data that reliably establish representative concentrations of the hazardous substances in a given environmental medium. To facilitate gathering the information necessary for the department to determine compliance with the applicable provisions of Part 201, Part 211, or Part 213, this operational memorandum designates consistent sampling and analysis protocols and consolidates, as attachments, specific sampling and analysis related specifications for the following:

Attachment 1. Target Detection Limits and Designated Analytical Methods

This attachment provides direction for analytical target detection limits for site assessment, site investigation, and response activities under Part 201, Part 211, and Part 213. This attachment constitutes the department's published list of target detection limits and available analytical methods pursuant to R 299.5103(l).

Attachment 2. Soil Leaching Methods

This attachment provides specifications for soil leaching methods acceptable to the department to establish the concentration of a hazardous substance leaching from soil. Alternate methods are provided pursuant to R299.5722(3)(b).

Attachment 3. Indoor Air Designated Methods and Target Detection Limits

This attachment provides direction for acceptable methods and analytical target detection limits for acceptable indoor air concentrations for response activities under Part 201, and Part 213.

Attachment 4. Sample Preservation, Sample Handling, and Holding Time Specifications

This attachment provides specifications applicable for the collection, preservation, holding times, and handling of groundwater and soil samples applicable to site assessment, site investigation, and response activities under Part 201, Part 211, and Part 213.

Attachment 5. Collection of Samples for Comparison to Generic Criteria

This attachment provides direction for collection of groundwater and soils samples. Additional guidance regarding sampling strategies is available in RRD Operational Memorandum No. 4.

Attachment 6. Sampling Methods for Volatile Organic Compounds

This attachment provides specifications for the collection and preservation of samples collected to determine concentrations of volatile organic compounds, and is applicable for site assessments, site investigations, and response activities under Part 201, Part 211, and Part 213.

Attachment 7. Low Level Mercury Sampling Specifications

This attachment provides specifications for the collection of groundwater samples from monitoring wells to determine mercury concentrations for the evaluation of groundwater that vents to surface water, and is applicable to site assessments, site investigation, and response activities under Part 201, Part 211, and Part 213.

Attachment 8. Assessments for Sites Contaminated with Petroleum Products

This attachment provides direction for the assessment of sites contaminated with petroleum products released from leaking underground storage tanks, and is applicable to site assessment, site investigation, and response activities under Part 211, and Part 213.

This document is intended to provide direction and guidance for sampling and analysis conducted for facilities regulated under Part 201, Part 211, and Part 213. State programs administered under other parts of NREPA or Federal programs may have requirements in addition to this guidance. Questions about sampling and analysis requirements should be directed to appropriate program staff.

original signed by Andrew W. Hogarth on October 22, 2004 Dated:_____

Andrew W. Hogarth, Chief

Remediation and Redevelopment Division

ATTACHMENTS

The effective date of this memo was extended to February 1, 2005 in a November 22, 2004 note to the DEQ-RRD and DEQ-STD listservers.

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 1

TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R299.5706a(4).
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Response Actions:	Includes "response activities" as defined in Part 201 and "corrective action" as defined in Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for analytical target detection limits (TDLs) for response actions under Part 201 and Part 213 and site assessments under Part 211. This attachment constitutes the department's published list of analytical target detection limits for hazardous substances and available analytical methods that are capable of achieving the target detection limits pursuant to R 299.5103(l).

The TDLs and designated analytical methods identified in this attachment shall apply to all sampling and analysis conducted more than 30 days after the date of issuance of Operational Memorandum No. 2.

Generic cleanup criteria for groundwater and soil have been developed pursuant to Sections 20120a(1) and 21304a of NREPA (see RRD Operational Memorandum No. 1). These criteria are the risk-based values the department has determined to be protective of the public health, safety, or welfare and the environment. The evaluation of sampling data to establish compliance with cleanup criteria under the provisions of Part 201, Part 211, and Part 213 requires the data reliably establish a representative concentration of the hazardous substance in a given environmental medium. This attachment establishes analytical target detection limits for hazardous substances and designates available analytical methods that are capable of achieving the target detection limits to facilitate gathering the information necessary for the department to determine compliance with the applicable provisions of Part 201, Part 211, or Part 213.

TARGET DETECTION LIMITS

Analytical TDLs have been established by the MDEQ for hazardous substances with generic cleanup criteria. In establishing TDLs the MDEQ considered the need to be able to measure the hazardous substances at concentrations at or below cleanup criteria. The TDLs were

derived by reviewing the low-level capabilities of state laboratories and methods published by government agencies and referenced in this document.

If the established TDL is greater than the risk-based cleanup criteria for a hazardous substance in a given environmental medium, the TDL shall be used in place of the risk-based value as the cleanup criterion.

For soil matrices, laboratory reporting limits should be equal to, or less than, the listed TDLs on a dry weight basis. For groundwater matrices, laboratory reporting limits should be equal to, or less than, the listed TDLs. Achieving the TDL is critical for site assessment and site investigation activities where the objective is the characterization of the nature and extent of contamination. For response activities under Part 201 or Part 213, where the goal is to determine compliance with applicable cleanup criteria alternate TDLs may be used if the pathways with the most restrictive cleanup criteria are appropriately determined to be "not relevant" and are therefore not applicable. Alternate TDLs are footnoted with the relevant pathway's applicable criteria.

DESIGNATED METHODS

Table 1 identifies the TDLs and the analytical methods judged capable of achieving the TDLs. The source documents for the analytical methods are listed in Table 2. The designated analytical methods include multiple methods in those cases where more than one method has been judged capable of achieving the TDL.

Alternate Acceptable Analytical Methods: The methods listed in Table 1 are primarily from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Edition 3, (SW-846) Office of Solid Waste & Emergency Response, U.S. EPA. Alternate methods, and revisions of the listed methods, may be used with prior written approval of the RRD. Except when specifically indicated in this document, prior written approval is not needed for the following specific cases:

- Revisions of methods in Table 1 from subsequent revisions published in SW-846.
- Methods approved by the U.S. EPA for use in the Contract Laboratory Program (CLP).
- Methods promulgated for use under the Federal Safe Drinking Water Act that are acceptable for raw source and finished drinking waters.
- Methods promulgated for use under the Federal Clean Water Act that are acceptable for wastewater, groundwater and surface water analysis.

Confirmations: Gas chromatography methods with mass spectrometry (GC/MS) confirmations of the contaminants' identity are preferred when the TDL can be met. When other GC methods are used, confirmation techniques should be used whenever possible such as measurements on dual columns and confirmation of a select number of samples with high levels of the contaminants that can be detected and confirmed by GC/MS.

CONTAMINANTS WITH TDLS HIGHER THAN THE MOST RESTRICTIVE CRITERIA

Table 6 lists contaminants that have TDLs greater than the most restrictive risk-based criteria. These TDLs are also identified in Table 1 through the use of bold font and by enclosing the TDLs with brackets. For these contaminants, laboratories should always report results below the TDL down to the laboratory's limits of detection. Appropriate codes must be used to indicate that the results are below the laboratory's reporting limits and are estimated. The results will be interpreted as provided in R299.5742.

CONTAMINANTS WITHOUT TDLS OR DESIGNATED ANALYTICAL METHODS

Table 7 lists contaminants with established risk-based criteria that do not have TDLs or designated analytical methods. For these contaminants, or for contaminants with no established criteria, proposed appropriate TDLs and analytical methods should be submitted to the MDEQ for review and approval. Analytical methods proposed must be supported by submission of detailed descriptions of the methods and method performance validations. When methods used are listed in Table 1 and applied to contaminants not listed in the published method, method performance validations for those contaminants must be provided to the MDEQ.

ELEVATION OF REPORTING LIMITS

Reporting limits may be elevated above the TDLs because of matrix effects, including interferences resulting from non-target or high levels of target compounds, interferences from species native to the sample matrices under investigation, and when results from the analysis of soils are adjusted for the moisture content. The use of elevated reporting limits must be approved by the MDEQ. For response actions under Part 201 or Part 213, elevated reporting limits may be acceptable if the most restrictive cleanup criterion is not exceeded. For contaminants where the TDLs are greater than the most restrictive risk-based criteria (Table 7) elevated reporting limits may be unacceptable. When reporting limits are increased for these contaminants, or when increased beyond the cleanup criteria, it is necessary to further evaluate the elevated reporting limits. This may include reviews of laboratory procedures to determine their appropriateness, re-analysis at other laboratories, further sample cleanups, modifications to methods, or other actions.

USE OF ALTERNATE REPORTING LIMITS

Alternate reporting limits may be acceptable:

- When site-specific background levels or statewide default background levels for certain metals are substituted as the cleanup criteria, it may not be necessary to report data below the background levels.
- For response actions under Part 201 or Part 213, when the most restrictive criteria has been appropriately documented to not be applicable, reporting limits may be specified, based on the most restrictive applicable criteria.
- When concentrations are determined for off-site waste disposal requirements.
- When sample concentrations lower than the TDL can be quantified; i.e., the lower sample concentrations are within the analytical range of the method.
- When monitoring levels of contaminants lower than the TDLs is necessary, particularly when risk-based criteria are lower than the TDL.

APPLICATION OF REPORTING LIMITS

The TDLs are applicable to site assessments, environmental investigations, and response activities performed pursuant to Part 201, Part 211, and Part 213. They may not be applicable to other environmental statutes. Facilities subject to regulation under other environmental statutes should consult the appropriate MDEQ division.

Questions about this memorandum attachment should be directed as follows:

- Site investigation and response activities under Part 201 and Part 213:
  A. Ralph Curtis, Laboratory Specialist
  Remediation and Redevelopment Division; Toxicology Unit
  Phone: 517-373-8389, FAX: 517-241-9581, Email: curtisar@michigan.gov
- Site assessments under Part 211:
  Marcia Jo Poxson
  Waste and Hazardous Materials Division; Storage Tank Unit
  Phone: 517-373-3290, FAX: 517-335-2245; Email: poxsonm@michigan.gov

The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division Operational Memorandum 6 , Revision 6, Analytical Method Detection Level Guidance for Environmental Contamination Response Activities under Part 201 of NREPA dated January 12, 2001, and addendum dated May 5, 2003.
- Storage Tank Division Operational Memorandum 4, Attachment 13, Analytical Detection Level Guidance under Part 211, and Part 213, of NREPA dated February 15, 2001, and addendum dated May 5, 2003.

Major changes from the direction in the rescinded documents are summarized as follows:

GENERAL CHANGES FROM PREVIOUS GUIDANCE

- The use of CFR 40 Part 136, Appendix B, to confirm TDLs was removed.
- Emphasis was placed on preferring GC/MS methods.
- Table 6 was added that listed contaminants with TDLs higher than the most restrictive criteria.
- Notations were added to contaminants in Table 1 to indicate: pathways that are relevant for the associated TDL; contaminants present in light petroleum products and oxygenates; and contaminants which are solvents commonly used in laboratories.
- Contaminant groupings in Table 1 were altered to increase compatibility with RRD Operational Memorandum No. 2, Attachment 4, Sample Preservation, Sample Handling, and Holding Time Specifications.

CHANGES IN METHODS

- Methods were removed from Table 1 that were never used. Language was added to allow methods from other programs.
- Additional methods approved in SW-846 were added to improve flexibility in choices.
- The notation SIM was added to specific methods, where appropriate, to indicate the use of the selected ion monitoring (SIM) technique for GC/MS methods.
- Methods for the analysis for 1,4-Dioxane that were laboratory specific were replaced with the source methods used.
- The method to determine the fraction of organic matter changed due to method revision.
- The method to determine Dacthal was changed to 8081B.
- Specific extraction methods for soil nitrate, nitrite, fluoride, and chloride were added.

- Language was added to specify distillation of ammonia from soils as the recommended method.
- The extraction method for chlorides was specified as "water extracts," as each laboratory had their own extraction procedure.
- Methods for the analysis for explosives were added.

TDL REVISIONS MADE WITH THIS DOCUMENT

- Table 3 "Contaminants Added to TDL and Designated Analytical Methods Lists" lists contaminants added to the MDEQ TDL and Designated Analytical Methods List .
- Table 4 "Contaminants Removed from TDL and Designated Analytical Methods Lists", lists contaminants removed from the MDEQ TDL and Designated Analytical Methods List .
- Table 5 "Rationale for Reducing TDLs from the Previous Operational Memoranda", lists those TDLs which have been reduced to allow measurement at or nearer to the most restrictive criteria, and rationale for the reduction.

APPENDAGES TO THIS ATTACHMENT:

TABLE 1. Target Detection Limits And Designated Analytical Methods
TABLE 2. Source Documents For Designated Analytical Methods
TABLE 3. New Contaminants Added to TDLs and Designated Analytical Methods List
TABLE 4. Contaminants Removed From TDLs and Designated Analytical Methods List
TABLE 5. Rationale For Reducing TDLs From Previous Operational Memoranda
TABLE 6. TDLS Greater Than The Most Restrictive Risk-based Criteria
TABLE 7. Contaminants With Established Risk-based Criteria And Without TDLs And Designated Analytical Methods

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This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Specific Contaminants				
Acetic Acid	64197	[1,000]	20,000	Analysis for acetate is used
Acetate	ACETATE	1,000	20,000	Ion Chromatography [1]
Chloride	16887006	10,000	200,000	300.1 9056 9212 9250 9251 9253 [325 methods] Use water extracts for soils
Dissolved Oxygen	DO	80	-----	360.1 360.2
Fluoride	7782414	1000	5000	9214 300.1 9056 340.1 Soils [2]
Formic Acid	64186	1,000	20,000	Analysis for formate is used
Formate [3]	FORMATE	1,000	20,000	Ion Chromatography [1]
Hardness[4]	HARDCALC	-----	NA	Calculate from separate Ca and Mg results using SM 2340B
Perchlorate	14797730	3	-----	314.0 9058
pH	PH	-----	-----	9040C (waters) 9045D (soils)
Phosphorus (White)	12185103	0.005	1	7580
Phosphorus (total)	7723140	10	200	365.4 (waters) 6010 6020 200.7 200.8 Soils [5]
Petroleum Hydrocarbon Material	PET_HYD	See Method	See Method	1664 9071B 8440
Sulfate	14808798	1000	50,000	300.1 9056 9035 9036 375.1 375.2 Soils [6]
Sulfide, Dissolved .and Acid Solution.	18496258	200	1000	[9030 with 9034 or 9215] 376.1 376.2
Total Dissolved Solids	TDS	10,000	----	160.1
Cyanide [7]	57125			
Cyanide, Available	CN_AVAIL	5	100	OIA 1677 Soils: Extract with 9013. 335.1 Modified for soils.
Cyanide, Amenable	CN_AMEN	5	----	9010B 9012A
Cyanide, Total	CN_TOTAL	----	100	9010B 9012A Kelada-01 335.2
Nitrogen Forms [8]				
Ammonia-N	7664417	25	1000	350.1/2/3 (Waters) For soils see [9]
Nitrate-N	14797558	100	1000	300.1 9056 353.2 For soils see [10]
Nitrite-N	14797650	100	1000	300.1 9056 353.2 For soils see [10]
Kjeldahl-N	TKN	100	1000	351.1 351.2 351.3 351.4
Urea	57136	400	20,000	983.01
Nitrogen, Total (elemental)	7727379	100	1000	See footnote 8

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Metals [11]	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg
Aluminum	7429905	50	1000
Antimony	7440360	2	[300]
Arsenic	7440382	5	100
Barium [12]	7440393	100	1000
Beryllium [12]	7440417	[1]	500
Boron	7440428	300	8000
Cadmium [12]	7440439	1	200
Chromium III	16065831	10	2000
Chromium (total)	7440473	10	2000
Cobalt	7440484	20	500
Copper [12]	7440508	4	1000
Iron	7439896	200	5000
Lithium	7439932	10	400

Metals [11]	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg
Magnesium	7439954	1000	4000
Manganese [12]	7439965	50	1000
Molybdenum	7439987	50	1000
Nickel [12]	7440020	20	1000
Selenium	7782492	5	200
Silver	7440224	[0.2]	[100]
Sodium	7440235	1000	10000
Strontium	7440246	1000	5000
Thallium	7440280	2	500
Thorium	7440611	10	1000
Vanadium	7440622	4	1000
Zinc [12]	7440666	50	1000

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods for Lead[11] See MDEQ Laboratory SOP #213
Lead, Total [12]	7439921	3	1000	Report as Lead, Total
Lead, Fine Fraction [13]	PB_FINE	-----	1000	Report as Lead, Fine Fraction
Lead, Coarse Fraction [13]	PB_COARSE	-----	1000	Report as Lead, Coarse Fraction
Contaminants				**Designated Methods**
Chromium VI	18540299	10	2000	7199 (waters) 3060A/7199 (soils)
Mercury, Total [14,15]	7439976	0.001	[50]	1669/1631 [16] 6000 & 7000 245.7 200.8
Metals by XRF				
Instrument Specific	Various	-----	Varies	6200[17]

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
DRO and GRO [18]				
Diesel Range Organics (DRO)	DRO	100	4000	Wisconsin Modified DRO
Gasoline Range Organics (GRO)	GRO	200	4000	Wisconsin Modified GRO
Carbonyls				
Acetaldehyde	75070	100	2500	8315A
Formaldehyde	50000	100	2000	8315A

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Glycols				Use water extracts for soils
Triethylene Glycol	112276	4,000	50,000	8015C
Ethylene Glycol	107211	10,000	10,000	8015C 8430
Propylene Glycol	57556	10,000	50,000	8015C 8430
Dissolved Gases In Waters[19]				
Methane [19]	74828	500	-----	Methods: RSKSOP-175 and Isotec Method
Ethane	76017			
Ethylene	75218			
Nitrous oxide	10024972			
Soil Gases [19]			**Soil Gas TDL %**	
Methane[19]	74828	-----	0.005 (50 ppm)	Modified EPA Method 8015B, EPA Method 8015B, EPA Method TO-3, or ASTM 3416M (EPA 3C), Field methods discussed in Operational Memorandum No. 6.
Soil Gases (except methane)	Various	-----	Varies	Laboratory Methods: TO Air Methods Field Sampling and Analysis: D5314 – 92

Polynuclear Aromatics (PNAs) [20]	CAS/ID	Water TDL GC/MS ug/L	Soil TDL GC/MS ug/Kg	Designated Methods
Acenaphthene	83329	5	330	8270C (SIM) 8310
Acenaphthylene	208968	5	330	8270C (SIM) 8310
Anthracene	120127	5	330	8270C (SIM) 8310
Benzo(a)anthracene	56553	1	330	8270C (SIM) 8310
Benzo(b)fluoranthene	205992	1	330	8270C (SIM) 8310
Benzo(k)fluoranthene	207089	[1]	330	8270C (SIM) 8310
Benzo(ghi)perylene	191242	[1]	330	8270C (SIM) 8310
Benzo(a)pyrene	50328	[1]	330	8270C (SIM) 8310
2-Chloronaphthalene	91587	5	330	8270C (SIM) 8310 8260B
Chrysene	218019	1	330	8270C (SIM) 8310
Dibenzo(ah)anthracene	53703	[2]	330	8270C (SIM) 8310
Fluoranthene	206440	1	330	8270C (SIM) 8310
Fluorene	86737	5	330	8270C (SIM) 8310
Indeno(1,2,3-cd)pyrene	193395	[2]	330	8270C (SIM) 8310
2-Methylnaphthalene	91576	5	330	8270C (SIM) 8310 8260B 8261
Phenanthrene	85018	2	330	8270C (SIM) 8310
Pyrene	129000	5	330	8270C (SIM) 8310

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Nitrosoamines				
N-Nitrosodi-n-propylamine	621647	[5]	[330]	8270C 8261 8070
N-Nitrosodimethylamine	62759	5	330	8270C 8261 8070
N-Nitrosodiphenylamine	86306	5	330	8270C 8261 8070
Benzidines				
Benzidine[21]	92875	[0.3]	[1000]	605 (Waters) 8270C (Ion Trap) (SIM)
3,3'-Dichlorobenzidine[21]	91941	[0.3]	[2000]	605 (Waters) 8270C (Ion Trap) (SIM)

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Acid Extractables (Phenols)				
2-Chlorophenol	95578	10	330	8270C 8041A
3-Chlorophenol	108430	10	330	8270C 8041A
4-Chloro-3-methylphenol	59507	5	280	8270C 8041A
2,4-Dichlorophenol	120832	10	330	8270C 8041A
2,6-Dichlorophenol	87650	5	330	8270C 8041A
2,3-Dimethylphenol	526750	5	330	8270C 8041A
2,4-Dimethylphenol	105679	5	330	8270C 8041A
2,6-Dimethylphenol	576261	4	[330]	8270C 8041A
3,4-Dimethylphenol	95658	5	[330]	8270C 8041A
3,5-Dimethylphenol	108689	5	330	8270C 8041A
2,4-Dinitrophenol	51285	25	830	8270C 8041A
2-Methyl-4,6-dinitrophenol	534521	[20]	[830]	8270C
Methylphenols [22]	1319773	30	1000	8270C
2-Methylphenol [22]	95487	10	330	8270C
3-Methylphenol [22]	108394	10	330	8270C
4-Methylphenol [22]	106445	10	330	8270C
2-Nitrophenol	88755	5	330	8270C 8041A
3-Nitrophenol	554847	20	830	8270C 8041A
4-Nitrophenol	100027	25	830	8270C 8041A
Pentachlorophenol [21, 23]	87865	1	20	8151A 515.1 515.2 8041A 8270C (SIM)
Phenol	108952	5	330	8270C 8041A
2,4,5-Trichlorophenol	95954	5	330	8270C 8041A
2,4,6-Trichlorophenol	88062	4	330	8270C 8041A

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Semivolatiles				
Acetophenone	98862	5	330	8270C
Aniline[21]	62533	4	[330]	8270C 8131 8270C (SIM) 8261
Azobenzene	103333	2	200	8270C
Benzal Chloride	98873	10	330	8270C
Benzoic acid	65850	50	3300	8270C
Benzotrichloride	98077	0.1	20	8121
Benzyl Alcohol	100516	50	3300	8270C
Bis(2-chloroethoxy)ethane	112265	5	330	8270C
Bis(2-chloroethoxy)methane	111911	5	330	8270C
Bis(2-chloroethyl)ether	111444	1	100	8270C 8430
Bis(2-chloroisopropyl) ether	108601	5	330	8270C
Bis(2-ethylhexyl)phthalate	117817	5	330	8270C 8061A
4-Bromophenyl phenylether	101553	5	330	8270C
Butyl benzyl phthalate	85687	5	330	8270C 8061A
Caprolactam	105602	10	330	8270C
Carbazole	86748	[10]	330	8270C
4-Chloroaniline	106478	10	330	8270C 8131
2-Chloronaphthalene	91587	5	330	8270C 8121 8310
4-Chlorophenyl phenylether	7005723	5	330	8270C
Dibenzofuran	132649	4	330	8270C
Dicyclohexyl phthalate	84617	5	330	8270C 8061A
Di(2-ethylhexyl)adipate	103231	5	330	8270C 8061A
Diethyl phthalate	84662	5	330	8270C 8061A
Dimethyl phthalate	131113	5	330	8270C 8061A
Di-n-butyl phthalate	84742	5	330	8270C 8061A
Di-n-octyl phthalate	117840	5	330	8270C 8061A
1,3-Dinitrobenzene	99650	5	330	8270C 8095
2,4-Dinitrotoluene	121142	5	330	8270C 8330A 8095
2,6-Dinitrotoluene	606202	5	330	8270C 8330A 8095
1,2-Diphenylhydrazine	122667	5	330	8270C
Hexachlorobenzene (C-66)[21]	118741	0.2	330	8121 8270C – Ion Trap - (SIM)

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Semivolatiles				
Hexachlorobutadiene (C-46) [21, 24]	87683	0.05	50	8121 8081B 8270C (SIM) 8261
Hexachloroethane	67721	5	300	8270C 8121
Hexachlorocyclopentadiene (C-56)	77474	5	330	8270C 8121
Isophorone	78591	5	330	8270C
4,4'-Methylene-bis-2-chloroaniline	101144	1	500	8270C
2-Methylnaphthalene	91576	5	330	8270C 8260B 8310
2-Nitroaniline	88744	25	830	8270C 8131
3-Nitroaniline	9909	25	830	8270C 8131
4-Nitroaniline	100016	25	830	8270C 8131
Nitrobenzene	98953	3	330 [25]	8270C 8330A 8095
Octachlorocyclopentene	706785	5	330	8270C
Pentachlorobenzene	608935	**[5]**	330	8270C 8121
Pentachloronitrobenzene	82688	20	330	8270C 8081B
Pyridine	110861	**[20]**	330	8270C 8261 8015C
1,2,3,4-Tetrachlorobenzene	634662	5	330	8270C 8121
1,2,3,5-Tetrachlorobenzene	634902	5	330	8270C 8121
1,2,4,5-Tetrachlorobenzene	95943	2	330	8270C 8121
p-Toluidine	106490	10	**[660]**	8270C

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods See Op Memo 2, Attachment 6 [26]
Volatiles				
Acetone [27]	67641	50	1000	8260B 8261
Acetonitrile [27]	75058	50	2500	8260B 8261 8033
Acrylamide	79061	0.5	-----	8032A 8316
Acrylonitrile	107131	2	**[{100}]**	524.2 8260B 8261 8031 8316
Acrolein[29]	107028	20	{250}	8260B 8261 8316
Benzyl Chloride	100447	5	{150}	8260B 8121
Benzene	71432	1	50	8260B 8261 8021B
Bromobenzene	108861	1	100	8260B 8021B
Bromochloromethane	74975	1	100	8260B 8261 8021B
Bromomethane (Methyl bromide)	74839	5	{200}	8260B 8261 8021B

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Volatiles				
2-Butanone (MEK)	78933	25	750	8260B 8261 8021B
n-Butyl Acetate	123864	10	250	8260B
n-Butyl Alcohol	71363	800	4400	8260B [28] 8015C
n-Butylbenzene	104518	1	50	8260B 8261 8021B
s-Butylbenzene	135988	1	50	8260B 8261 8021B
t-Butylbenzene	98066	1	50	8260B 8261 8021B
Carbon Disulfide	75150	5	250	8260B 8261
Carbon Tetrachloride	56235	1	50	8260B 8261 8021B
Chlorobenzene	108907	1	50	8260B 8261 8021B
Chloroethane	75003	5	250	8260B 8261 8021B
2-Chloroethylvinyl ether [29]	110758	10	5000	8260B
Chloromethane	74873	5	250	8260B 8261 8021B
2-Chlorotoluene	95498	5	50	8260B 8261 8021B
4-Chlorotoluene	106434	5	50	8260B 8261 8021B
Cyclohexanone	108941	50	2500	8260B 8261 8315A
1,2-Dibromo-3-chloropropane[21]	96128	0.2	**[{10}]**	8011 504.1 8260B 8081B (SIM)
Dibromomethane	74953	5	250	8260B 8261 8021B
1,2-Dichlorobenzene	95501	1	100	8260B 8261 8021B 8121
1,3-Dichlorobenzene	541731	1	100	8260B 8261 8021B 8121
1,4-Dichlorobenzene	106467	1	100	8260B 8261 8021B 8121
1,4-dichloro-2-butene, trans	764410	1	50	8260B 8261 8021B
Dichlorodifluoromethane	75718	5	250	8260B 8261 8021B
1,1-Dichloroethane	75343	1	50	8260B 8261 8021B
1,2-Dichloroethane	107062	1	50	8260B 8261 8021B
1,1-Dichloroethylene	75354	1	50	8260B 8261 8021B
1,2-Dichloroethylene, cis	156592	1	50	8260B 8261 8021B
1,2-Dichloroethylene, trans	156605	1	50	8260B 8261 8021B
1,2-Dichloropropane	78875	1	50	8260B 8261 8021B
2,2-Dichloropropane	594207	1	50	8260B 8261 8021B
1,3-Dichloropropane	142289	1	50	8260B 8261 8021B
1,1-Dichloropropene	563586	1	50	8260B 8261 8021B

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Volatiles				
1,3-Dichloropropene [30]	542756	1	100	8260B 8261 8021B
1,3-Dichloropropene, cis	10061015	1	50	8260B 8261 8021B
1,3-Dichloropropene, trans	10061026	1	50	8260B 8261 8021B
1,3-Diethylbenzene	141935	1	150	8260B
Diethyl ether [27]	60297	10	200	8260B 8015C
Diethoxymethane	462953	10	500	8260B
1,4-Dioxane[21]	123911	1	500	8260B [28] 8261 1624 (SIM)
Epichlorohydrin	106898	[5]	{100}	8260B
Ethylbenzene	100414	1	50	8260B 8261 8021B
Ethylene Dibromide[21]	106934	0.05	[{20}]	8011 504.1 8260B 8261
Ethylene Oxide	75218	200	10000	8260B 8015B
2-Hexanone	591786	50	2500	8260B 8261 8021B
Isobutyl Alcohol	78831	1000	4400	8260B 8261 8015C
Isopropyl Alcohol	67630	400	4400	8260B [28] 8015C
Isopropylbenzene	98828	5	250	8260B 8261 8021B
p-Isopropyl toluene (p-Cymene)	99876	5	100	8260B 8261 8021B
Methyl Alcohol [31]	67561	400	4400	8260B [28] 8015C
4-Methyl-2-pentanone (MIBK) [27]	108101	50	2500	8260B 8261 8021B
Methylene Chloride [27]	75092	5	{100}	8260B 8261 8021B
Methyl iodide	74884	1	100	8260B
Methylcyclopentane	96377	50	2500	8260B
Naphthalene[21]	91203	5	330	8260B 8261 8270C (SIM) 8310
Pentane	109660	100	5000	8260B
n-Propyl benzene	103651	1	100	8260B 8261 8021B
Styrene [29]	100425	1	50	8260B 8261 8021B
1,1,1,2-Tetrachloroethane	630206	1	100	8260B 8021B
1,1,2,2-Tetrachloroethane	79345	1	50	8260B 8261 8021B
Tetrachloroethylene	127184	1	50	8260B 8261 8021B
Tetrahydrofuran	109999	90	1000	8260B 8261
Tetranitromethane	509148	100	[500]	8260B
Toluene	108883	1	100	8260B 8261 8021B

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Volatiles				
1,2,4-Trichlorobenzene	120821	5	330	8260B 8261 8021B
1,1,1-Trichloroethane	71556	1	50	8260B 8261 8021B
1,1,2-Trichloroethane	79005	1	50	8260B 8261 8021B
Trichloroethylene	79016	1	50	8260B 8261 8021B
Trichlorofluoromethane	75694	1	100	8260B 8261 8021B
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	1	250	8260B
1,2,3-Trichloropropane	96184	1	100	8260B 8261 8021B
Trihalomethanes [32]		100	-----	8260B 8261
Dibromochloromethane	124481	5	100	8260B 8261 8021B
Chloroform	67663	1	50	8260B 8261 8021B
Bromodichloromethane	75274	1	100	8260B 8261 8021B
Bromoform	75252	1	100	8260B 8261 8021B
1,2,4-Trimethylbenzene	95636	1	100	8260B 8261 8021B
1,3,5-Trimethylbenzene	108678	1	100	8260B 8261 8021B
2,2,4-Trimethylpentane	540841	50	2500	8260B
Vinyl Acetate	108054	100	5000	8260B
Vinyl Chloride	75014	1	{40}	8260B 8261 8021B
Xylenes [33]	1330207	3	150	8260B 8261 8021B
m-Xylene	108383	1	50	8260B 8261 8021B
p-Xylene	106423	1	50	8260B 8261 8021B
o-Xylene	95476	1	50	8260B 8261 8021B
Oxygenates [31]				**Designated Methods** [28]
t-Butyl alcohol (TBA)	75650	50	2,500	8260B
Di-isopropyl ether (DIPE)	108203	5	250	8260B
Ethyl(tert)butylether (ETBE)	637923	5	250	8260B
Ethyl alcohol	64175	1,000	2,500	8260B 8015C
Methanol	67561	400	4400	8260B 8015C
Methyl(tert)butylether (MTBE)	1634044	5	250	8260B
Tertiaryamylmethylether (TAME)	994058	5	250	8260B
Carbamates				
Aldicarb	116063	2	50	531.1 8318A
Aldicarb Sulfone [34]	1646884	2	**[200]**	531.1 8318A
Aldicarb Sulfoxide [34]	1646873	2	**[200]**	531.1 8318A

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Carbamates				
Carbaryl	63252	20	200	531.1 8318A 8270C
Carbofuran	1563662	40	200	531.1 8318A
Diuron	300541	1	500	632 8321B 8325
Linuron	330552	0.1	-----	632
Oxamyl	23135220	100	1000	531.1 8318A
Acid Herbicides				
Dacthal metabolites [35]	DACMET	1	-------	8151A 515.1 515.2 515.4
Dalapon	75990	10	500	8151A
2,4-Dichlorophenoxyacetic acid	94757	10	200	8151A
Dicamba	1918009	1	50	8151A
Dinoseb	88857	[1]	[200]	8151A 8041A
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	94746	5	300	8151A
MCPP	93652	5	300	8151A
Silvex (2,4,5-TP)	93721	30	300	8151A
Picloram	1918021	40	500	8151A
2,4,5-T	93765	10	500	8151A
Chlorinated Pesticides				
Alachlor	15972608	1	20	8081B 8270C 525.2 507
Aldrin	309002	[0.01]	20	8081B
Chlordane [36]	57749	2	30	8081B
Chlorpyrifos, ethyl	2921882	[2]	[100]	8081B 8141B
4,4'-DDD [37]	72548	0.1	20	8081B
4,4'-DDE [37]	72559	0.1	20	8081B
4,4'-DDT	50293	[0.02]	20	8081B
Dacthal	1861321	5	100	8081B 1656 608.2
Dichloran (2,6-Dichloro-4-nitroaniline)	99309	0.01	0.1	608.2
Dieldrin	60571	[0.02]	20	8081B
Endosulfan [38]	115297	0.03	20	8081B
Endosulfan I	959988	0.03	20	8081B
Endosulfan II	33213659	0.03	20	8081B
Endosulfan Sulfate	1031078	0.05	20	8081B

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Chlorinated Pesticides				
Endrin	72208	0.02	20	8081B
Endrin Aldehyde	7421934	0.02	20	8081B
Endrin Ketone	53494705	0.02	20	8081B
Heptachlor	76448	**[0.01]**	20	8081B
Heptachlor epoxide	1024573	0.01	20	8081B
Hexabromobenzene	87821	0.02	100	8081B
alpha-Hexachlorocyclohexane (BHC)	319846	0.05	10	8121 8081B
beta-Hexachlorocyclohexane (BHC)	319857	0.02	20	8081B 8121
delta-Hexachlorocyclohexane (BHC)	319868	0.05	20	8081B 8121
Lindane (gamma-BHC)	58899	0.03	**[20]**	8081B 8121
Methoxychlor	72435	0.5	50	8081B
Mirex	2385855	**[0.02]**	50	8081B
Propachlor	1918167	50	200	8081B
Toxaphene	8001352	**[1]**	170	8081B
3-Trifluoromethyl-4-nitrophenol	88302	50	1000	8081B
tris(2,3-Dibromopropyl) phosphate	126727	**[10]**	330	8081B
Organophosphorus				
Atrazine	1912249	3	50	8141B 8270C 619 507
Cyanazine	21725462	2	200	8141B 629
Diazinon	333415	1	50	8141B 507
Dichlorvos	62737	1	**[50]**	8141B 507
Disulfoton	298044	1	50	8141B 507
EPTC	759944	3	100	8141B 507
Fonofos	944229	5	100	8141B 622.1
Molinate	2212671	2	100	8141B 507
Methyl parathion	2980000	1	40	8141B
Metolachlor	51218452	10	200	507 551.1
Metribuzin	21087649	0.1	10	507 551.1 1656
Prometon	1610180	50	200	507 619
Propazine	139402	100	2000	507 619
Simazine	122349	4	80	8141B 507 525.2 619 1656
Terbacil	5902512	20	-----	8141B 507
Triphenylphosphate	115866	10	500	8141B
Terbufos	13071799	5	-----	8141B 507

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Specific Pesticides				
Clopyralid	1702176	1	20	PAM II ACR 75.6 ACR 86.1 547 8151A
Diallate	2303164	0.5	20	1618 1656 8081B
Diquat	85007	20	-----	549
Endothall	145733	100	-----	548
Glyphosate	1071836	100	1000	547 SM6651
Aminomethylphosphoric acid (AMPA-Glyphosate metabolite)	AMPA	100	10,000	547 SM6651
Pendimethalin	40487421	10	200	1656
Tebuthiuron	34014181	100	2000	8321B
Triallate	2303175	50	2000	8270C
Trifluralin	1582098	30	200	8270C 8081B

PCB AND PBB Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Polybrominated biphenyls (FireMaster)[39]	67774327	0.01	50	8081B 8082A
Polychlorinated biphenyls (PCBs) [40]	1336363	[0.2]	330	8082A 8270C
Aroclor (unspecified) [41]	1267792	-----	-----	8082A 8270C
Aroclor 1016	12674112	-----	-----	8082A 8270C
Aroclor 1221	11104282	-----	-----	8082A 8270C
Aroclor 1232	11141165	-----	-----	8082A 8270C
Aroclor 1242	53469219	-----	-----	8082A 8270C
Aroclor 1248	12672296	-----	-----	8082A 8270C
Aroclor 1254	11097691	-----	-----	8082A 8270C
Aroclor 1260	11096825	-----	-----	8082A 8270C
Aroclor 1262	37324235	-----	-----	8082A 8270C
Aroclor 1268	11100144	-----	-----	8082A 8270C
Polychlorinated biphenyls congeners	Various	-----	-----	1668

Dioxins & Furans [42] Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746016	[0.00001]	0.001	8290A 1613
2,3,7,8-Tetrabromodibenzo-p-dioxin	50585416	0.0001	0.01	8290A 1613 (Lab specific procedures)

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Polybrochlorinated and polybrominated diphenyl ethers	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Decabromodiphenyl ether	1163195	10	330	8270C1614
Polybrominated diphenyl ethers	Various		----	1614

Explosives	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Method
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	35572782	1	50	8095
4-Amino-2,6-dinitrotoluene (4-AM-DNT)	1946510	1	50	8095
3,5-Dinitroaniline (3,5-DNA)	618871	1	50	8095
1,3-Dinitrobenzene (1,3-DNB)	99650	1	50	8095
2,4-Dinitrotoluene (2,4-DNT)	121142	1	50	8095
2,6-Dinitrotoluene (2,6-DNT)	606202	1	50	8095
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	1	50	8095
Nitrobenzene (NB)	98953	5	50	8095
Nitroglycerine (NG)	55630	5	50	8095
2-Nitrotoluene (2-NT)	88722	5	50	8095
3-Nitrotoluene (3-NT)	99081	5	50	8095
4-Nitrotoluene (4-NT)	99990	5	50	8095
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691410	10	50	8095
Pentaerythritoltetranitrate (PETN)	78115	5	50	8095
1,3,5-Trinitrobenzene (1,3,5-TNB)	99354	1	50	8095
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479458	1	50	8095
2,4,6-Trinitrotoluene (2,4,6-TNT)	118967	1	50	8095

Parameter	CAS/ID	Water TDL MFL	Soil TDL %	Designated Method
Asbestos	1332214	7	[1]	100.1 [43]

Parameter	CAS/ID	Designated Methods
Acute Toxicity	ACUTE	EPA-821-R-02-012
Chronic Toxicity	CHRONIC	EPA-821-R-02-013
Organic Carbon [44]	OC	Waters: 415.3 [45] Soils: Walkley-Black. [46] Total Organic Carbon [47]
Soil Bulk Density	SBD	ASTM Methods. [48] D2937-94
Soil Vapor Permeability	SVP	ASTM 1990 Methods D5126-90 and D5084-90

Abbreviations used in Table 1:

GC/MS: Gas chromatography with mass spectrum confirmation.
ICP/ES: Inductive coupled plasma emission spectroscopy.
SIM: Selected/single ion monitoring.
ICP/MS: Inductive coupled plasma with mass spectrometry detection.
MFL: Million fibers per liter (MFL) greater than 10 micrometer.
pH: Acidity as measured with pH meter.
GSI: Groundwater surface water interface.

Notations in Table 1:

- The TDLs in bold type and enclosed with **[ ]** brackets indicate that the contaminant's TDL is higher than the most restrictive criteria.
- For volatile organics, TDLs enclosed with **{ }** brackets indicate that the low level soil method may be required to reach a risk-based criteria. Check with the laboratory to determine if risk-based criteria can be reached for methanol-preserved samples, to determine if the low level method must be used.
- Contaminants listed in italicized format indicate that analysis is not available from the MDEQ laboratory.
- Underlined TDLs indicate the TDL was lowered from the previous operational memorandum.

Table 1 Footnotes:

1. The analysis using ion chromatography is not performed routinely by environmental laboratories. Arrangements for laboratories to perform this analysis must be made well in advance of sampling.
2. The bottle shake procedures, using reagent water, can be used for extraction of soil fluoride. If interferences are encountered, distillation procedures must be used. Colorimetric methods for the measurement of fluoride cannot be used.
3. Analysis of formate is used to determine compliance with formic acid cleanup criteria.
4. Hardness results must be calculated using separate determinations of calcium and magnesium and appropriate procedures for determining metals in SW-846. Hardness results determined by titration methods or other means than from calcium and magnesium results cannot be used for purposes of Part 201 or Part 213. No TDLs are needed because the methods available for metals can determine calcium and magnesium at any levels expected in surface and groundwaters.
5. Soil samples for total phosphorus must be digested using Kjeldahl or similar digestion techniques. See Association of Official Analytical Chemists 957.18
6. Soil sulfate analysis: Add to 5 g soil, 20 ml of extracting solution, 0.5N Ammonium Acetate/0.25N Acetic Acid in water mixture, extract for one hour on a mechanical shaker, filter on 42 Whatman ™ filter.
7. R 299.5750 footnote (P) requires, amenable cyanide or OIA 1677 methods to quantify cyanide concentrations for compliance with all groundwater criteria, and total cyanide or OIA 1677 methods to quantify cyanide concentrations for compliance with soil criteria. Method OIA 1677 is the preferred method for both waters and soils. (See Cyanide Information Sheet) The standard TDL for total cyanide in soils, in the methods provided, is 200 ug/Kg. The 100 ug/Kg TDL is applicable for site assessment and site investigation, and the total cyanide method is used with appropriate leaching procedures (See RRD Operational

TABLE 1. ABBREVIATIONS AND FOOTNOTES

Memorandum No. 2, Attachment 2). A TDL of 200 ug/Kg for cyanide may be used for response activities under Part 201 or Part 213 when the GSI pathway is appropriately documented to be not relevant.

8. The concentrations of all potential sources of nitrogen in groundwater and soils must be added together and compared to the nitrate drinking water criteria and soils protective of drinking water criteria. (See R299.5750 footnote(N)). All potential sources of nitrogen may be determined as elemental nitrogen in waters and soils provided the TDLs for nitrate are met. Several instruments and methods are available. Prior approval must be obtained from the MDEQ for use of specific methods to measure elemental nitrogen. Approval will be based on a review of the quality control and site-specific factors. For an example of the quality control required, see Method 440.0, Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis, Carl F. Zimmermann, Carolyn W. Keefe, University of Maryland System Center for Environmental Estuarine Studies, Chesapeake Biological Laboratory Solomns, MD 20688-0038 and Jerry Bashe, Technology Applications, Inc., 26 W. Martin Luther King Drive, Cincinnati, OH 45219, Revision 1.4, September 1997, National Exposure Research Laboratory, Office of Research and Development, U.S.EPA, Cincinnati, Ohio 45268. Other methods may be proposed.
9. Soil Ammonia: Air dry soil; do not heat. Soil ammonia must be distilled from soils. Standard Methods 4500 and EPA Methods 350.2 or 350.3, modified for soils can be used. Soil ammonia cannot be determined using extraction procedures.
10. Nitrate/nitrite, Reference: Methods of Soil Analysis, Part 2, Number 9 in the Agronomy Series, 1982. Extraction of soils for exchangeable nitrate/nitrite. Extraction can be accomplished by extraction of 3 g soil with 30 ml of 2M KCl for 30 minutes. Filter on 42 Whatman ™ filter.
11. The methods designated for analyses of metals include the methods in SW-846 (Methods 6000 & 7000 series), and Methods 200.7, 200.8 approved by the U.S. EPA for waters. ICP/MS procedures 6020 and 200.8 are preferred for waters analyses. Metals digestion procedures that allow recoverable metals to be determined must be used. The U.S. EPA Method 200.2, Sample Preparation Procedure for Spectrochemical Determinations of Total Recoverable Elements, Rev 2.8, is preferred for soils.
12. Criteria for the GSI pathway are based upon the hardness and pH of the receiving waters. See R 299.5750 footnote (G) for additional information.
13. Laboratories must determine lead concentrations in both the fine and coarse soil fractions when possible, and calculate total lead based on the lead concentrations in each fraction taking into consideration the relative weights of each fraction. When it is not possible to separate out any fraction, total lead must be determined and the appropriate project manager immediately informed of the affected samples. If upon sieving, the weights of any of the fractions are too small for sampling, lead analysis must be conducted on that fraction with sufficient sample and total lead should be conducted on a separate aliquot of the sample. The appropriate project manager must be immediately informed of the situation, and advised on any options that can be exercised, such as determining the lead in the sample available and qualifying the results. The MDEQ Laboratory SOP #213 provides appropriate procedures for sample preparation by the laboratory. The concentration of lead in each soil fraction should be compared to the lead direct contact criteria. The concentration of lead in the fine fraction should be compared to the lead particulate inhalation criteria. The total lead concentration should be compared to the remaining lead

TABLE 1. ABBREVIATIONS AND FOOTNOTES

soil criteria. Additional guidance is available in RRD Operational Memorandum No. 2, Attachment 5.

14. R 299.5750 footnote (Z) notes that generic cleanup criteria are based upon the toxicity of different species of mercury for different exposure pathways. The footnote allows comparison of generic criteria to species specific analytical data only if sufficient facility characterization has been conducted to rule out the presence of other species of mercury. Species specific analytical methods are not included in this document. Any proposal to use species specific methods requires MDEQ approval.
15. For response activities under Part 201 and Part 213, if the GSI pathway has been appropriately documented to be not relevant, a water TDL of 0.2 ug/L may be used.
16. The GSI criterion is a total mercury value and must be compared to total mercury analytical data. Low level mercury analysis (method 1631) must be used for waters. Low level mercury sampling specifications are provided in RRD Operational Memorandum No. 2, Attachment 7.
17. The reliability of XRF measurements are highly dependent upon the soil characteristics, mode of operation, training of personnel operating the instrument, and other factors. Results must be considered as screening measurements and cannot be used to establish compliance, unless coupled with adequate laboratory analysis to establish the validity of the results as quantitative.
18. Evaluation of Aesthetic Impacts – See RRD Operational Memorandum No. 2, Attachment 8 regarding application of these methods. GC/MS methods may be employed if it can be demonstrated that data is equivalent to the Wisconsin Modified Methods.
19. Dissolved Gases in Waters: Samples should be drawn from the wells using bladder pumps and collected in Tedlar bags. The use of bailers is not an acceptable method for sampling dissolved gases from wells. Care must be taken to keep gases dissolved until transferred to a suitable container. For the arrangement of a good sampling mechanism used to retain the pressure and keep gases dissolved, see the field sampling method "Collection of Ground Water Samples for Dissolved Gas Analysis" developed by Isotech Laboratories, Incl, 1308 Parkland Court, Champaign, IL 61821-1826, (217-398-3490). TDLs for gases other than methane are not provided. Consult the laboratories regarding reporting limits.
    Methane in Soils: See Operational Memorandum No. 6, Methane, for guidance on sampling and measuring methane in the field. Laboratory methods to analyze for light hydrocarbons include Method 3C designed for landfill gases, and various other methods using various types of detectors such as flame ionization. Since some labs may have separate canisters and instruments for trace and high levels of gases, the laboratory should be advised of the source of the methane and the expected levels in the samples in order to plan their analyses and provide suitable containers. Landfills are expected to contain percentage levels of methane, while ambient and indoor air may be expected to contain low parts per million or parts per billion.
    Soil Gases other than methane: Soil gas concentrations should be measured as a percent by volume in the soil gas, or converted to percent by volume (50 ppm = .005% by volume). Appropriate field sampling procedures in the ASTM Standard Method D 5314-92 should be used for sampling and analysis of soil gases other than methane. Other methods may be used if approved by the MDEQ. TDLs are only provided for methane. Consult with laboratories regarding reporting limits and other requirements for other gases. TO Air methods refer to various methods in Compendium of Methods for the Determination of Toxic

TABLE 1. ABBREVIATIONS AND FOOTNOTES

Organic Compounds in Ambient Air, U.S. EPA. Consult the laboratory regarding appropriate sampling procedures for specific methods.

20. GC/MS may be used anytime the laboratory's reporting limits for the method can measure the applicable criteria, including Ion Trap and single/selected ion monitoring (SIM). SIM can be used to lower the reporting limits for the PNAs about twenty times less than obtainable using full scan on the GC/MS.
21. Achieving the TDL is critical for site assessment and site investigation activities where the objective is the characterization of the nature and extent of contamination. If GC/MS methods (8260B and 8270C) can not meet the TDLs, alternate methods must be used to achieve the TDL. All contaminants identified in the site characterization which exceed generic residential cleanup criteria are contaminants of concern. Once the contaminants of concern are identified at a facility, methods and TDLs can be used to target those specific contaminants. For situations where reporting limits are elevated refer to the previous discussion regarding the use of elevated reporting limits (page 3).
22. Isomer specific concentrations of 2-, 3-, and 4-, methylphenols must be added together for comparison to methylphenols criteria for pathways other than the GSI pathway. For the GSI pathway isomer specific concentrations should be compared to the following values: 2-methylphenol 82 ug/l; 3-methylphenol 71 ug/l; 4-methylphenol 25 ug/l.
23. For response activities under Part 201 and Part 213, if the GSI and the drinking water pathways have been appropriately documented to be "not relevant", then a water TDL of 20 ug/L and soil TDL of 800 ug/Kg may be used.
24. For response activities under Part 201 and Part 213, if the GSI pathway has been appropriately documented to be "not relevant", then a water TDL of 10 ug/L and soil TDL of 330 ug/Kg may be used.
25. This TDL applies only for response activities under Part 201 and Part 213, if the drinking water pathway has been appropriately documented to be not relevant. See the parameter group "Explosives" for the appropriate method for this compound for site assessment and site investigation. Aniline is a product of nitrobenzene degradation in waters and soils and should be included in the analytical scheme when possible.
26. Soil sampling collection and preservation specifications for volatiles including protocol for methanol preservation are contained in RRD Operational Memorandum No. 2, Attachment 6.
27. This is a common laboratory solvent. Cautious review is required of analytical results for laboratory blanks to assess compliance.
28. High temperature purging and/or isotope dilution procedures may be required.
29. This contaminant is a reactive compound which requires special sampling and holding time requirements.
30. The concentrations of the cis and trans isomers must be added and reported as 1,3-Dichloropropene.
31. These contaminants are oxygenates and may be found at sites where gasoline products were used.
32. Trihalomethanes refers to chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The concentrations of all trihalomethanes must be added and compared to the criteria. (See R 299.5750 footnote (W)).
33. The concentrations of the m-, p-, and o- xylene isomers must be added and the total compared to the total xylenes criteria.
34. Aldicarb Sulfone and Aldicarb Sulfoxide are metabolites of Aldicarb.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

35. The monoacid (CAS 887547) and diacid (CAS 2136790) metabolites of Dacthal are measured as one compound and compared to the criteria for Dactal (CAS 1861321).
36. For comparison to the criteria, isomer specific concentrations for trans-Chlordane, (CAS RN 5103719), and cis-Chlordane, (CAS RN 510374) must be reported separately and the sum of their concentrations reported as Chlordane, (CAS RN 57749). If compounds other than cis and trans-Chlordane are used to calculate the chlordane concentration, report the concentrations of each separately and report Chlordane, (CAS RN 57749) using the guidance in Method 8081B for calculation. Some components of the mixture may have specific criteria, which must also be met.
37. 4,4'-DDD and 4,4'DDE are metabolites of DDT.
38. Isomer specific concentrations of Endosulfan I, (CAS 959988), and Endosulfan II, (CAS 33213659) must be added for comparison to Endosulfan criteria.
39. The term "Polybrominated biphenyls" listed in the rules and in this table (CAS 67774327) refers to a product used in Michigan, called Firemaster FF1. Firemaster FF1 consisted of several polybrominated biphenyls, the most prevalent being hexabrominated biphenyl (56%). Subsequently, cleanup criteria was established for waters and soils which applied to that product, and designated methods for the product were based on the concentrations of hexabrominated biphenyl. Recently the group of contaminants known as brominated biphenyl congeners have become a concern and it is necessary to distinguish between the product Firemaster FF1 and the individual brominated biphenyl congeners. Calibration and quantitation of FireMaster in samples should be accomplished by using technical brand FireMaster as the calibrant and quantitating using the procedures in method 8082 for calibrating Aroclor products. If the FireMaster technical product is not available, use the most dominant hexabromobiphenyl peak present in the FireMaster product as the calibrant, and report the concentrations found for that isomer as FireMaster.
40. Commercial products with specific mixtures of polychlorinated congeners were sold in the United States under product names beginning with Aroclor. The term in the table, Polychlorinated biphenyls (PCBs) refers to the total concentration of all Aroclor products found at a facility. The concentrations of the Aroclors found at a facility must be added together to obtain a total concentration, and the total concentration used for comparison to the criteria. (R 299.5750 footnotes (J) and (T)). Laboratories should report data below the reporting limits and above the method detection limits when possible, coded to indicate estimates.
41. When attempts are not successful to match the patterns of the Aroclor products with the pattern found in a sample, laboratories should report Aroclor (unspecified), (CAS 1267792). The concentration should be determined by quantitation with an aroclor with the most similar pattern to that in the sample.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

42. The concentrations of polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based on their relative potency must be added together Those isomers with non-zero TEF are provided in the table below. The toxicity equivalency of a specific dioxin, furan or PCB in a sample is calculated by multiplying its concentration by its respective TEF. The toxicity equivalencies must be added together to obtain a total toxic equivalency (TEQ) and the TEQ compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin. (R 299.5750 footnote (O)).

TOXICITY EQUIVALENT FACTORS FOR CHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

COMPOUND	TEF	COMPOUND	TEF
2,3,7,8-TCDD	**1.0**	**2,3,4,7,8-PeCDF**	**0.5**
1,2,3,7,8-PeCDD	**1.0 (0.5)***	**1,2,3,4,7,8-HxCDF**	**0.1**
1,2,3,4,7,8-HxCDD	**0.1**	**1,2,3,6,7,8-HxCDF**	**0.1**
1,2,3,6,7,8-HxCDD	**0.1**	**1,2,3,7,8,9-HxCDF**	**0.1**
1,2,3,7,8,9-HxCDD	**0.1**	**2,3,4,6,7,8-HxCDF**	**0.1**
1,2,3,4,6,7,8-HpCDD	**0.01**	**1,2,3,4,6,7,8-HxCDF**	**0.01**
1,2,3,4,6,7,8,9-OCDD	**0.0001 (0.001)***	**1,2,3,4,7,8,9-HxCDF**	**0.01**
2,3,7,8-TCDF	**0.1**	**1,2,3,4,6,7,8,9-OCDD**	**0.0001 (0.001)***
1,2,3,7,8-PeCDF	**0.05**		

* For comparing groundwater samples to GSI criteria, use the TEF in parentheses. (R 323.1209).

43. Bulk sampling requirements as designated by the laboratory chosen for the analysis must be used. Laboratories certified by various state and federal agencies for asbestos analysis should be used. MDEQ approved methods must be used. One procedure approved is: Method Number ID-191 Matrix: Bulk, 29 CFR, Part 1915, Occupational Safety and Health Standards for Shipyard Employment, Subpart Z, Toxic and Hazardous Substances, 1915.1001 App K, Polarized light microscopy of Asbestos – Non Mandatory, U.S. Department of Labor, Occupational Safety and Health Administration. For samples with more than 1 percent asbestos content in soils, or above 7 MFL in waters, additional information of the asbestos types may be confirmed using Transmission Electron Microscopy. One method approved for use is: CFR, Part 763, Subpart E, Appendix A, Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Non Mandatory-and Mandatory Section to Determine Completion of Response Actions. For preparation of soils, see U.S. EPA, Region 1 – Office of Environmental Evaluation and Measurement, The Protocol for Screening Soil and Sediment Samples for Asbestos Content used by the U.S. EPA, Region 1 Laboratory.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

44. Organic carbon and total organic carbon are different descriptions for the same parameter being determined, organic carbon. The following are requirements in the sampling and analysis for organic carbon.
    a) Results for organic carbon may not be used to calculate organic matter concentrations without prior approval from the MDEQ.
    b) Results for organic matter may not be used to calculate organic carbon concentrations without prior approval from the MDEQ.
    c) Soil samples must be representative of the soils at sites, from about six inches below the surface down to the mean annual depth of the water table, and representative of the soils based on heterogeneity.
    d) Soil vegetation should not be included with the soil samples as organic carbon results must represent that in the natural soil.
    e) Soil samples should not be taken from areas significantly impacted by contamination.
45. Method 415.3, "Determination of Total Organic Carbon and Specific UV Absorbance at 254 nm in Source Water and Drinking Water", Revision 1.0, June 2003, U.S. EPA, Office of Research and Development, U.S. EPA, Cincinnati, OH 45268, or an equivalent method, is recommended. Other methods can be used upon approval by the MDEQ and equivalency to the analysis and quality control as provided in method 415.3 will be the basis by which other methods are evaluated.
46. Walkley-Black methods measure the organic carbon in soils that is easily oxidized after removal of inorganic forms of carbon by acidification and heating. These methods are most appropriate for soils with less than 2 percent organic matter, and should not be used for soils with more than 6 percent organic matter.
47. Total organic carbon (TOC) methods generally refer to those methods that measure the organic carbon by ignition at high temperatures. See method 415.3 for guidance for waters. For soils, the following are minimum sampling and analysis requirements for these methods. Prior approval must be obtained from the MDEQ to use specific methods. Approval to use proposed methods will be based on a review for adequate quality control and application based on site specific factors.
    a) Instrument systems must be used that are capable of quantitatively determining organic carbon in the presence of inorganic forms of carbon, such as carbonate and bicarbonate.
    b) Methods must demonstrate capability to remove inorganic forms prior to measurements for organic carbon.
    c) Strong acids must be used to remove inorganic forms of carbon. Persulfate and hydrochloric acids are recommended.
    d) Methods that use a mixture of water and soil, and/or use methods designed for waters and/or wastes, are unacceptable.
    e) Methods that determine organic carbon by subtracting inorganic carbon measurements from total carbon measurements are unacceptable.
    f) Organic carbon must be reported as a percentage of the dry weight of the unacidified samples to the nearest 0.1% unit.
    g) TOC methods are most appropriate for soils with greater the 6 percent organic matter.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

48. Soil bulk density is defined as the ratio of the mass of dry solids to the bulk volume of the soil occupied by those dry solids. The bulk volume includes the volume occupied by the soil solids and the pore spaces. The dry solids must be determined by drying the soil to constant mass in an oven at 105 ± 5 degrees centigrade. ASTM 1994, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method, D2937-94, is the designated method for analysis of soil bulk density. Other ASTM methods may be acceptable when approved by the MDEQ and applied to the appropriate soils types, as provided in the individual methods.

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency – Office of Solid Waste & Emergency Response, Edition 3 (SW-846) (http://www.epa.gov/epaoswer/hazwaste/test/8_series.htm)

Method	Title
3060A	Alkaline Digestion for Hexavalent Chromium
3550	Ultrasonic Extraction
5021A	Volatile Organic Compounds in Various Sample Matrices using Equilibrium Headspace Analysis
5035A	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
6000	SW-846 Manual, Chapter 3 and 6000 Series Methods
6200	Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment
7000	SW-846 Manual, Chapter 3 and 7000 Series methods
7196A	Chromium, Hexavalent (Colorimetric)
7199	Chromium, Hexavalent by Ion Chromatography
7473	Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry
7474	Mercury in Sediment and Tissue Samples by Atomic Fluorescence Spectrometry
7580	White Phosphorus by Solvent Extraction and Gas Chromatography
8011	1,2-Dibromoethane and 1,2-Dibromo-3-chloropropane by Microextraction and Gas Chromatography
8015C	Non-halogenated Organics Using GC/FID
8021B	Halogenated and Aromatic Volatiles by Gas Chromatography using Electrolytic Conductivity and Photoionization Detectors in Series: Capillary Column Technique
8031	Acrylonitrile by Gas Chromatography
8032A	Acrylamide by Gas Chromatography
8033	Method 8033, Acetonitrile by Gas Chromatography with Nitrogen-Phosphorus Detection
8041A	Phenols by Gas Chromatography
8061A	Phthalate Esters by Capillary Gas Chromatography With Electron Capture Detector (GC/ECD)
8081B	Organochlorine Pesticides and PCBs as Aroclors by GC Capillary Column Technique
8082A	Polychlorinated Biphenyls (PCBs) by Gas Chromatography
8121	Chlorinated Hydrocarbons by Gas Chromatography: Capillary Column Technique
8131	Aniline and Selected Derivatives by Gas Chromatography
8141B	Organophosphorus Pesticides by Gas Chromatography: Capillary Column Technique
8151A	Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation, Derivation: Capillary Column Technique
8260B	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique
8261	Volatile Organic Compounds by Vacuum Distillation in Combination with Gas Chromatography/Mass Spectrometry (VD/GC/MS)

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency – Office of Solid Waste & Emergency Response, Edition 3 (SW-846)

Method	Title
8270C	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, (GC/MS): Capillary Column Technique
8270C Ion Trap	This reference is simply to point out that the Method 8270C above allows the use of the ion trap technology and may be needed to reach low detection limits.
8270C SIM	This reference is simply to point out that the selective ion procedure can be used in Method 8270C above and may be needed to reach low detection limits.
8290A	Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans, (PCDFs) by High-Resolution Gas Chromatograph/ High-Resolution Mass Spectrometry (HRGC/HRMS)
8310	Polynuclear Aromatic Hydrocarbons (GC/HPLC and UV or fluorescence detectors)
8315A	Determination of Carbonyl Compounds by HPLC
8316	Acrylamide, Acrylonitrile and Acrolein by High Performance Liquid Chromatography (HPLC)
8318A	N-Methylcarbamates by HPLC
8321B	Solvent Extractable Nonvolatile Compounds by HPLC/MS or UV Detection
8325	Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Particle Beam/Mass Spectrometry (HPLC/PB/MS)
8330A	Nitroaromatics and Nitramines by HPLC
8430	Analysis of Bis(2-chloroethyl) Ether and Hydrolysis Products by Direct Aqueous Injection GC/FT-IR (Gas Chromatography/Fourier Transform Infrared Spectrometer)
9010B	Total and Amenable Cyanide
9012	Total and Amenable Cyanide (Colorimetric, Automated UV)
9013	Cyanide Extraction Procedure for Solids and Oils
9014	Titrimetric and Manual Spectrometric Determinative Methods for Cyanide
9030	Acid-Soluble and Acid-Insoluble Sulfides
9034	Titrimetric Procedure for Acid-Soluble and Acid Insoluble Sulfides
9035	Sulfate (Colorimetric, Automated, Chloraniliate)
9036	Sulfate (Colorimetric, Automated, Methylthymol Blue, AA II)
9040C	pH Electrometric Measurement
9045C	Soil and Waste Ph
9056	Determination of Inorganic Anions by Ion Chromatography
9058	Determination of Perchlorate Using Ion Chromatography with Chemical Suppression Conductivity Detection
9070A	See Method 1664, Publication No.EPA-821-R-98-002
9071B	n-Hexane Extractable Material (HEM) for Sludge, Sediment, and Solid Samples
9212	Potentiometric Determination of Chloride in Aqueous Samples with Ion-Selective Electrode
9213	Potentiometric Determination of Cyanide in Aqueous Samples and Distillates with Ion-Selective Electrode
9214	Potentiometric Determination of Fluoride in Aqueous Samples with Ion-Selective Electrode

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency – Office of Solid Waste & Emergency Response, Edition 3 (SW-846)

Method	Title
9215	Potentiometric Determination of Sulfide in Aqueous Samples and Distillates with Ion-Selective Electrode
9250	Chloride (Colorimetric, Automated Ferricyanide AAI)
9251	Chloride (Colorimetric, Automated Ferricyanide AAII)
9253	Chloride (Titrimetric, Silver Nitrate)

Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, Georgia 30613

Method	Title
100.1	Analytical Method for Determination of Asbestos Fibers in Water

Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, Appendix A, Revised: July 1990

Method	Title
605	Benzidines

Methods for the Determination of Organic Compounds in Drinking Water & Supplement I, III, U.S. EPA, EMSL, Cincinnati, OH 45268, Edition: December 1988 and July 1990

Method	Title
502.2	Method 502.2, Volatile Organic Compounds In Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors In Series
504.1	1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-chloropropane (DBCP) in Water by Microextraction and Gas Chromatography
507	Determination of Nitrogen and Phosphorous-Containing Pesticides in Water by Gas Chromatography with a Nitrogen-Phosphorous Detector
515.1	Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector
515.2	Determination of Chlorinated Acids in Water using Liquid-Solid Extraction and Gas Chromatography with an Electron Capture Detector
515.3	Determination of Chlorinated Acids in Water using Liquid-Solid Extraction and Gas Chromatography with an Electron Capture Detector (Stand alone Method)
515.4	Method 515.4, Determination of Chlorinated Acids in Drinking Water by Liquid-Liquid Microextraction, Derivatization, and Fast Gas Chromatography with Electron Capture Detection, Revision 1.0, April 2000
524.2	Method 524.2, Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry
525.2	Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capilliary Column Gas Chromatography/Mass Spectrometry

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Methods for the Determination of Organic Compounds in Drinking Water & Supplement I, III, U.S. EPA, EMSL, Cincinnati, OH 45268, Edition: December 1988 and July 1990

Method	Title
531.1	Measurement of N-Methylcarbomoylzimes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post Column Derivatization, Revision 3.1
547	Determination of Glyphosate in Drinking Water by Direct-Aqueous-Injection HPLC, Post-Column Derivatization, and Fluorescence Detection
548	Determination of Endothall in Drinking Water by Aqueous Derivatization, Liquid Solid Extraction, and Gas Chromatography with Electron-Capture Detection
549	Determination of Diquat and Paraquat in Drinking Water by Liquid-Solid Extraction and HPLC with Ultraviolet Detection
551.1	Determination of Chlorination Disinfection Byproducts, Chlorinated Solvents, and Halogenated Pesticides/Herbicides in Drinking Water by Liquid-Liquid Extraction and Gas Chromatography with Electron Capture Detection

EPA:USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis and Classical Chemistry Parameters, Multi-Media, Multi-Concentration, ILM05.1, June 2001

Method	Title
CLP-CN	Exhibit D – Part D, Analytical Methods for Total Cyanide Analysis

U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology Engineering and Analysis Division (4303), 401 M Street SW, Washington, D.C.20460

Method	Title
Kelada-01	Kelada Automated Test Methods For Total Cyanide, Acid Dissociable Cyanide, And Thiocyanate, Revision 1.2
OIA-1677	Available Cyanide by Flow Injection, Ligand Exchange, and Amperometry, August 1999, EPA-821-R-99-013
200.2	Revision 2.8: Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements, October 1999, EPA-821-R-99-018
218.6	Revision 3.4, Determination Of Dissolved Hexavalent, Chromium In Drinking Water, Groundwater, and Industrial Wastewater Effluents by Ion Chromatography, October 1999, EPA-821-R-99-016
245.7	Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, Draft, January 2001, EPA-821-R-01-008
1636	Determination of Hexavalent Chromium by Ion Chromatography, January 1996

EPA:Volatile/Semivolatile Organic Compounds by Isotope Dilution GC/MS, USEPA Office of Water Regulations and Standards, Ind. Tech. Div., Edition: June 1989

Method	Title
1624	Volatile Organic Compounds by Isotope Dilution GC/MS

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology Engineering and Analysis Division (4303), 401 M Street SW, Washington, D.C.20460

Method	Title
1630	Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, August 1998
1631E	Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry
1631E (mod)	EPA-821-R-01-013, January 2001, Appendix to Method 1631 Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation
1669	Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels, July 1996

U.S. Environmental Protection Agency, Office of Water(4304T), 1200 Pennsylvania Avenue, NW, Washington, D.C. 20460

Method	Title
EPA-821-R-00-002	Method 1668, Revision A, Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS
EPA-821-R-02-012	Short Term Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, October 2002
EPA-821-R-02-013	Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition, October 2002.

Analytical Methods For the National Sludge Survey, US Environmental Protection Agency, Officer of Water (WH-585), Edition: September 1990

Method	Title
1613	Tetra-through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS, Rev B
1618	Organo-Halide Pesticides, Organo-Phosphorus Pesticides, and Phenoxy Acid Herbicides by Wide Bore Capillary Column Gas Chromatography with Selective Detectors

Methods for Chemical Analysis of Water and Wastes, USEPA, EMSL, Cincinnati.OH 45268

Method	Title
160.1	Residue, Filterable (Gravimetric, Dried at 180°C)
200.7	ICP-AES Method for Trace Element Analysis of Water and Wastes
200.8	Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry
300.1	The Determination of Inorganic Anions in Water by Ion Chromatography -
314	Method 314.0, Determination of Perchlorate in Drinking Water Using Ion Chromatography
325.1	Chloride (Colorimetric, Automated Ferricyanide, AAI)
325.2	Chloride (Colorimetric, Automated Ferricyanide, AAII)
340.1	Fluoride, Total
350.1	Nitrogen, Ammonia (Colorimetric, Automated Phenate)

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Methods for Chemical Analysis of Water and Wastes, USEPA, EMSL, Cincinnati.OH 45268

Method	Title
350.2	Nitrogen, Ammonia (Colorimetric; Titrimetric; Potentiometric – Distillation Procedure)
350.3	Nitrogen, Ammonia (Potentiometric, Ion Selective Electrode)
351.x	Kjeldahl Nitrogen
353.2	Nitrogen, Nitrate-Nitrite, Colorimetric, Automated, Cadmium Reduction
360.1	Oxygen, Dissolved, Membrane Electrode
360.2	Oxygen, Dissolved, Modified Winkler Full Bottle Technique
365.4	Phosphorous, Total (Colorimetric, Automated, Block Digester AA II)
375.1	Sulfate (Colorimetric, Automated, Chloranilate)
376.2	Sulfide (Colorimetric, Methylene Blue)
375.2	Sulfate (Colorimetric, Automated, Methylthymol Blue, AAII)
376.1	Sulfide, Titrimetric, Iodine

Standard Methods for the Examination of Water and Wastewater

Method	Title
SM6651	Glyphosate Herbicide
SM2340 B	Hardness by Calculation

Methods for the Determination of Nonconventional Pesticides in Municipal and Industrial Wastewater, USEPA Office of Water, Engineering and Analysis Division, WH-552, Edition: April 1992

Method	Title
1656	The Determination of Organo-Halide Pesticides in Municipal and Industrial Wastewater
608.1	The Determination of Organochlorine Pesticides in Municipal and Industrial Wastewater
608.2	The Determination of Certain Organochlorine Pesticides in Municipal and Industrial Wastewater
619	The Determination of Triazine Pesticides in Municipal and Industrial Wastewater
629	The Determination of Cyanazine in Municipal and Industrial Wastewater

Official Methods of Analysis, Association of Official Analytical Chemists, Edition: 15, 1990

Method	Title
983.01	Urea and Methyleneureas
957.18	Microdetermination of Phosphorus, Kjeldahl Digestion Method

Pharmaceutical Industry Pollutants, USEPA, Engineering and Analysis Division, EPA 821 B-94-001

Method	Title
1671	Volatile Organic Compounds Specific to the Pharmaceutical Manufacturing Industry By GC/FID

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Method

Walkley-Black Method

Instruments are available that utilize a form of the Walkley-Black digestion procedure. The following documents provide the original method and some modifications.

Walkley, A., and Black., 1934. An examination of the Degtijareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci.37:29-38

Walkley, A., 1947. A critical examination of a rapid method for determining organic carbon in soils: Effect of variations in digestion conditions and of inorganic soil constituents. Soil Sci.63:251-257

Jackson, M.L.1958.Soil Chemical Analysis.214-221.

Schollenberger, C.J.1927. A Rapid Approximate Method for Determining Soil Organic Matter. Soil Sci.24:65-68

USEPA Office of Research and Development, USEPA, Cincinnati, OH 45268

Method	Title
415.3	Determination of Total Organic Carbon and Specific UV Absorbance at 254 nm in Source Water and Drinking Water, Revision 1.0, June 2003

Methods of Soil Analysis

Keeney, D. R. and D. W. Nelson. 1987.
Nitrogen--Inorganic Forms, sec. 33-3, extraction of exchangeable ammonium, nitrate, and nitrite. pp.648-9. In A. L. Page et al., eds., **Methods of Soil Analysis: Part 2, Chemical and Microbiological Properties.** *Agronomy, A Series of Monographs*, no.9 pt.2, Soil Science Society of America, Madison, Wisconsin USA.

Modified Wisconsin Methods

Method	Title
Wisconsin Modified GRO	Method for Determining Gasoline Range Organics, Wisconsin DNR, September 1995, WDNR PUBL-SW-140
Wisconsin Modified DRO	Method for Determining Diesel Range Organics, Wisconsin DNR, September 1995, WDNR PUBL-SW-141

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency – Office of Solid Waste and Emergency Response, Edition 3

Method	Title
4030	Soil Screening for Petroleum Hydrocarbons by Immunoassay
4035	Soil Screening for Polynuclear Aromatic Hydrocarbons by Immunoassay

ASTM Standards, Americal Society of Testing Materials

Method	Title
D 5314-92	Standard Guide for Soil Gas Monitoring in the Vadose Zone

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Methane Procedures

Method	Title
RSKSOP-175	Standard Operating Procedure, Sample Preparation and Calculation for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibration Technique, R.S. Kerr Environmental Research Laboratory, USEPA,1994.
IsoTech Laboratories Method	Collection of Ground Water Samples for Dissolved Gas Analysis, Isotech Laboratories, Inc., 1308 Parkland Court, Champaign, IL 61821-1826, (217-398-3490)
Method 3C	40 Code of Federal Regulations, Part 60, Appendix A, Method 3C – Determination of carbon dioxide, methane, nitrogen, and oxygen from stationary sources

Pesticide Analytical Methods (PAM), I and II

Method	Title
ACR 75.6	Pesticide Analytical Manual, U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Third Edition, Revised 1999.
ACR 86.1	Pesticide Analytical Manual, U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Third Edition, Revised 1999.

TABLE 3. CONTAMINANTS ADDED TO TDLs AND DESIGNATED ANALYTICAL METHODS LIST

Note: Some parameters in this group may be in Table 1 also. They are included in the table below to indicate an addition as a group.

Contaminant Group	Contaminant	CAS/ID	WATER TDL ug/L	SOIL TDL ug/Kg
Specific Contaminants	*Acetate*	ACETATE	1,000	20,000
	Asbestos	1332214	7 MFL	1 %
	Dissolved Oxygen	DO	80	-----
	Formate	FORMATE	1,000	20,000
	Perchlorate	14797730	3	-----
	Petroleum Hydrocarbon Material	PET_HYD	5,000	250,000
	pH	pH	-----	-----
	Total Dissolved Solids	TDS	10,000	----
Nitrogen Forms	Kjeldahl-N	TKN	50	1,000
	Nitrogen, Total (elemental)	7727379	100	1,000
Metals	Chromium III	16065831	10	2,000
	Lead, Coarse Fraction	7439921	3	1,000
	Lead, Fine Fraction	7439921	3	1,000
Glycols	Triethylene Glycol	112276	4,000	50,000
Volatiles	Trihalomethanes (group)	THM	100	-----
	Tetranitromethane	509148	100	500
Oxygenates	*Di-isopropyl ether (DIPE)*	108203	5	250
	Ethyl(tert)butylether (ETBE)	637923	5	250
	Tertiaryamylmethylether (TAME)	994058	5	250
Carbamates	Linuron	330552	0.1	-----
	Oxamyl	23135220	10	100
Acid Herbicides	*Dacthal metabolites*	DACMET	1	-----
Chlorinated Pest.	Endosulfan (group)	115297	0.03	20
Organophosphorus	Disulfoton	198044	1	50
	EPTC (s-ethyl-diproplythiocarbamate)	759944	3	100
	Molinate	2212671	2	100
	Terbacil	5902512	20	-----
	Triphenylphosphate	115866	10	500
	Turbofos	13071799	20	-----
Specific Pesticides	Aminomethylphosphoric acid (AMPA-Glyphosate metabolite)	AMPA	100	10,000
	Clopyralid	1702176	1	20
	Fonofos	944229	10	-----
	Metribuzin	21087649	0.1	10
PCB AND PBB	Aroclor (unspecified)	1267792	0.2	330
Soil Bulk Density	Soil Bulk Density	SBD	-----	-----

TABLE 3. CONTAMINANTS ADDED TO TDLs AND DESIGNATED ANALYTICAL METHODS LIST

Note: Some parameters in this group may be in Table 1 also. They are included in the table below to indicate an addition as a group.

Contaminant Group	Contaminant	CAS/ID	WATER TDL ug/L	SOIL TDL ug/Kg
Explosives	2-Amino-4,6-dinitrotoluene (2-Am-DNT)	35572782	1	50
	4-Amino-2,6-dinitrotoluene (4-AM-DNT)	1946510	1	50
	3,5-Dinitroaniline (3,5-DNA)	618871	1	50
	1,3-Dinitrobenzene (1,3-DNB)	99650	1	50
	2,4-Dinitrotoluene (2,4-DNT)	121142	1	50
	2,6-Dinitrotoluene (2,6-DNT)	606202	1	50
	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	1	50
	Nitrobenzene (NB)	98953	5	50
	Nitroglycerine (NG)	55630	5	50
	2-Nitrotoluene (2-NT)	88722	5	50
	3-Nitrotoluene (3-NT)	99081	5	50
	4-Nitrotoluene (4-NT)	99990	5	50
	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691410	10	50
	Pentaerythritoltetranitrate (PETN)	78115	5	50
	1,3,5-Trinitrobenzene (1,3,5-TNB)	99354	1	50
	2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479458	1	50
	2,4,6-Trinitrotoluene (2,4,6-TNT)	118967	1	50

TABLE 4. CONTAMINANTS REMOVED FROM TDLs AND DESIGNATED METHODS LIST

Contaminant	CAS/ID
Epifluorohydrin	503093
Epibromohydrin	3132647

Contaminant	CAS/ID
Methane (soils-soil gas))	74828
1,2,3-Trichlorobenzene	87616

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

WATER				
CONTAMINANT	CAS/ID	New TDL ug/L	Previous TDL ug/L	RATIONALE
Specific Contaminants				
Acetic Acid	64197	[1,000]	18,000	GSI = 360
Formic Acid	64186	1,000	18,000	Formate TDL
Nitrogen Forms				
Ammonia-N	7664417	25	50	CALC GSI = 29
Metals				
Antimony	7440360	2	5	GSI DW = 2
Arsenic	7440382	5	20	DW PROPOSED = 10
Copper	7440508	4	5	CALC GSI = 4.1
Nickel	7440020	20	25	CALC GSI = 24
Vanadium	7440622	4	10	DWC = 4.5
DRO and GRO				
Diesel Range Organics	DRO	100	400	Consistency with
Gasoline Range Organics	GRO	200	400	previous guidelines for STD
Organics, Carbonyls				
Acetaldehyde	75070	100	500	GSI = 130
Dissolved Gases				
Methane	74828	500	500,000	Explosive Criteria = 520
Polynuclear Aromatics				
Benzo(ghi)perylene	191242	[1]	5	WS = 0.26
Benzo(b)fluoranthene	205992	1	2	WS = 1.5
Benzo(k)fluoranthene	207089	[1]	5	WS = 0.8
Benzo(a)pyrene	50328	[1]	2	GCC = 0.64
Chrysene	218019	1	5	WS = 1.6
Fluoranthene	206440	1	5	GSI = 1.6
Phenanthrene	85018	2	5	GSI =2.4
Semivolatiles				
Aniline	62533	4	20	GSI = 4
4-Chloroaniline	106478	10	20	Superfund QL = 10
Dibenzofuran	132649	4	5	GSI = 4
Hexachlorobutadiene (C-46)	87683	0.05	5	GSI = 0.053
1,2,4,5-Tetrachlorobenzene	95943	2	5	GSI = 2.9
Volatiles				
Tetrahydrofuran	109999	90	100	DWC = 95

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

WATER				
		New TDL	Previous TDL	
CONTAMINANT	CAS/ID	ug/L	ug/L	RATIONALE
Oxygenates				
t-butyl Alcohol	75650	50	800	Monitoring of oxygenates
Acid Herbicides				
Dinoseb	88857	[1]	5	GSI = 0.48
Chlorinated Pesticides				
Endosulfan I	959988	0.03	0.05	GSI = 0.03
Endosulfan II	33213659	0.03	0.05	GSI = 0.03
Polychlorinated biphenyls				
Aroclor 1232	11141165	0.2	0.4	Default to total PCB TDL

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

SOILS				
CONTAMINANT	CAS/ID	New TDL ug/kG	Previous TDL ug/kG	RATIONALE
Specific Contaminants				
Acetic Acid	64197	20,000	900,000	DW PC = 41,000
Formic Acid	64186	20,000	900,000	Acetate TDL
Cyanides				
Cyanide, Total	CN_TOTAL	100	200	GSI PC = 104
Cyanide, Available	CN_AVAIL	100	500	GSI PC = 104
Metals				
Antimony	7440360	**[300]**	500	GSI DW = 300
Mercury, Total	7439876	**[50]**	100	GSI = 0.026
Silver	7440224	**[100]**	500	GSI PC = 67
Acid Extractables (Phenols)				
2,4-Dinitrophenol	51285	830	1700	Superfund QL = 830
4-Chloro-3-methylphenol	59507	280	330	DW = 280
2-Methyl-4,6-dinitrophenol	534521	**[830]**	1700	DW PC = 400
3-Nitrophenol	554847	830	1700	Consistency
4-Nitrophenol	100027	830	1700	Superfund QL = 830
Semivolatiles				
Aniline	62533	330	1700	DW PC = 420
4-Chloroaniline	106478	330	1700	Superfund QL = 330
Hexachlorobutadiene (C-46)	87683	50	330	GSI PC = 91
2-Nitroaniline	88744	830	1700	Superfund QL = 830
3-Nitroaniline	9909	830	1700	Superfund QL = 830
4-Nitroaniline	100016	830	1700	Superfund QL = 830
Volatiles				
Benzyl Chloride	100447	150	200	DW PC = 154
1,4-Dioxane	123911	500	1000	DW PC = 680
Oxygenates				
t-butyl Alcohol	75650	2500	4400	Monitoring of oxygenates
Ethyl Alcohol	64175	2500	4400	Monitoring of oxygenates
Chlorinated Pesticides				
alpha-Hexachlorocyclohexane (BHC)	319846	10	20	DW PC = 18
Organophosphorus				
Atrazine	1912249	50	150	DW PC = 60
Cyanazine	21725462	200	500	DW PC = 200

Abbreviations Used in Table 5:

CALC GSI: Groundwater to surface water interface criterion that is based on a calculation.
Consistency: TDL was set at a level consistent with other contaminants of this type.
DW: Drinking water.
DWC: Drinking water criteria.
DW PC: Soil protective of drinking water criteria.
GCC: Groundwater direct contact criteria.
GSI: Groundwater to surface water interface.
PC: Protection criteria.
STD: Storage Tank Division.
Superfund QL: Quantitation limit established in the U.S. EPA Contract Laboratory Program.
WS: Water solubility criteria.

TABLE 6. TDLS GREATER THAN THE MOST RESTRICTIVE CRITERIA

CONTAMINANT	CAS/ID	WATER		SOIL	
		TDL	LOWEST HEALTH BASED CRITERIA	TDL	LOWEST HEALTH BASED CRITERIA
		ug/L	ug/L	ug/Kg	ug/Kg
Specific Contaminants					
Acetic Acid	64197	1,000	360		
Metals					
Beryllium	7440417	1 [1]	0.24		
Mercury, Total	7439976			50	1.2
Silver	7440224	0.2 [1]	0.06	100	27
Polynuclear Aromatics					
Benzo(k)fluoranthene	207089	1	0.8		
Benzo(ghi)perylene	191242	1	0.26		
Benzo(a)pyrene	50328	1	0.64		
Dibenzo(ah)anthracene	53703	2	0.21		
Indeno(1,2,3-cd)pyrene	193395	2	0.022		
Nitrosoamines					
N-Nitrosodi-n-propylamine	621647	5	0.19	330	100
Benzidines					
Benzidine	92875	0.3	0.0037	1000	6
3,3'-Dichlorobenzidine	91941	0.3	0.14	2000	28
Acid Extractables (Phenols)					
4-Chloro-3-methylphenol	59507			330	280
2,6-Dimethylphenol	576261			330	88
3,4-Dimethylphenol	95658			330	200
2-Methyl-4,6-dinitrophenol	534521	20	2.6	830	400
Semivolatiles					
Aniline	62533			330	80
Carbazole	86748	10	3.9		
Hexabromobenzene	87821	10	0.17		
Pentachlorobenzene	608935	5	0.019		
Pyridine	110861	20	7.3		
p-Toluidine	106490			660	300
Volatiles					
Acrylonitrile	107131			100	52
1,2-Dibromo-3-chloropropane	96128			10	4
Epichlorohydrin	106898	5	2		
Ethylene Dibromide	106934			20	1
Tetranitromethane	509148			500	51

TABLE 6. TDLS GREATER THAN THE MOST RESTRICTIVE CRITERIA

CONTAMINANT	CAS/ID	WATER		SOIL	
		TDL	LOWEST HEALTH BASED CRITERIA	TDL	LOWEST HEALTH BASED CRITERIA
		ug/L	ug/L	ug/Kg	ug/Kg
Carbamates					
Aldicarb Sulfone	1646884			200	40
Aldicarb Sulfoxide	1646873			200	80
Acid Herbicides					
Dinoseb	88857	1	0.48	200	43
Chlorinated Pesticides					
Aldrin	309002	0.01	8.7E-6		
Chlordane	57749	0.05	0.0025		
Chlorpyrifos, ethyl	2921882	0.2	0.002	10	1.5
4,4'-DDT	50293	0.02	0.00001		
Dieldrin	60571	0.02	6.5E-6		
Heptachlor	76448	0.01	0.0018		
Lindane (gamma BHC)	58899			20	0.99
Mirex	2385855	0.02	6.8E-6		
Toxaphene	8001352	1	0.000068		
tris(2,3-Dibromopropyl) phosphate	126727	10	0.71		
Organophosphorus					
Dichlorvos	62737			50	32
Polychlorinated Biphenyls					
Polychlorinated Biphenyls	1336363	0.2	0.000026		
Dioxins & Furans					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746016	1E-5	3.0E-9		
Asbestos					
Asbestos	1332214			1%	68,000

1. The calculated GSI may be below the TDL in Table 1.

TABLE 7. CONTAMINANTS WITH ESTABLISHED RISK-BASED CRITERIA WITHOUT TDLS AND DESIGNATED ANALYTICAL METHODS

CONTAMINANT	CAS NO
Acrylic acid	79107
Camphene	79925
1-Chloro-1,1-difluoroethane	75683
Diacetone alcohol	123422
Diethylene glycol monobutyl ether	112345
Diisopropylamine	108189
N,N-Dimethylacetamide	127195
N,N-Dimethylaniline	121697
Dimethylformamide	68122
Dimethylsulfoxide	67685
Diquat (soils)	85007
Endothall (soils)	145733
Ethyl Acetate	141786
Ethylene glycol monobutyl ether	111762
1-Formylpiperidine	2591868

CONTAMINANT	CAS NO
Gentian violet	548629
n-Heptane	142825
n-Hexane	110543
2-Methoxyethanol	109864
N-Methyl-morpholine	109024
Oxo-hexyl acetate	88230357
2-Pentene	109682
Phthalic Acid	88993
Phthalic Anhydride	85449
Piperidine	110894
Propionic Acid	79094
Propyl alcohol	71238
Tributylamine	102829
Triethanolamine	102716
2,2,4-Trimethyl-2-pentene	107404

CYANIDE
REMEDIATION AND REDEVELOPMENT DIVISION (RRD)
INFORMATION SHEET
October 22, 2004

Purpose: To provide background information relevant to the Part 201 criteria for cyanide and the analytical methods recommended for measuring cyanide in environmental samples.

Footnote (P): The footnote in the Part 201 criteria tables that refers to cyanide is Footnote (P). It reads as follows:

"Amenable cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with all groundwater criteria. Total cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with soil criteria. Industrial/commercial direct contact criteria may not be protective of the potential for release of hydrogen cyanide gas. Additional land or resource use restrictions may be necessary to protect for the acute inhalation concerns associated with hydrogen cyanide gas."

Cyanide Criteria: Cyanide is presented in the Part 201 rules with the Chemical Abstract Service Registry (CAS) Number of 57-12-5. This CAS number corresponds to the cyanide ion, commonly referred to as free cyanide. Cyanide can exist free in solution or combine with a variety of other chemicals to form cyanide compounds. The form of cyanide that actually causes toxicity is free cyanide. As a result, the basis for the Part 201 criteria is free cyanide and any compound containing cyanide that dissociates to release free cyanide under environmental conditions.

Forms of Cyanide:
Free Cyanide: Free cyanide is the most toxic component of the various cyanide forms. In water where free cyanide exists, it combines with hydrogen to form hydrogen cyanide (HCN) based on the availability of hydrogen ions or the pH of the solution. The cyanide ion is the predominant stable form of cyanide in water with a pH of 9.2. As the pH drops and more hydrogen ions become available, increasing amounts of HCN are formed. At a pH of 7.0, about 99.5 percent of the cyanide exists as HCN.

Metal-Cyanide Complexes: Almost all metals form cyanide complexes with varying degrees of stability. Those that are extremely stable and dissociate very little include

cyanide complexes of iron, cobalt, and gold. Those that readily dissociate include zinc and cadmium. Those that moderately dissociate include copper, nickel, mercury, and silver.

Metal-cyanide complexes in soil and water dissociate at varying rates. This breakdown releases free cyanide into the soil or water, generally at relatively low concentrations. The dissociation rates vary greatly and are affected by water temperature, pH, total dissolved solids, and metal-cyanide complex concentrations. Metal-cyanide complexes dissociate more rapidly in neutral or low pH environments.

The iron cyanides, the most common forms of cyanides in the environment, are highly stable and dissociate very little. Some will dissociate when exposed to various wavelengths of light, releasing cyanide ions. Common forms of iron-cyanide complexes are Prussian blue (ferric-ferrocyanide and containing 55 percent cyanide), Turnbull's blue (containing 53 percent cyanide), and Cyanide Yellow (containing 51 percent cyanide). Companies that use cyanides will treat their wastes with iron compounds to stabilize the cyanides as iron cyanides, thus reducing the risk to the environment and the public.

Analytical Methods: Operational Memorandum No. 2 (Op Memo #2) provides requirements for the analysis of cyanides. The term "Available Cyanide" in Op Memo #2 refers to those cyanide species that are measured by the following United States Environmental Protection Agency methods: Method 335.1 (Cyanide, Amenable to Chlorination), and Method OIA -1677 (Available Cyanide by Flow Injection, Ligand Exchange, and Amperometry). Available cyanide methods specified in Op Memo #2 measure free cyanide and those cyanide species that can readily or moderately dissociate under environmental conditions to release free cyanide. The term "Total Cyanide" in Op Memo #2 refers to all cyanide species measured using the following methods: 901013, 9012A, and Kelada-01 335.2. These methods include those species in the available cyanide category and those that dissociate very little such as the ironand cobalt-cyanide complexes.

Even though Rule 750, Footnote (P) states that the Amenable Cyanide Methods (i.e., Methods 901913 and 9012A, hereinafter "Amenable Methods") are methods that can be used to measure cyanide in groundwater, these methods have several problems. They are plagued with interferences, their detection capability is not sufficient to measure the most restrictive criterion, their accuracy is questionable, and sometimes false negative results are obtained. As a result of these issues, data produced from these methods should be carefully reviewed and where possible, compared to data from preferred analytical methods. Method OIA-1677 measures the same cyanide compounds as the Amenable Methods but is significantly more reliable. Method OIA-1677 is more economical, accurate, and precise. It has fewer interferences, a lower detection level, and completely measures some cyanide species that are not completely measured in the Amenable Methods. Method OIA-1677 is the method preferred by the RRD for measuring available cyanide.

Site Characterization and Data Interpretation: When measuring cyanide in water for comparison to the cyanide criteria, the Part 201 rules identify the Amenable Method or Method OIA-1677 as acceptable methods. However, as indicated above,

Method OIA-1677 is preferred due to its superior method performance. To measure cyanide in soil, either Method OIA-1677 or total cyanide methods must be used. It is appropriate to utilize Method OIA-1677 to measure cyanide levels in soil having total cyanide results that exceed applicable criteria.

Compliance with soil criteria is demonstrated when total cyanide results are below applicable criteria. If total cyanide results exceed applicable criteria, further analysis using an available cyanide method, preferably Method OIA-1677, can be performed. Noncompliance is demonstrated for both water and soil when results from the available cyanide methods are above the applicable criteria. The differences between the measurements provided by the total and available cyanide methods can be attributed to the stable forms of cyanides, mainly iron and cobalt cyanides.

SOIL FRACTION PREPARATION FOR LEAD ANALYSIS
(Creating Total, Fine and Coarse Soil Samples)

1.0 Applicable Analytical Methods

1.1 Not Applicable.

2.0 Matrix or Matrices

2.1 Soils.

3.0 Method Detection Limits (MDLs)

3.1 Not Applicable. Available MDLs included in analytical methods listed in Section 14.15.

4.0 Scope and Application

4.1 This method applies to soils collected by applicable Michigan Department of Environmental Quality (MDEQ) regulatory programs where lead exposure from soils are evaluated. Applicable regulatory programs are designated by MDEQ.

5.0 Method Summary

5.1 The sample preparation procedure consists of agitating and mixing, removing extraneous objects such as rocks and vegetation, weighing, oven drying, and sieving.

6.0 Definitions

6.1 Total Soil Fraction – A dried sample that will pass through a 2 millimeter (10 mesh) sieve.

6.2 Fine Soil Fraction – The portion of the total soil fraction that will pass through a 250 micron (60 mesh) sieve.

6.3 Coarse Soil Fraction – The portion of the total soil fraction that will not pass through a 250 micron (60 mesh) sieve.

6.4 Laboratory Control Sample (LCS) – Spiked reagent water at a level equivalent to 400 mg/Kg of lead in the soil, used to evaluate method performance.

6.5 Reference Sample – Standard reference material (SRM) processed as samples that are used to assess the accuracy and precision of the procedure. Depending upon the regulatory program and type of site, specific SRMs may be designated by different MDEQ programs. The MDEQ Laboratory will specify applicable reference samples when they are not designated by the applicable MDEQ regulatory programs responsible for collecting the samples. Contact the appropriate regulatory program under which the samples are taken, or the MDEQ Laboratory for information regarding designated reference samples. See Attachment 1 – Designated Reference Samples for current SRMs designated by applicable MDEQ programs and the MDEQ Laboratory for this method.

7.0 Interferences

7.1 In sample preparation, contamination is of prime concern. The work area, including bench top and fume hood, should be cleaned frequently in order to eliminate environmental contamination.

8.0 Safety

8.1 Safety glasses and shoes that cover the feet are required in all designated laboratory areas.

8.2 It is recommended that the analyst wear gloves and a lab coat when performing this procedure.

8.3 The analyst must be familiar with the Laboratory Chemical Hygiene Plan.

8.4 The analyst must be familiar with the Laboratory Safety Policy (internal procedure SOP 100).

8.5 The analyst must be familiar with any material safety data sheets (MSDSs) applicable to this method.

8.6 The analyst must be familiar with the location of safety equipment including showers, eye wash stations, and spill kits.

8.7 The analyst should thoroughly wash hands in warm soapy water when leaving the work area and before handling food or drink.

8.8 The analyst should assume that all samples have the potential to be hazardous and should exercise caution when transporting, handling, and/or opening any samples.

8.9 General good laboratory practices are required. The analyst should take all necessary precautions in order to minimize the potential of exposure to samples and reagents used in this method.

9.0 Equipment and Supplies

9.1 Analytical balance – capable of weighing to 0.1 mg.

9.2 Aluminum weighing boats or ceramic dishes.

9.3 Oven – capable of maintaining ±2°C.

9.4 Desiccator

9.5 2 mm (10 mesh) stainless steel or plastic sieve.

9.6 250 micron (60 mesh) stainless steel or plastic sieve.

9.7 Mechanical shaking device.

9.8 Plastic vials with snap lids.

9.9 Mortar and pestle, glass or ceramic.

10.0 Reagents and Standards

10.1 All purchased reference samples must be traceable to the stock inventory tracking log.

10.2 All purchased reference samples must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. Original certificates are maintained by the Laboratory's Quality Assurance/Quality Control Officer.

10.4 Refer to the appropriate analytical method for the preparation of standard stock solutions, calibration standards, and quality control solutions.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Solid samples are collected in 250 mL glass jars with aluminum or teflon lined screw caps. The proper bottle code for the MDEQ laboratory is MS.

11.2 Solid samples are stored at 4°C. No chemical preservation is necessary.

11.3 The recommended maximum holding time for solid samples is six months.

12.0 Quality Control

12.1 Reference Sample – A reference sample must be analyzed and results reported with each batch of samples. See Attachment 1 – Designated Reference Sample for current SRM designated by applicable MDEQ programs and the MDEQ Laboratory.

12.2 Twenty percent of soil samples will be designated as laboratory prepared duplicate samples. If the sample has been designated as a laboratory duplicate sample, the sample will be split into equal aliquots after sieving.

12.3 LCS – An LCS using lead spiked into reagent water must be analyzed and reported for each batch of samples. The LCS must contain a lead concentration equivalent to 400 mg/Kg of lead in the soil samples.

12.4 Refer to appropriate analytical method for further quality control requirements.

13.0 Calibration and Standardization

13.1 Balance calibration.

13.1.1 Level the balance by adjusting the left and right screw feet. The bubble should appear in the center of the circle when properly leveled.

13.1.2 Allow the balance to warm up for a minimum of 60 minutes.

13.1.3 Hold the "menu bar" down until the screen reads "CAL." Release.

13.1.4 The screen will advance to flashing "0.0000 g."

13.1.5 Place the 50 g weight on the balance. Close the draft shield.

13.1.6 The screen will advance to flashing "50.0000 g."

13.1.7 Remove the 50 g weight from the balance. Close the draft shield.

13.1.8 Ensure that the balance returns to "0.0000 g."

13.1.9 Check and record in the balance logbook the 1 g, 2 g, 5 g, 10 g, 20 g, and 50 g weights. The weights must be within ±0.0003 g with the exception of the 50 g weight, which must be within ±0.0005 g. If they do not meet this criteria, the balance must be recalibrated. If the calibration cannot be successfully performed, the service technician should be contacted for repair, calibration, and certification.

13.1.10 The balance is professionally tested and certified on an annual basis or before if necessary.

13.2 Daily Calibration Check

13.2.1 Level the balance by adjusting the left and right screw feet. The bubble should appear in the center of the circle when properly leveled.

13.2.2 Tare the balance and ensure that it reads 0.0000 g.

13.2.3 Check the calibration with the 50 g weight (±0.0005g). If this criterion is not met, recalibrate the balance (Section 13.1) and recheck the 50 g weight. Record in the balance logbook.

13.2.4 Each day, the analyst should check and record in the balance logbook the 1 g, 2 g, 5 g, 10 g, 20 g, and 50 g weights. The weights must be within ±0.0003 g with the exception of the 50 g weight, which must be within ±0.0005 g.

13.3 Analytical calibration

13.3.1 Follow instructions given in the analytical method selected.

14.0 Procedure

14.1 Remove all rocks and vegetation from the soil.

14.2 Mix the sample thoroughly to achieve homogeneity and sieve using a 2 mm (10 mesh) sieve.

14.3 Manually agitate the sample contents to mix the soil (i.e., breakup large soil clumps, etc.) using a pre-cleaned, ceramic spatula until the mixture appears homogeneous.

14.4 Label and weigh aluminum weighing boats or ceramic dishes; record weight.

14.5 Mix the sample and transfer a portion (>20 g) of the sample into a clean, labeled and weighed aluminum weighing boat or ceramic dish. (For samples with <35% moisture a 20 g portion is sufficient. For samples with moisture >35% a larger aliquot, 50 - 100 g, is required.)

14.6 Weigh the aluminum weighing boat or ceramic dish containing sample; record weight.

14.7 Dry the sample in an oven at a temperature of 105°C, ±2°C for 24 hours, ±2 hours.

14.8 Remove the samples from the oven and immediately place in a desiccator. The sample must be kept in the desiccator for at least one hour to cool.

14.9 Weigh the aluminum weighing boat or ceramic dish containing dried sample; record weight.

14.10 Sieve the soil through a 250 micron (60 mesh) sieve for 10 minutes using a mechanical shaking device. **Do not grind samples prior to sieving**.

14.11 Weigh the sieved soil and record this weight. Place the sieved portion into a mortar and grind with a ceramic pestle; place the ground sample into a separate plastic vial

and label as the Fine Soil Fraction and sample identification. (The sieve, mortar and pestle should be cleaned between samples.)

14.12 Weigh the soil that did **not** pass through the sieve and record this weight. Place the portion that did **not** pass through the sieve into a mortar and grind with a ceramic pestle; place the ground sample into a separate plastic vial and label as the Coarse Soil Fraction and sample identification. (The sieve, mortar, and pestle should be cleaned between samples.)

14.13 Twenty percent of soil samples will be designated as laboratory prepared duplicate samples. If the sample has been designated as a laboratory duplicate sample, the sample will be split into equal aliquots after sieving.

14.14 Samples are now ready for digestion using EPA SW-846 Method 3050B on one gram of sample (±0.01 gram).

14.15 Analyze samples using appropriate procedures as may be designated by the regulatory program under which the samples are taken. Analysis by inductively coupled plasma emission spectroscopy (ICP), EPA SW-846 Method 6010 or atomic absorption is recommended.

14.16 LCS – An LCS using lead spiked into reagent water must be analyzed and reported for each batch of samples. The LCS must contain a lead concentration equivalent to 400 mg/Kg of lead in the soil samples.

15.0 Calculations

15.1 Calculate the percent total solids in the soil.

$$\% \text{ Total Solids (S)} = \frac{DW}{WW} \times 100$$

Where:

DW = Sample weight (g) dried at 105°C
WW = Sample weight (g) before drying

15.2 Calculate analytical results to three figures, regardless of the actual significance of the figures. Do not correct results for blanks. Calculations are further discussed in analytical methods listed in Section 14.15.

15.3 Analytical results for lead are based on dry weight (mg/Kg dry).

15.4 Calculate the concentration of total lead in the soil using the concentrations of lead in the fine and coarse fractions multiplied by their respective weights and divided by the total weight of those fractions.

Total Lead = $[(A \times W_f) + (B \times W_c)] / (W_f + W_c)$

Where:

A = Concentration of Lead (mg/Kg dry) in fine fraction
B = Concentration of Lead (mg/Kg dry) in coarse fraction
W_f = Total weight of fine fraction
W_c = Total weight of coarse fraction

Note: Fine and coarse fractions are required to be tested for lead concentrations where lead exposures from soils are evaluated for MDEQ regulatory programs. Testing the total sample and subtracting one of the fractions to find the other is not acceptable.

16.0 Method Performance

16.1 Not applicable. Available data included in analytical methods listed in Section 14.15.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Whenever feasible, staff should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

17.3 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Report all results to three figures, regardless of the actual significance of the figures. Do not correct results for blanks.

18.2 Report the calculated total lead concentration as "Lead, Total (calculated)," the lead concentration analyzed in the fine fraction as "Lead, Fine Fraction," and the lead concentration analyzed in the coarse fraction as "Lead, Coarse Fraction."

18.3 Report all results based on dry weight.

18.4 Report the percent total solids in the soil.

18.5 Further assessment is included in analytical methods listed in Section 14.15.

19.0 Corrective Actions

19.1 Preventative maintenance is performed on a routine basis. A maintenance logbook is kept with the analytical balance.

19.2 Analytical methods listed in Section 14.15 include additional corrective actions.

20.0 Waste Management

20.1 Generated waste and samples can be thrown out with the trash if they do not contain identified hazardous material (i.e., samples from an industrial site, etc.) that require handling and proper disposal as a hazardous waste.

20.2 Broken/waste glass is collected at the bench in a plastic pail until transferred to a collection barrel for proper disposal.

21.0 References

21.1 "Short Sheet: TRW Recommendations for Sampling and Analysis of Soil At Lead (Pb) Sites," Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, DC 20460, EPA #540-F-00-010, OSWER #9258.7-38, April 2000.

21.2 Issue Paper, "Response to Directive 13 of the State of Michigan's Childhood Lead Poisoning Prevention: A Call to Action," Toxics Steering Group Lead Subcommittee, Michigan Department of Environmental Quality, January 21, 2004.

22.0 Attachments

22.1 Attachment 1 – Designated Reference Sample

MDEQ SOP# 213 REVISION # 2

APPROVED BY _____ DATE 1/28/05
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 1/28/05
COMPLIANCE OFFICER

APPROVED BY _____ DATE 1/28/05
QA OFFICER

APPROVED BY Sandra K Gregg DATE 1-28-2005
UNIT MANAGER

APPROVED BY Vincent A. Bremer DATE 1-28-2005
ANALYST

Attachment 1

Current MDEQ Designated Reference Samples

1. All sites, those expected to have soils contaminated with lead bearing materials and those not expected to have soils contaminated with lead bearing materials, are required to use National Institute of Standards & Technology, Standard Reference Material, NIST SRM 2586 as the designated reference sample.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS – ATTACHMENT 2
SOIL LEACHING METHODS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-Based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Leachate:	Specific aqueous solutions are used to evaluate the risks due to hazardous substances in soils as a result of the leaching of the substances into surface waters, groundwater, and drinking waters. The term "leachate", as used in this guidance, refers to those solutions after the leaching process is completed.

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides specifications for designated methods to evaluate the capability of the soil to leach hazardous substances, for site assessment, site investigation and response activities under Part 201, Part 211, and Part 213. Designated methods include those specified in R 299.5722(3)(a) and alternate leaching methods identified in this document.

Generic cleanup criteria for groundwater and soil have been developed pursuant to Sections 20120a(1) and 21304a of NREPA (see RRD Operational Memorandum No. 1). These criteria are the risk-based values the department has determined to be protective of the public heath, safety, or welfare and the environment. To assure that soils do not pose a threat of aquifer contamination, the concentration of a hazardous substance in soil must be below that which produces a concentration in soil leachate that is equal to the most restrictive applicable groundwater criteria. Leach testing is not required to demonstrate compliance with applicable criteria if soil concentrations do not exceed the applicable generic criteria (see RRD Operational Memorandum No. 1, Residential and Commercial I Soil and Industrial and Commercial II, III, and IV Soil tables, Groundwater protection columns). If the leachate concentration generated by background soils, or the background groundwater concentration is greater than the generic criteria, the background concentration shall be used in place of the risk-based value as the cleanup criterion. Background soils and background groundwater concentrations must represent background conditions not impacted by a release at, or regionally proximate to, the facility. RRD Operational Memorandum No. 4 provides guidance on establishing background concentrations.

If concentrations exceed applicable generic criteria additional leach testing may be conducted to demonstrate compliance for soils. Leachable concentrations must be determined by a method that best represents in-situ conditions. Methods the MDEQ has designated as acceptable soil leachate methods are identified in R 299.5722(3)(a) as the toxicity characteristic leaching

procedure (TCLP), and the synthetic precipitation leaching procedure (SPLP). Further details concerning these procedures are provided in Table 1.

If contaminants in the soils have the potential to be characteristically hazardous, then TCLP testing must be conducted to determine the applicability of Part 111, Hazardous Waste Management, of NREPA (Part 111) and the associated administrative rules.

When soil leachate analysis methods are relied upon, analysis of samples of those soils must also be conducted, following an appropriate available method, to determine concentrations of contaminants in the soils prior to leaching. Soil sample analysis results must be provided with the leachate data. Soil sample collection and preservation specifications for volatiles analysis may require that different collection methods be used to obtain samples appropriate for both leachate and soil analyses. Additional guidance on sample collection and preservation specifications for volatiles is available in RRD Operational Memorandum No. 2, Attachment 6.

Soils which exceed the TCLP regulatory levels must be managed according to Part 111.

Questions regarding this document should be directed to Mr. A. Ralph Curtis at 517-373-8389, curtisar@michigan.gov.

The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division, Operational Memorandum 12, Alternate Soil Leaching Procedures, dated January 5, 1995.
- Storage Tank Division Operational Memorandum 14, Analytical Parameters and Methods, Sample Handling, and Preservation for Petroleum Releases, Table 3 Acceptable Soil Leaching Procedures for Evaluating the Mobility of Specific Contaminants in Soil, dated June 12, 1998.

APPENDAGE

Designated Soil Leaching Methods

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

DESIGNATED SOIL LEACHING METHODS

1. Toxicity Characteristic Leaching Procedure (TCLP) EPA Method 1311. Use buffered acetic acid solutions at pH 2.88 or 4.93 for leaching soils to determine the concentrations of metals, semi volatiles, pesticides, PCBs, and volatiles that can be leached. This method is not acceptable for leaching soils to determine the concentrations of cyanides, sulfides, and hexavalent chromium that can be leached.
2. Synthetic Precipitation Leaching Procedure (SPLP) EPA Method 1312. Use Extraction Fluid #1, H2SO4 & HNO3 solutions at pH 4.20, for leaching soils to determine the concentrations of metals, semi volatiles, pesticides, and PCBs that can be leached. Use Extraction Fluid #3, reagent water, for leaching soils to determine the concentrations of cyanides, sulfides, volatiles, and hexavalent chromium that can be leached.
3. ASTM Neutral Leach Procedure, ASTM D3987-85. Use reagent water for leaching soils to determine the concentrations of semi volatiles, pesticides, PCBs, cyanide, sulfides, and hexavalent chromium that can be leached. This method is not acceptable for leaching soils to determine the concentrations of metals and volatiles that can be leached. This procedure provides for reporting the leachable contaminant levels in terms of the weight of the soil (mg/Kg). However, in order to use this soil leaching procedure for the purpose of evaluating contaminant mobility and potential impact on groundwater, leachable contaminant levels must be reported in terms of the volume of the leaching fluid, in ug/L units. This requirement must be conveyed to the lab prior to sample analysis.
4. ASTM D5233-92 ASTM Single Batch. Use buffered acetic acid solutions at pH 2.88 or 4.93, to leach soils and determine the concentrations of metals, semi volatiles, pesticides, and PCBs that can be leached. The method is not acceptable for leaching soils to determine the concentrations of volatiles, cyanides, sulfides, and hexavalent chromium that can be leached. The method is useful for large particle-sized materials. Any monolith subject to this method must also be evaluated with ASTM D4842-89 to evaluate freeze-thaw effects.

Soil Collection for Determining Volatiles Leachable to Groundwater.

To evaluate leaching of volatiles from soils, using the appropriate methods above, the MDEQ requires a specific sample collection and preservation procedure. A syringe-type coring device, documented to be effective for retaining the volatiles that are to be analyzed, is used to collect a 25 gm (±3 gm) soil sample. The sample must be weighed in the field by subtracting the device weight from the weight of the device with the soil. Exposing the soil to the environment to obtain the weight either in the field or in the laboratory to is not acceptable. The sample must be frozen immediately whenever feasible, otherwise the sample must be cooled to 4° C (± 2°), and transferred to the laboratory. The soil must be extruded from the syringe-type coring device directly into the leaching fluid within 48-hours of collection. After completion of the leaching procedure, an aliquot of leachate must be immediately collected and preserved as a volatile organic water sample. If large sample sizes are required, multiple coring devices should be used.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS – ATTACHMENT 3
INDOOR AIR DESIGNATED METHODS AND TARGET DETECTION LIMITS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Response Actions:	Includes "response activities" as defined by Part 201 and "corrective action" as defined by Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides guidance for Target Detection Limits (TDLs) and designated methods judged capable of achieving the TDLs for acceptable indoor air concentrations. Acceptable indoor air concentrations were generated as part of the calculation used to establish groundwater and soil volatilization to indoor air cleanup criteria. Representative indoor air sampling may be used to evaluate whether there is a current unacceptable exposure that requires mitigation for due care or interim response activities at a facility. Indoor air sampling is not appropriate for evaluating compliance with soil or groundwater cleanup criteria. This document must be used in coordination with the guidance on indoor air sampling provided in RRD Operational Memorandum No. 4.

This attachment establishes analytical target detection limits for hazardous substances and designates available analytical methods that are capable of achieving the target detection limits to facilitate gathering the information necessary for the department to determine compliance with the applicable provisions of Part 201, or Part 213.

TARGET DETECTION LIMITS AND AVAILABLE METHODS

Table 1 provides TDLs for hazardous substances with established acceptable indoor air concentrations. These TDLs were derived by reviewing the low-level capabilities of state laboratories and methods published by government agencies and referenced in this document. Laboratory reporting limits should be equal to or less than these reporting limits to evaluate indoor air exposure risks.

Analytical methods judged capable of achieving the TDLs are specified in Table 1. Other validated and published methods from nationally recognized organizations can also be used, provided the TDLs in Table 1 are met. Organizations that publish such methods include the American Society for Testing and Materials (ASTM), National Institute for Occupational Safety and Health, (NIOSH) and the U.S. EPA. Modifications of methods are acceptable if method performance documentation that demonstrates adequate performance is available and provided to the MDEQ.

The methods specified in this document were published in the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), by the Office of Research and Development of the U.S. EPA. The method titles are included with the source documentation listed in Table 1.

INDOOR AIR CONTAMINANT LIST

Indoor air sampling should not be evaluated without adequate site characterization to evaluate the soil and groundwater contaminants that exceed volatilization to indoor air cleanup criteria. All contaminants identified in the site characterization which exceed generic residential cleanup criteria are contaminants of concern. Table 1 does not include all contaminants that can be measured by the designated methods. When reporting analyses for indoor air, the laboratory should report the identified contaminants of concern and any additional contaminants that are routinely analyzed and reported to clients. Contaminants of concern and the capabilities of candidate laboratories must be reviewed when selecting a laboratory as a laboratory may or may not routinely analyze for all contaminants specified in Table 1.

RESULT REPORTING

The TDLs need to be achieved to evaluate whether there is a current unacceptable exposure that requires mitigation for due care or interim response activities at a facility. Levels below the TDL may be required to evaluate ambient air conditions within the immediate vicinity of the building. The laboratory's reporting levels for specific samples will be dependent upon the air volume collected. Careful planning is required during the sampling phase to ensure valid data is obtained for evaluation of both the indoor as well as ambient air if required.

Concentrations of contaminants in air are reported in units such as micrograms of contaminant per cubic meter of air and micrograms of contaminant per liter of air: Units of micrograms of contaminant per liter of air are equivalent to parts per billion of contaminant in the air on a volume basis, and are abbreviated as PPBV.

- Results must be appropriately coded to indicate the confidence of the data. Results with no codes are meant to be quantitative and within the accuracy and precision routinely achieved for the method.
- Results must be reported with the actual calculated reporting limit determined from the capabilities of the method and the volume of air used.
- Results for compounds detected below the laboratory reporting limits must be reported and coded to indicate estimated data.

Questions about this memorandum attachment should be directed to: A. Ralph Curtis, Laboratory Specialist, Remediation and Redevelopment Division, Toxicology Unit, Phone: 517-373-8389, FAX: 517-241-9581, Email: curtisar@michigan.gov.

APPENDAGE:

Table 1 – Target Detection Limits, Designated Analytical Methods, and Source Documents

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This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision

Table 1. Target Detection Limits, Designated Analytical Methods, and Source Documents

Polychlorinated Biphenyls	CAS	TDL (PPBV)	Designated Methods
Polychlorinated biphenyls (PCBs) [1]	1336363	0.02	TO-10A
Aroclor 1016	12674112	------	TO-10A
Aroclor 1221	11104282	------	TO-10A
Aroclor 1232	11141165	------	TO-10A
Aroclor 1242	53469219	------	TO-10A
Aroclor 1248	12672296	------	TO-10A
Aroclor 1254	11097691	------	TO-10A
Aroclor 1260	11096825	------	TO-10A
Aroclor 1262	37324235	------	TO-10A
Aroclor 1268	11100144	------	TO-10A
Pesticides			
Aldrin	309002	0.002	TO-10A
Chlordane [2]	57749	0.1	TO-10A
Chlordane, trans	5103719	0.04	TO-10A
Chlordane, cis	5103742	0.04	TO-10A
Chlorpyrifos, ethyl	2921882	1	TO-10A
Dieldrin	60571	0.003	TO-10A
Heptachlor	76448	0.01	TO-10A
Hexachlorobenzene	118741	0.03	TO-10A
Hexachlorocyclopentadiene	77474	0.01	TO-10A
alpha-Hexachlorocyclohexane	319846	0.007	TO-10A
Tris(2,3-dibromopropyl) phosphate	126727	0.02	TO-10A
Polycyclic Aromatic Hydrocarbons			
Acenaphthene	83329	100	TO-13
Acenaphthylene	208968	20	TO-13
Anthracene	120127	500	TO-13
Fluoranthene	206440	80	TO-13
Fluorene	86737	80	TO-13
Naphthalene	91203	2	TO-13
Phenanthrene	85018	0.05	TO-13
Pyrene	129000	50	TO-13
Mercury Vapor and Particulates			
Mercury, Total	7439976	0.2	Various [3]

Table 1. Target Detection Limits, Designated Analytical Methods, and Source Documents

Polar/Non-Polar Organic Compounds	CAS	TDL(PPBV)	Designated Methods
Acetone	67641	3000	TO-11A TO-17 TO-15A
Acetonitrile	75058	30	TO-15A TO-17
Acetophenone	98862	300	TO-15A
Acetaldehyde	75070	5	TO-11A TO-15A
Acrolein	107028	0.01	TO-15A TO-17
Acrylonitrile	107131	0.2	TO-15A TO-17
Azobenzene	103333	0.4	TO-13
Benzene	71432	1	TO-15A TO-17
Benzyl Chloride	100447	0.2	TO-15A TO-17
Bis(2-chloroethyl)ether	111444	0.04	TO-13 TO-15A TO-17
Bromobenzene	108861	4	TO-1
Bromodichloromethane	75274	0.3	TO-15A TO-17
Bromoform	75252	10	TO-15A TO-17
Bromomethane	74839	3	TO-15A TO-17
2-Butanone	78933	500	TO-15A TO-17
n-Butyl acetate	123864	4000	TO-17
t-Butyl alcohol	75650	1000	TO-17
Carbon disulfide	75150	400	TO-15A TO-17
Carbon tetrachloride	56235	0.5	TO-15A TO-17
Chlorobenzene	108907	40	TO-15A TO-17
Chloroethane	75003	5000	TO-15A TO-17
Chloroform	67663	5	TO-15A TO-17
Chloromethane	74873	20	TO-15A TO-17
2-Chlorotoluene	95498	40	TO-15A TO-17
Cyclohexanone	108941	500	TO-17
Decabromodiphenyl ether	1163195	20	TO-17
Dibromochloromethane	124481	0.5	TO-15A TO-17
1,2-Dibromo-3-chloropropane	96128	0.1	TO-15A TO-17
1,2-Dichlorobenzene	95501	800	TO-13 TO-15 TO-17
1,4-Dichlorobenzene	106467	2	TO-13 TO-15 TO-17
Dichlorodifluoromethane	75718	20,000	TO-15A TO-17
1,1-Dichloroethane	75343	300	TO-15A TO-17
1,2-Dichloroethane	107062	0.5	TO-15A TO-17
1,1-Dichloroethylene	75354	0.3	TO-15A TO-17
1,2-Dichloroethylene, cis	156592	20	TO-15A TO-17
1,2-Dichloroethylene, trans	156605	40	TO-15A TO-17

Table 1. Target Detection Limits, Designated Analytical Methods, and Source Documents

Polar/Non-Polar Organic Compounds	CAS	TDL(PPBV)	Designated Methods
1,2-Dichloropropane	78875	2	TO-15A TO-17
1,3-Dichloropropene	542756	3	TO-15A TO-17
Diethyl ether	60297	7000	TO-15A
Di-isopropyl ether	108203	200	TO-15A TO-17
Epichlorohydrin	106898	0.5	TO-15A TO-17
Ethylbenzene	100414	40	TO-15A TO-17
Ethylene dibromide	106934	0.06	TO-15A TO-17
Ethyl(tert)butylether	637923	200	TO-15A TO-17
Formaldehyde	50000	0.5	TO-11A TO-15A
Hexachloroethane	67721	2	TO-13 TO-15A TO-17
Hexachlorobutadiene	87683	0.5	TO-13 TO-15A TO-17
2-Hexanone	591786	20	TO-15A TO-17
Isobutyl alcohol	78831	800	TO-15A TO-17
Isopropylbenzene	98828	50	TO-15A TO-17
Methyl(tert)butylether	1634044	2000	TO-15A TO-17
Methyl alcohol	67561	2000	TO-15A TO-17
Methylene chloride	75092	30	TO-15A TO-17
4-Methyl-2-pentanone	108101	1000	TO-15A TO-17
Naphthalene	91203	2	TO-13 TO-17
Nitrobenzene	98953	0.4	TO-13 TO-15A TO-17
Pentane	109660	9000	TO-17
Pentachloronitrobenzene	82688	3	TO-17
Pyridine	110861	2	TO-17
Styrene	100425	20	TO-15A TO-17
Tertiaryamylmethylether	994058	30	TO-15A TO-17
1,1,2,2-Tetrachloroethane	79345	0.2	TO-15A TO-17
1,1,1,2-Tetrachloroethane	630206	2	TO-15A TO-17
Tetrachloroethylene	127184	20	TO-15A TO-17
Tetrahydrofuran	109999	3000	TO-1
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	40,000	TO-15A TO-17
1,2,4-Trichlorobenzene	120821	200	TO-13 TO-15A TO-17
1,1,1-Trichloroethane	71556	500	TO-15A TO-17
1,1,2-Trichloroethane	79005	0.8	TO-15A TO-17
Trichloroethylene	79016	7	TO-15A TO-17
Trichlorofluoromethane	75694	30,000	TO-15A TO-17

Table 1. Target Detection Limits, Designated Analytical Methods, and Source Documents

Polar/Non-Polar Organic Compounds	CAS	TDL(PPBV)	Designated Methods
1,2,4-Trimethylbenzene	95636	700	TO-15
1,3,5-Trimethylbenzene	108678	700	TO-15
Toluene	108883	200	TO-15A TO-17
Vinyl acetate	108054	100	TO-15A TO-17
Vinyl chloride	75014	3	TO-15A TO-17
Xylenes	1330207	2000	TO-15A TO-17

Footnotes:

1. The term Polychlorinated bipenyls (PCBs) refers to the total concentration of Aroclors found at the site. The Aroclors must be summed and reported as total PCBs. The Aroclors analyzed are listed without TDLs. The individual TDLs for these Aroclors must be sufficiently low that the reporting limit for PCBs can be met.
2. The concentrations of the trans and cis isomers must be summed and reported as Chlordane. Other procedures for summing concentrations of appropriate compounds may be used.
3. There are many instruments available to measure mercury vapor and particulates. Each instrument has instructions provided by the manufacturer. The appropriate method, or instructions for the use of the instrument, is dependent upon the specific instrument used.

Source Documents for Indoor Air Measurements

All of the following methods are from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Center for Environmental Research Information, Office of Research and Development, U.S. EPA, Cincinnati, OH 45268, January 1999 (http://www.epa.gov/ttn/amtic/files/ambient/airtox/tocomp99.pdf):

Method TO-10A: Determination of Pesticides and Polychlorinated Biphenyls in Ambient Using Low Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detection (GC/MD).

Method TO-11A: Determination of Formaldehyde in Ambient Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC).

Method TO-13A: Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).

Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by GC/MS.

Method TO-17: Determination of VOCs in Ambient Air Using Active Sampling on to Sorbent Tubes.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 4
SAMPLE PRESERVATION, SAMPLE HANDLING, AND HOLDING TIME SPECIFICATIONS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides sampling handling, preservation, and holding time specifications. This attachment applies to site assessments, site investigation and response activities under Part 201, Part 211, and Part 213.

SAMPLE CONTAINERS AND PRESERVATIVES

Containers and preservatives should be obtained from the laboratory performing the analysis whenever possible. When this is not possible, arrangements must be made with the selected laboratory to ensure the sample containers and preservatives to be used are appropriate. Preservatives must be provided with appropriate identification marks, safety information, instructions for use if necessary, and with expiration dates. The preservatives and expiration dates must be recorded into field logbooks as samples are collected so that each preserved sample is cross referenced with the added preservative(s).

The specific size, types of containers, and associated container codes used by the MDEQ laboratory are identified in Table 1. Preservatives normally used are listed in Table 2. Appropriate containers for each contaminant are specified with their respective bottle codes in Table 3.

Chemical preservatives should be used in their recommended dosages. If a little preservative is good, more is not necessarily better. Preservatives must be replaced at intervals specified by the manufacturer or laboratory and whenever contamination is suspected. Chemical preservatives should not be added to soil samples, except when specified in a sampling protocol, e.g., methanol preservation of soils analyzed for volatile organic compounds. Chemical preservatives should never be added to unknown or untreated liquid wastes and to samples of unknown matrix or source. Violent reactions can occur as acids are added to basic waste or conversely when bases are added to acidic waste. Adding acids to samples

containing high cyanide or sulfide levels could result in generation of dangerous quantities of cyanide or sulfide gas.

Sample preservation should be performed immediately upon sample collection or arrangements made with the laboratory to preserve samples within the specified time. For composite samples, when possible, each aliquot used to make the composite should be preserved at the time of collection. When use of an automated sampler prevents preservation of each aliquot, the aliquots should be maintained at about four degrees centigrade (4° C) until composite samples can be preserved.

If a sample reacts vigorously when preservatives are added, discard the sample and obtain a new sample without preservation. Label the sample appropriately to advise the laboratory that it is not preserved; record the behavior of the sample in the field logbook and on chain of custody or sample receipt forms so that it is appropriately communicated to the laboratory.

CONTAMINATION FROM SAMPLE CONTAINERS OR PRESERVATIVES

Documentation must be maintained by the laboratory to uniquely identify the source of the material used to make each preservative. The results of methanol blanks, trip, and field blank samples should be routinely reviewed for evidence of contamination from preservatives or sample containers. In the event preservative and sample containers cannot be ruled out as contamination sources, relevant information must immediately be provided to the laboratory, and suspect supplies not used until their suitability can be established. If the laboratory determines that preservative or sample containers are possible sources of contamination, the laboratory should then inform their clients as appropriate.

HOLDING TIMES

Samples should be processed and/or analyzed as soon as possible after collection. Table 3 specifies the maximum amount of time the sample and any sub-sample generated from the sample can be held. Samples not meeting these specifications must receive a holding time code or other data qualifier. Where more than one holding time is specified, all applicable holding times should be used to validate results. Samples may be held for longer periods only if the laboratory has data on file to show that the specific types of samples under study are stable for longer periods.

Sample collection and delivery to the laboratory must ensure holding times will not be exceeded. Laboratory sample schedules are contingent upon priorities of other samples and unforeseen events such as instrument malfunction. Schedules can change after samples have been delivered to the laboratory. To minimize the impact of schedule changes, it is important to provide instructions to the laboratory, before or during sample receipt at the laboratory, concerning actions to take when a schedule change affects the ability to meet holding times.

Results from samples analyzed past the holding times are not necessarily unusable. When holding times are exceeded, the usability of the data will depend on such factors as the relationship between sample levels and cleanup criteria, the type of decisions to be based on the data, the presence of other data from other samples, and other factors relative to whether the data establishes a reliable representative concentration of the hazardous substance. When holding times are exceeded, results should be interpreted as a minimum concentration.

VOLATILE CONTAMINANTS

Specifications for collecting soil samples using methanol preservation are provided in RRD Operational Memorandum No. 2, Attachment 6. The preservation of samples to be analyzed for volatile contaminants is dependent upon the requirements provided in SW-846, Method 5035A.

This method should be consulted for guidance. Table 3 below has the requirements taken from Method 5035A. Future revisions of Method 5035A may alter these requirements.

DE-CHLORINATION

Water samples existing naturally in the environment should not need de-chlorination. De-chlorination procedures may be required for some samples taken from water sources where chlorination is used. De-chlorination is accomplished using the instructions provided in Table 3, footnote number 4, under De-chlorinate. Specific procedures for methods and contaminants may apply and should be used when possible. Applicable contaminants for which de-chlorination procedures may be required are provided below.

- Acetonitrile
- Acrolein
- Acrylonitrile
- Acrylamide
- Benzidines
- Chlorinated Acids/Herbicides
- Chlorinated Pesticides
- 1,2-Dibromo-3-Chloropropane
- 1,2-Dibromoethane (EDB)
- Nitrosamines
- Organophosphorus Pesticides
- Phenolics
- Polychlorinated biphenyls
- 1,2,3-Trichloropropane
- Semivolatiles
- Volatiles

ANALYSIS OF GASOLINE OXYGENATES

High temperature purging during analysis of acid preserved samples can cause ethers to degrade which may result in underreporting of some ethers. When a sample is collected and preserved with acid for the analysis of volatiles that include gasoline oxygenate compounds, methyl(tert)butylether, t-Butyl alcohol, Di-isopropyl ether, Ethyl(tert)butylether, Ethyl alcohol, Methyl alcohol, and Tertiaryamylmethylether, the acid-preserved samples should be neutralized prior to analysis. Trisodium phosphate dodecahydrate (TSP) has been determined by the U.S. EPA to be effective and safe for this purpose. Separate samples may be collected specifically for the analysis of oxygenates, and preserved using TSP to adjust the pH to > 11 rather than preserving them with acid.

SAFETY

Be aware of dangers associated with chemical preservatives and their handling. Obtain Material Safety Data Sheets (MSDSs) from the laboratory providing the preservative prior to the sampling event to determine appropriate safety precautions and first aid. MSDSs should accompany personnel in the field. Preservatives must be stored in sealed containers away from other preservatives, and away from environmental and quality control samples. Use safety glasses and appropriate gloves to handle chemicals and properly place them into a closed chamber at the site until proper disposal can be arranged.

APPLICABILITY

Many published methods include specifications for sample containers, preservation, and holding times that may be specific for certain contaminants analyzed using the specific method. Those specifications may be more detailed than the specifications provided in Table 3 or in similar generic tables. When samples are collected for analysis by a method not specifically listed in Table 3, the method-specific requirements for sample containers, preservation, and holding times must be followed.

There are additional sources of holding time and preservation guidance, including the Clean Water Act, the Resource Conservation Recovery Act, the Safe Drinking Water Act, and the U.S. EPA CLP. The guidelines and specifications in this document are applicable to water and soil matrices and for contaminants regulated under Parts 201, 211, and 213. These guidelines and specifications may not be applicable to other matrices or to cleanups conducted under other regulatory programs. When samples are required to meet the criteria of another regulatory agency, the requirements for sample preservation, sample containers, and holding time of that agency should be applied.

Questions concerning this memorandum should be directed to Mr. A. Ralph Curtis, RRD, at 517-373-8389; or email to curtisar@michigan.gov.

The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division Operational Memorandum 16, Sample Preservation, Sample Handling, and Holding Time Guidelines for the Act 307 Program, dated January 4, 1995.
- Storage Tank Division Operational Memorandum 14, Analytical Parameters and Methods, Sample Handling, and Preservation for Petroleum Releases, Table 4, Container, Preservation, and Holding Time Requirements for Common Petroleum Product Sampling and Analysis, dated June 12, 1998.

APPENDED TABLES:
Table 1. Sample Containers and Container Codes
Table 2. Preservatives
Table 3. Specifications for Sample Containers, Preservation, and Holding Times

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This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

Table 1. Sample Containers and Container Codes

Container Code	Size ml	Bottle Type
DO	250	Glass, glass stopper
GN	500	Plastic
GA	500	Plastic
GG	250	Glass, screw cap
GB	500 250	Plastic Plastic
S	250	Plastic
MA	500	Plastic
MAD	500	Plastic
MD	500	Plastic
MN	500	Plastic
OG	250	Glass, wide mouth
VOA	40	Glass Septum vial
ON	1000	Glass, amber
Sealed Vial	Varies	Laboratory Specific

Container Code	Size ml	Bottle Type
BNA	1000	Glass, amber
MS	250	Glass, wide mouth
GS	250	Glass, wide mouth
OS/BNA	250	Glass, wide mouth
VOA	40	Glass, septum vial (soils require MeOH kit)
SCD	NA	Soil coring device [1,2]
MO	250	Glass, wide mouth
OL	250	Glass, wide mouth
HW	250	Glass, wide mouth
MX	250	Glass, wide mouth
OX	250	Glass septum jar
L	500	Fluoropolymer [1,3]
M	250	Glass or HDP[1]
HDP	125	High Density Polyethylene[1]

1. SCD, L, M and HDP are not MDEQ Lab bottle codes.
2. The syringe type coring device, SCD, refers to the samplers listed in Method 5035A, or other validated samplers.
3. Contact the lab regarding availability and cleaning instructions.

Table 2. Preservatives

The following table represents the preservatives normally used for sampling and the approximate amounts to meet a targeted preservation.

Preservative	Concentration	Preservation	Approximate Amount
Sulfuric Acid (H2SO4)	Conc.	pH < 2	5 drops per 250 ml.
Nitric Acid (HNO3)	1:1	pH < 2	5 ml per 250 ml.
Hydrochloric Acid (HCl)	1:1	pH < 2	5 drops per 40 ml.
Sodium Hydroxide (NaOH)	10 N	pH > 9	2 drops per 250 ml.
		pH > 12	10 drops per 250 ml.
Chloroacetic Acid	0.1 N	pH 4-5	Varies with sample
Trisodium phosphate dodecahydrat	Powder	pH> 10	Varies with sample

e (TSP)			
MeOH	Lab Grade	1:1	10 ml per 10 gr soil.
Ascorbic Acid	Powder	Oxidizing Agents	About 0.6 gr per L.
Sodium Arsenite	0.1 N	Oxidizing Agents	5 ml per L.
Zinc Acetate (ZnAc)	2 N	Interferences	10 drops per 250 ml.
Disodium EDTA	2.5 %	Interferences	1 ml per 100 ml.
Ethylenediamine	Powder	Interferences	50 mg per L.

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants [2]	Methods [3]	Container Codes [1]		Preservation [4]	Holding Time [5]
		Soil	Water		
Specific Contaminants					**Collection to Analysis**
Acidity	305.1		MN	4° C	14 Days
Alkalinity	310.1		MN	4° C	14 Days
Anions by Ion Chromatography	9056 300.1		MN	Contaminant Specific [6]	
Acetate			MN	4° C	2 Days
Formate			MN	4° C	2 Days
Bromide			MN	None Required	28 Days
Chloride			MN	None Required	28 Days
Fluoride			MN	None Required	28 Days
Nitrate or Nitrite-N			MN	4° C	48 Hours
Nitrate and Nitrite-N			MN	pH < 2 H2SO4, 4° C	28 Days
Ortho-Phosphate-P			MN	4° C	48 Hours
Sulfate			MN	4° C	28 Days
Bromate			MN	None Required	28 Days
Chlorate			MN	None Required	28 Days
Chlorite			BNA	50 mg Ethylenediamine per L. 4° C	14 Days
Asbestos	100.1		GN	4° C	48 Hours
Biochemical Oxygen Demand	405.1		GN	4° C	48 Hours [7]
Bromide	320.1	GS	MN	None Required	28 Days
Chemical Oxygen Demand	410		GA	pH < 2 H2SO4, 4° C	28 Days
Chloride	325	GS	MN	None Required	28 Days
Chlorine, Total Residual	330		GN	None Required	Immediately
Color	110		GN	4° C	48 Hours
Conductance, Specific	9050A	----	MN	4° C	28 Days
Fluoride	340.1	----	MN	None Required	28 Days
Hardness	130.2	----	MA	pH < 2 1:1 HNO3 / H2SO4, 4° C	6 Months
Hydrogen Ion, pH	9040, 9045	GS	MN	None Required	24 Hours

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants	Methods	Containers		Preservation	Holding Time
		Soil	Water		
Specific Contaminants					**Collection to Analysis**
Iodide	345.1	----	MN	4° C	28 Days
Odor	SM 2150B	----	GN	4° C	24 Hours
Total Organic Carbon (TOC)	415.1	----	GA	pH < 2 H2SO4 / HCl/NaHSO4, 4° C	28 Days
Fraction of Organic Carbon	Walkley-Black	GS	GN	4° C	28 Days
Fraction of Organic Matter	D2974	GS	GN	4° C	28 Days
Oxygen, Dissolved, Probe	360.1	----	DO	None Required	Immediately
Oxygen, Dissolved, Winkler	360.2	----	DO	Fix on site with DO Kit [10], avoid aeration, store at 10-20° C in dark.	8 Hours
Perchlorate	340.1 9058	GS	MN	None Required	28 Days
Petroleum Hydrocarbon Material[8]	1664 9071B	2xOG	2xOG	pH < 2 HCL, 4° C. For dry soils cool to 4° C. For pourable sediments and soils add 2 ml 1:1 HCl per 100g, 4° C	ASAP [9]
Phenolics	420.2	----	GG/GP	pH < 2 H2SO4, 4° C	28 Days
Phosphorus, Ortho, Dissolved	365	----	GN(D)	Filter on site immediately, 4° C	48 Hours
Phosphorus, Elemental		----	GA	4° C	48 Hours
Phosphorus, Total	365.4	----	GA	pH < 2 H2SO4, 4° C	28 Days
Residue, Total	160.3	----	GN	4° C	7 Days
Residue, Filterable (TDS)	160.1	----	GN	4° C	7 Days
Residue, Non-Filterable (TSS)	160.2	----	GN	4° C	7 Days
Residue, Settleable	160.5	----	GN	4° C	48 Hours
Residue, Volatile	160.4	----	GN	4° C	7 Days
Silica	370.1	----	GN	4° C	28 Days
Sulfate	375.1	----	MN	4° C	28 Days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants	Methods	Containers		Preservation	Holding Time
		Soil	Water		
Specific Contaminants					**Collection to Analysis**
Sulfide	9030 376.1		S	See Footnote 11	7 Days
		GS		Cover surface of collected soil with 2 M ZnAc until moistened. No headspace.	
Sulfite	377.1	----	HDP	Avoid contact with air, cool < 50° C and add 1 ml EDTA [12] per 100 ml., < 50° C	Immediately
Temperature	170.1	----	----	Not Applicable	On site
Total Recoverable Petroleum Hydrocarbons (TRPH)	8440 [13]	GS	----	4° C	ASAP [9]
Turbidity	180.1	----	GN	4° C	48 Hours
Biological Tests					
Coliform, Fecal and Total	9131 9132	----	M	4° C	8 Hours [14]
Fecal Streptococci	SM 9230	----	M	4° C	6 Hours
Cyanides					
Cyanide, Total	9010B	GS	----	See Footnote [15]	14 Days
				Unpreserved	24 Hours
Cyanide, Available	OIA1677	GS	GB	See Footnote [15]	14 Days
				Unpreserved	24 Hours
Cyanide, Amenable (Free)	D4298-02	----	GB	pH ≥ 12 NaOH, store in dark, 4° C	24 Hours to diffusion
Nitrogen Forms					
Ammonia – N	350.1	GS	GA	pH < 2 H_2SO_4, 4° C	28 Days
Kjeldahl – N	351.1	GS	GA	pH < 2 H_2SO_4, 4° C	28 Days
(Nitrate + Nitrite) – N	353.2	GS	GA	pH < 2 H_2SO_4, 4° C	28 Days
(Nitrate + Nitrite) – N	353.2	GS	GA	4° C	24 Hours
Nitrate – N or Nitrite – N	353.2	GS	GN	4° C	48 Hours

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants	Methods	Containers		Preservation	Holding Time	
		Soil	Water			
Mercury					**Collection to Analysis**	
Mercury, Total	7470 7471	MS	MA	pH < 2 1:1 HNO3 , 4° C	28 Days	
Mercury, Low Level	1669/1631	MS	L	10 ml 1:1 Hg-free HNO3 per L, 4° C	28 Days	
Hexavalent Chromium						
Chromium VI (waters)	7199	----	HDP	Use buffer solution [16] to adjust pH 9-9.5 (check with pH paper or pH meter) 4° C	24 Hours	
	7196	----	MN	4° C	24 Hours	
					Collection To Preparation	**Preparation To Analysis**
Chromium VI (soils)	3060A [17]	MS	----	4° C, Store field-moist.		
				Dry Soils:	2 Days	7 Days
				High moisture soils and sediments:	30 Days	7 Days
Low Molecular Weight Acids	5560 C	GS	GN	None Required	NA	NA
Glycols	8015C	GS	GN	None Required	NA	NA
Phosphorus, White [18]	7580	OX	VOA	Limit contact with air. No headspace, 4° C, store in dark. Tightly seal extracts and refrigerate.	5 Days	
				Extracts:		
				Ether Extract	----→	8 Hours
				Iso-Octane Extract	-----→	30 Days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants	Methods	Containers		Preservation	Holding Time	
		Soil	Water			
Metals					**Collection To Analysis**	
Metals, Totals	6010/6020	MS [19]	MA	pH < 2 1:1 HNO3, 4° C	6 Months	
Metals, Dissolved	6010/6020	----	MD MA(D)	Filter and preserve < 24 Hours of sampling. pH < 2 1:1 HNO3 , 4° C	6 Months	
Specific Organic Compounds						
Acetonitrile	8033	----	2 x VOA	pH < 2 H2SO4, 4° C	14 Days	
Acrolein	603 8316	----	2 x VOA	pH 4-5 HCl, 4° C	14 Days	
Acrolein	603	----	2 x VOA	4° C	3 Days	
Acrylonitrile	603	----	2 x VOA	4° C	14 Days	
Acrolein and Acrylonitrile	603	----	2 x VOA	pH 4-5 HCl, 4° C	14 Days	
Acrolein and Acrylonitrile	603	----	2 x VOA	4° C	3 Days	
Acrylamide	8032	----	2 x VOA	pH < 2 HCL/H2SO4, 4° C	14 Days	
Specific Organic Compounds					**Collection to Preparation**	**Preparation to Analysis**
Benzidines	605 8270C	OS BNA	BNA	Adjust pH 2-7 using H2SO4 and 10 N NaOH. If 1,2-dephenylhydrazine is expected to be present, adjust pH to 3.8-4.2 H2SO4 and 10 N NaOH 4° C, store extracts in inert atmosphere in dark	W: 7 days	7 days
Carbamates	8318	OS BNA	BNA	Cool, pH 4-5 using 0.1 N Chloroacetic Acid, 4° C, store sample and extracts in dark	W: 7 days S: 7 days	40 days 40 days
Carbonyls	8315A	OS BNA	BNA	4° C	W: 3 days S: 3 days	3 days 3 days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

		Containers				
Contaminants	**Methods**	**Soil**	**Water**	**Preservation**	**Holding Time**	
Specific Organic Compounds					**Collection To Preparation**	**Preparation To Analysis**
Chlorinated Acids/Herbicides	8151A	OS/B NA	BNA	4° C, store samples and extracts in dark	W: 7 Days S: 14 Days	40 Days 40 Days
Dioxins and Furans	8290 1613	OS/B NA	ON	4° C, store in the dark	30 Days	45 Days
1,2-Dibromoethane (EDB) 1,2-Dibromo-3-Chloropropane, 1,2,3-Trichloropropane	8011 504.1		VOA	4° C	W: 14 Days	Immediately
Nitrosamines	8270C	OS/B NA	BNA	pH 7-10 with H2SO4 and 10 N NaOH, store extracts in sealed vials, in dark at -10° C	W: 7 Days S: 14 Days	40 Days 40 Days
Chlorinated Pesticides [20]	8081A	OS/B NA	2 x ON See 23 [23]	pH 5-9 with H2SO4 and 10 N NaOH within 72 hours, 4°C, store extracts in dark.	W: 7 Days S: 14 Days	40 Days 40 Days
Organophosphorus Pesticides [21]	8141A	OS/B NA	ON	4° C Store samples and extracts in dark	W: 7 Days S: 14 Days	40 Days 40 Days
Polychlorinated biphenyls	8082	OS/B NA	2 x ON See 23 [23]	4° C Store extracts in dark	W: 7 Days S: 14 Days	40 Days 40 Days
Semivolatiles [22]	8270C	OS/B NA	2 x BNA See 23	Store extracts in sealed vials, in dark at -10° C	W: 7 Days S: 14 Days	40 Days 40 Days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Contaminants	Methods	Containers	Preservation	Holding Time
Volatiles (waters)				**Collection To Analysis**
Fuel Oxygenates	8260B	2 x VOA	no headspace, TSP to pH > 11, 4° C	180 Days
Reactive compounds [24]	8260B	2 x VOA	no headspace, 4° C	ASAP [9]
Other Compounds	8260B	2 x VOA	pH < 2 using 1:1 HCl or solid NaHSO4, no headspace, 4° C	14 Days
Volatiles (soils) [25]				
Reactive Compounds Examples include styrene, 2-Chloroethylvinylether	Low Concentration	Sealed Vial	Use reagent water (no acid preservative), freeze > -20° C , < -7° C on site	ASAP [9]
		SCD	4° C or freeze > -20° C , < -7° C on site, extruded into sealed vial without acid preservative within 48 hours	ASAP [9]
Volatile Compounds	Methanol	2 x VOA	Preserve on site using ratio 1:1 methanol to soil, 4° C	14 Days
Volatile Compounds	Methanol	SCD	4° C or freeze > -20° C , < -7° C on site and extruded into sealed vial with methanol within 48 hours	14 Days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Hazardous Waste Characterization Using Method 1312

Contaminants	Containers	Field Collection To TCLP Extraction	TCLP Extraction To Preparative Extraction	Preparative Extraction To Determinative Analysis	Total Elapsed Time
Volatiles	OX	14 Days	Not Applicable	14 Days	28 Days
Semivolatiles	MX	14 Days	7 Days	40 Days	61 Days
Mercury	MX	28 Days	Not Applicable	28 Days	56 Days
Metals	MX	180 Days	Not Applicable	180 Days	360 Days

Radiochemistry Contaminants

Radiochemistry Contaminant	Method	Containers Water	Preservation	Holding Time Collection To Analysis
Gross Alpha, and Gross Beta	9310	1 L HDP or Glass	pH to 2 1 N HNO3	6 Months
Alpha Emitting Radium Isotopes	9315	1 L HDP or Glass	pH to 2 1 N HNO3	6 Months
Radium 228	9320	1 L HDP or Glass	pH to 2 1 N HNO3	6 Months

Unpreserved samples for analysis of radiochemistry contaminants must be received at the laboratory within five days of collection.

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

Wisconsin GRO/DRO Guidelines

Contaminants Organic Compounds	Methods	Containers		Preservation [26]	Holding Times	
		Soil	Water		Collection To Preparation	Preparation To Analysis
Gasoline Range Organics	8015-Wis					
Waters:			3 x VOA	0.5 ml 1:1 HCl to sample bottle first, no headspace, avoid agitation, 4° C	14 Days	14 Days
Carbonate aquifer waters:			3 x VOA	Preserved with Sodium Azide [27]	14 Days	14 Days
Carbonate aquifer waters:			3 x VOA	Without Sodum Azide [27]	2 Days	14 Days
Soils:		VOA		Preserve in field with MeOH, 4° C	21 Days	21 Days
		SCD		4° C, preserve with MeOH < 48 Hours	21 Days	21 Days
Diesel Range Organics	8015-Wis					
Waters:			BNA [28]	5 ml 1:1 HCL to sample bottle first, no headspace, 4° C	7 Days	47 Days
Carbonate aquifer waters:			BNA [28]	Preserved with Sodium Azide [27]	7 Days	47 Days
Carbonate aquifer waters:			BNA [28]	Without Sodium Azide [27]	2 Days	47 Days
Soils:		VOA SCD		4° C, preserve with MeOH 1:1 < 72 hours	47 Days	47 Days

Table 3. Specifications for Sample Containers, Preservation, and Holding Times

For soils requiring leach tests to evaluate the mobility of non-volatile contaminants in soils [29]

Contaminants[31]	Methods	Containers	Preservations (sample and leachate)		Holding Times [30]			
			Sample	Leachate [32]	Collection To Leaching	Leaching To Preparation	Leaching To Analysis	Preparation To Analysis
Mercury	7470	MX	4° C	pH < 2 1:1 HNO3, 4° C	28 Days		28 Days	
Metals	6010B/6020	MX	4° C	pH < 2 1:1 HNO3, 4° C	180 Days		180 Days	
Semivolatiles	8270C	MX	4° C	4° C, Store extracts from the leachates in dark at -10 ° C	14 Days	7 Days		40 Days
Pesticides	8081A	MX	4° C	pH 5-9 10 N NaOH and H2SO4, 4° C	14 Days	7 Days		40 Days
PCBs	8082	MX	4° C	4° C, Store extracts from the leachate in dark	14 Days	7 Days		40 Days

For soils requiring leach tests to evaluate the mobility of volatile contaminants in soils

Contaminants	Methods	Containers	Preservations (sample and leachate)		Holding Times	
			Sample	Leachates	Collection To Leaching	Leaching To Analysis
Volatiles [33]	8260B	2 x SCD	< 4° C	pH < 2 1:1 HCl, 4° C	48 Hrs	14 Days

Table 3 Footnotes

1. The container sizes and types specific for the MDEQ Environmental Laboratory (MDEQ Lab) are listed in this table when applicable. Other laboratories may specify other sizes and types. Letters in parentheses () indicate that the included letter must be added to the prefix code on the bottle from the MDEQ Lab to indicate to the laboratory what process was used, if any, for preservation.
2. "Contaminants" refers to elements, individual compounds, groups of compounds, chemical or physical properties. Contaminant groups in Table 3 are underlined and are simply identified for convenience. These group names do not reflect any official or standardized groups used by other agencies. Italicized contaminant names indicates that the MDEQ Lab does not perform analysis for the contaminant.
3. Methods in the table are listed primarily to clarify the type of method routinely used for environmental samples and preservation used for associated contaminants. The methods listed are not the only methods acceptable. RRD Operational Memorandum No. 2, Attachment 1, TDLs and Available Methods lists the available analytical methods the MDEQ has determined capable of achieving theTDLs. When available methods are used, applicable sample preservation techniques within those methods must be used.
4. Abbreviations and terms used for preservation are as follows:

Abbreviation	Meaning	Abbreviation	Meaning
< - >	Less than - Greater than	HNO3	Nitric acid
M	Molar concentration	NaOH	Sodium hydroxide
N	Normal concentration	ZnAc	Zinc acetate
HCl	Hydrochloric acid	° C	Degrees centigrade
H2SO4	Sulfuric acid	In Situ	Measure in matrix
EDTA	Ethylenediamine,tetra,acetic acid		

ASAP – Make arrangements to deliver samples overnight and have laboratory analyze samples upon receipt.
Immediately - Transport samples to laboratory within 24 hours or overnight. Plans must be made in advance to have the laboratory analyze the samples upon receipt.
4° C – Store samples at about four degrees centigrade. Just above freezing up to six degrees C is acceptable. Ice is preferred to cool samples. If commercial ice packs are used, the bottom, walls, and top inside cover of the cooler must be lined with the packs so as to completely encapsulate the samples as much as possible. A temperature control sample should be included when blue ice packs are used.
De-chlorinate – Means that a portion of the sample should be separated and tested for residual chlorine. Diethyl-p-phenylenediamine (DPD) kits are commercially available to test for residual chlorine in the field. About 25 mg ascorbic acid powder per 40 ml sample, for each 5 mg/L of residual chlorine determined from the DPD kit, should be added to sample bottles testing positive that are to be used to analyze for volatile contaminants, prior to sampling. For non-volatile contaminants use 80 mg/L sodium thiosulfate per liter of sample for each 5 mg/L of residual chlorine found. If pH adjustment is necessary, perform pH adjustment after dechlorination. Do not mix dechlorination reagents with the preservatives used to adjust the pH. Treat the samples only if they contain free or combined chlorine. Most environmental samples are not chlorinated while tap water samples originating from a municipal water source usually are chlorinated.
pH – Indicates an estimated hydrogen ion measurement. Use only the specified chemicals to adjust pH. Do not add more than is needed to obtain the desired pH. If preservation using hydrochloric or sulfuric acids (HCl or H2SO4) is needed, two drops of 1:1 HCl, or H2SO4 for every 40 ml of sample, will lower the pH to less than two for most waters.

Table 3 Footnotes

5. "Holding Time" refers to the maximum time that a sample or sub-sample can be held before the next step in the analysis is performed. Samples may be held for other specified times if the laboratory has supporting data to demonstrate stability. Exceptions to times specified in the heading of this column are explained within the table for each applicable contaminant.
6. The method of preservation and the holding time for samples analyzed by this method are determined by the anions of interest. In a given sample, the anion that requires the most preservation treatment and the shortest holding time will determine the preservation treatment. Note: The addition of EDA has no effect on bromate or chlorate, so they can also be determined in a sample preserved with EDA. Residual chlorine dioxide should be removed from the sample. Any residual chlorine dioxide present in the sample will result in the formation of additional chlorite prior to analysis. If any concentration of chlorine dioxide is suspected in the sample, the sample must be purged with an inert gas (helium, argon, or nitrogen) for approximately five minutes or until no chlorine dioxide remains. This sparging must be conducted prior to ethylenediamine preservation and at time of sample collection.
7. Limit compositing to less than 24 hours and then follow grab sample guideline of 24 hours after collection.
8. Several methods are available to measure TPH. Results are method dependent.
9. No hold time has been established. Samples should be analyzed as soon as possible.
10. The MDEQ Lab DO kit uses solutions designated as DO-1 (Manganese Sulfate) and DO-2 (alkaline Iodide-Azide).
11. Prior to collection, add to sample bottle 8 drops 1 M ZnAc per 100 ml sample to be collected and enough 10 N NaOH expected to make pH > 9. Collect sample with minimum of aeration, add more NaOH as needed to increase pH > 9. Fill bottle without headspace. If the sulfide concentration is expected to exceed 64 mg/L, increase the amount of ZnAc proportionally.
12. Disodium EDTA. Prepare using 2.5 g per 100 ml distilled water.
13. Applicable to mineral oils. Not appropriate for analysis of soils for gasoline and other light petroleum fractions.
14. Under the Federal Safe Drinking Water Act guidance, a 30-hour holding time for coliform samples mailed from water treatment systems is acceptable. Water samples for coliform analysis should have 1-2 inches of headspace in the sample container.
15. Aqueous samples should be tested for sulfides, oxidizing agents, and soluble aldehydes within 15 minutes of sampling to determine and preserve as appropriate. Alternatively, all samples may be preserved with NaOH to a pH>12 and sent to the lab for analysis within 24 hours.

    A. Test for Oxidizing Agents

    Test a drop of the sample with potassium iodide-starch test paper. A blue color indicates the need for treatment.
    To samples testing positive add 0.1N Sodium Arsenite solution a few ml at a time until a drop of sample produces no color on the indicator paper. Add an additional 5 ml of Sodium Arsenite solution for each liter of sample.
    Ascorbic Acid can be used as an alternative although it is not as effective as Sodium Arsenite. Add a few crystals of Ascorbic Acid at a time until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of Ascorbic Acid for each liter of sample volume.

Table 3 Footnotes

B. Test for Sulfides (Note that samples are always treated with Lead Carbonate or Cadmium Nitrate.)

Samples with visible particulates must be filtered.
Keep this filter (#1).
Treat samples with solid Lead Carbonate or Cadmium Nitrate powder and immediately filter.
Discard this filter.
Test filtrate for sulfides using Lead Acetate paper and further treat samples showing positive results with Lead Carbonate or Cadmium Nitrate powder and filter.
Discard this filter.
Continue testing until samples show a negative result for sulfides using Lead Acetate paper.

C. Soluble Aldehydes Test

Use a separate solution of the sample to test for aldehydes.
Treat samples showing a positive result with 20 ml of 3.5% Ethylenediamine solution per liter of sample.

D. Preservation

Reconstitute the sample by adding the sediment collected on filter #1 back into the filtrate.
Add NaOH until the sample pH > 12 and cool to 4°C.
Maximum holding time is now 14 days. Equipment blanks must be handled the same as real samples.

16. Buffer Solution. Dissolve 33 g of ammonium sulfate in 75 ml of reagent water and add 6.5 ml of ammonium hydroxide. Dilute to 100 ml with reagent water. Degas the solution with helium gas for 5-10 minutes prior to use. Add the buffer solution, drop wise, to the sample and check after addition with pH paper, or continuously with a pH meter.
17. Method 3060A must be used for preparation of soils. Barium chromate is only partially soluble using Method 3060A. This method may not be appropriate for investigations involving this contaminant when high levels of barium are found at sites.
18. White phosphorus from munitions is released into the environment in the form of small, discrete particles. These particles persist in soils, sediments, and may occur as suspended or colloidal particles in anoxic waters. Therefore, some samples or sample aliquots from a given location may contain P4 particles while others do not. The nature and distribution of P4 contamination from other, non-military, sources has not been studied, but sample collection procedures should address the likelihood that P4 is present in discrete particles, and must be designed to ensure that multiple representative samples of the matrix of interest are collected. In addition, soil and sediment samples must be carefully homogenized and sub-sampled.

    Aqueous samples should be poured gently into the sample container to minimize agitation which might drive off the volatile P4. If bubbling does occur while transferring the sample to the container, the sample should be discarded and another sample collected. Each container should be filled with sample until it overflows. Each container should be tightly sealed with a PTFE-lined cap. The container should then be inverted to check for air bubbles. If any air bubbles are present, a new sample must be collected.

19. If boron is a chemical of concern at a site, use a wide mouth plastic container for collection of soil samples.

Table 3 Footnotes

20. If analysis includes BHCs, cis, trans-Permethrin, or Trifluralin, samples should be extracted as soon as is practical. See requirements for specific pesticides, published under the Safe Drinking Water Act and applicable to drinking water samples.
21. If analysis includes Disulfoton Sulfoxide, Diazinon, Pronamide, or Terbufos, samples must be extracted as soon as is practical.
22. Includes groups referred to in other guidance as:
    Total Petroleum Hydrocarbons (TPH), Acid Extractables (Phenols), Chlorinated Hydrocarbons, Nitroaromatics and Isophorone, Nitrosoamines except Diphenylnitrosamine, Polynuclear Aromatics, Phthalate Esters, Haloethers, and Phenolics.
23. If samples are to be analyzed for semivolatiles and pesticides/PCBs, collect a total of three containers. For quality control purposes, collect an additional container for each contaminant group, for every 20 samples.
24. Reactive contaminants with cleanup criteria include 2-chloroethylvinyl ether and styrene. Contact the laboratory regarding other contaminants.
25. Soil sampling collection and preservation specifications for volatiles, including requirement for methanol preservation, are contained in RRD Operational Memorandum No. 2, Attachment 6. Soils collected to determine volatiles leached from soils must be collected and analyzed as provided in footnote [33].
26. Specifications must be followed from Modified DRO, Method for Determining Diesel Range Organics, Wisconsin DNR, September 1995 for DRO and Modified GRO, Method for Determining Gasoline Range Organics, Wisconsin DNR, September 1995, for GRO.
27. The pH of all water samples must be determined by the laboratory unless sample vials containing acid for field preservation were supplied by the lab. The pH measurement may be performed on left-over sample. If the pH is greater than two, the sample results must be flagged. Flagging is not required of samples collected from carbonate aquifers if preserved with sodium azide or extracted within 48 hours of collection.
28. The Wisconsin procedure requires a Teflon™ lined cap. The Teflon™ must be touching the sample.
29. The data in this table applies to soils to determine potential leaching of contaminants. See RRD Operational Memorandum No.2, Attachment 2, Soil Leaching Methods for applicable leaching tests.

    Each soil type tested should have associated quality control as provided in the leaching procedures. This requires spiking the leaching solution with the contaminants of concern at levels above the TDLs listed in RRD Operational Memorandum No.2, Attachment 1. When relevant pathways have been evaluated for response activity under Part 201 or Part 213, spiking the leaching solution may be appropriate at approximately one-half of the cleanup criteria for the appropriate pathway whenever possible. Duplicate samples should be collected to facilitate the spiking of samples.

Table 3 Footnotes

The crushing, cutting, grinding, sieving, and filtering, or other procedures used in leaching procedures may alter the physical characteristics of soils. As the physical characteristics of soils may affect the mobility of contaminants, such procedures are not appropriate for soils for the purposes of this test. Such procedures may be appropriate for other types of material such as brick and concrete.

Samples collected and stored using a syringe-type coring device (SCD), as specified in Method 5035 of SW-846, should be extruded directly into the leaching solution by the laboratory to minimize exposure to the atmosphere.

After completion of the leaching procedure for soils, aliquots taken for analysis of specific contaminants must be immediately collected and preserved as specified in Table 3 for aqueous solutions of the respective contaminants.

30. Other holding times, specific for compounds within the contaminant groups, may be more appropriate. If the compounds of concern at a site have been established, use specifications in this table specific for these compounds, or specifications as may be provided in the analytical method itself.
31. Contact the MDEQ Lab concerning the use of leaching procedures for other contaminants.
32. Extracts from leaching tests should be preserved immediately after leaching, according to the guidance given in the individual analysis methods for the contaminants being measured.
33. Sample collection procedures using a syringe-type coring device, as provided in Method 5035, are appropriate when leaching is used to evaluate the mobility of volatile components leached from soils. Extrusion of the soil sample into the leaching solution by the laboratory is required within 48 hours. After completion of the leaching procedure, an aliquot of leaching solution must be immediately collected and preserved as specified in Table 3 for associated contaminants in aqueous solutions. If larger sample sizes are required, multiple devices must be used.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 5
COLLECTION OF SAMPLES FOR COMPARISON TO GENERIC CRITERIA

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Low Flow:	Minimal drawdown groundwater sampling procedures as described in the United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, December, 1995, EPA Groundwater Issue
Response Actions:	Includes "response activities" as defined by Part 201 and "corrective action" as defined by Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for collection of groundwater and soil samples for comparison to generic criteria for site assessment, site investigation, and response actions under Part 201, Part 211, and Part 213.

Generic cleanup criteria for groundwater and soil have been developed pursuant to Sections 20120a(1) and 21304a of NREPA (see RRD Operational Memorandum No. 1). These criteria are the risk-based values the department has determined to be protective of the public health, safety, or welfare and the environment. The evaluation of sampling data to establish compliance with cleanup criteria under the provisions of Part 201, Part 211, and Part 213 requires data that reliably establish a representative concentration of the hazardous substance in a given environmental medium. The representativeness of the data can be maximized by using proven accurate and reproducible techniques and verified by using appropriate quality assurance and control procedures in the field and laboratory. This operational memorandum designates sampling, analysis, and quality assurance and control protocols for consistent data collection to facilitate gathering the information necessary for the department to determine compliance with the applicable provisions of Part 201, Part 211, or Part 213. Additional guidance regarding sampling strategies and methodology is available in RRD Operational Memorandum No. 4.

CALIBRATION OF FIELD EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data should be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment used for field sampling should be examined to certify that it is in operating condition. This includes checking the manufacturing's operating manual and the instructions for each instrument to ensure that all maintenance requirements are being observed. Calibration of field instruments should be performed in accordance with the manufacturer's recommendations and guidelines and at the intervals specified by the manufacturer or more frequently as conditions dictate. At a minimum, equipment should be calibrated prior to each sampling event. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it should not be used in the field until it is serviced and calibrated.

COLLECTION OF SOIL SAMPLES FOR COMPARISON TO THE GENERIC CRITERIA

General Considerations

The soil and groundwater terminology used for this discussion include the following:

- Unsaturated/Vadose Zone: a subsurface zone above the capillary fringe in which the soil pores are only partially filled with water. The moisture content is less than the porosity.
- Saturated Zone: contains two components
    - Capillary Fringe: a subsurface zone above the water table in which the soil pores are filled with water and the pressure heads are less than atmospheric.
    - Water Table: the water level surface below the ground at which a well screened in an unconfined aquifer would fill with water.
- Smear Zone: the vertical area over which groundwater fluctuates (thereby the contaminated water will smear floating and dissolved contamination into the soils in the zone).

Soil samples must be representative of the soils located in the area affected by the release of hazardous substances. The exposure assumptions for soil pathways are based on dry soil. For comparison to the applicable generic soil criteria soil samples must be collected from the vadose zone. The results must be reported by the laboratory on a dry weight basis (adjusted for the vadose zone soil moisture content). Soil analytical methods cannot be applied to saturated soils because they do not provide representative results.

Neither soil nor water sample analyses methods are appropriate for comparison of saturated "soils" samples to generic soil or groundwater cleanup criteria. The cleanup criteria are based upon exposure assumptions appropriate only for soil or water, individually, and are not applicable to exposure to saturated "soil" as a mixture of soil and water.

Contaminants present in the unsaturated soil zone shall be evaluated by comparison of soil sample analyses to the applicable soil criteria. If contaminants are present in a saturated soil zone a monitoring well should be properly installed and the groundwater sampled. These groundwater sample results shall be compared to the applicable groundwater criteria. If free product is suspected and/or a smear zone exists near the water table, a monitoring well shall be appropriately installed so that the water table is bisected by the well screen. Additional

guidance regarding monitor well construction is available in RRD Operational Memorandum No. 4.

While analysis of saturated "soil" samples cannot be used to demonstrate compliance with generic cleanup criteria, laboratory analyses or field instrument readings of saturated soils may be of qualitative value for remedial evaluation and design purposes. For example indications of high concentrations in saturated soils may indicate a need to prevent construction worker exposure to shallow saturated soils. This information may also assist in determining the nature of the contaminant and in treatment evaluations. If such data are included as part of response actions under Part 201 or Part 213 rationale for the use must be provided.

If the water surface elevation drops significantly from the time that the original soil investigation was performed, samples should be collected from any former "smear zone" prior to site closure.

Evaluating Exposure Due To Lead In Soil

The amount of lead in soil has historically been evaluated by analyzing lead concentrations in the total soil sample. However, recent evidence indicates that the fine soil fraction, defined as less than 250 microns in size, is more appropriate for comparison to soil direct contact criteria (DCC) and particulate inhalation criteria (PSIC). Exposure to lead in ingested soil and dust is best represented by the lead concentration in the particle size fraction that sticks to hands or that is most likely to accumulate in the indoor environment as a result of wind-blown soil deposition and transport of soil on clothes, shoes, pets, toys and other objects. Additionally, exposure to lead in inhaled soil and dust is best represented by the lead concentration in the particle size fraction likely to enter the respiratory system and become lodged in the alveoli. The particle size fraction of soil and dust likely to be ingested or inhaled is the fine soil fraction. Generally the fine fraction has the higher concentration of lead, but it is possible that the coarse fraction may contain more lead. Therefore, when collecting soils for facility evaluation, both fine and coarse fraction analyses are necessary to determine lead exposure. MDEQ Laboratory SOP #213 provides appropriate procedures for sample preparation. To assure protectiveness, the concentration of lead in each fraction must be compared to the direct contact criteria separately. Only the concentration of lead in the fine fraction must be compared to particulate soil inhalation criteria. The concentration the total lead concentration must be compared to other lead soil criteria. For response actions under Part 201 and Part 213, if the direct contact and particulate inhalation pathways have been appropriately documented to be "not relevant" it is not necessary to analyze the fractions separately.

COLLECTION OF GROUNDWATER SAMPLES FOR COMPARISON TO THE GENERIC CRITERIA

General Considerations

Groundwater samples collected for analyses must be representative of the water moving in the aquifer, in the contaminant plume or in the target zone where contaminants are expected to be located or to migrate. Groundwater samples must represent the contaminant concentrations, including dissolved and naturally suspended particles. Stagnant water in monitor well casings is not representative of the groundwater. Purging of the stagnant water in monitor well casings is necessary but must minimize changes in groundwater chemistry to yield water samples that are representative of the groundwater. Indicator parameters including temperature, pH, dissolved oxygen, specific conductivity and turbidity must be monitored during the purging process to determine stabilization between the well casing waters and the formation waters. Turbidity is the most conservative indicator of stabilization as it is often the last to stabilize. Turbidity in

groundwater samples may be naturally occurring, caused by the contamination, or a result of sampling disturbances such as accidental inclusion of aquifer matrix materials from disturbances or mixing that may occur while sampling. Knowledge of site geology, well design, and sampling methodology is helpful in determining the source of turbidity and the method of sampling. Turbidity due to sampling disturbances should be eliminated or minimized while naturally occurring turbidity or turbidity due to contamination should not.

A sampling methodology must be used that accounts for the effects of aquifer heterogeneities while minimizing alterations in water chemistry that could result from sampling disturbances. The MDEQ will accept properly conducted purging methods designed to minimize drawdown by controlling the flow from the well while monitoring stabilization indicator parameters, commonly referred to as Low-Flow methods. Available Low-Flow procedures include United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, December 1995, EPA Ground Water Issue, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, Robert Puls and Michael Barcelona (http://www.epa.gov/ahaazvuc/download/issue/lwflw2a.pdf) and *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, United States Environmental Protection Agency Region 1, July 30, 1996, Revision 2 (http://www.epa.gov/region01/measure/well/wellmon.html). If another sampling methodology is used, documentation must be submitted to the MDEQ with the data that demonstrates why it is as representative of aquifer conditions as low-flow methodologies. Careful use of the Low-Flow methods is essential in collection of groundwater samples from wells that contain non-aqueous phase liquids, as these substances may be stratified in the monitoring well. Where non-aqueous phase liquid is present, refer to additional guidance for sampling strategies for non-aqueous phase liquids available in RRD Operational Memorandum No. 4, Attachment 5.

Collection of Inorganic Groundwater Samples

Traditionally, the standard practice for collecting metals samples from monitoring wells to evaluate the drinking water pathway had prescribed that samples be filtered with a 0.45 micron filter before inorganic analysis. The practice minimizes the potential for artificially elevated particulate loading resulting in overestimation of metal concentrations. However, U.S. EPA has determined that contaminant concentrations and the potential human health risk may be drastically underestimated for filtered samples (*Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, U.S. EPA Region 1, July 30, 1996, Rev 2). Use of the Low-Flow sampling methodologies minimizes sampling disturbances, improves the data quality, and is the method recommended by the MDEQ.

Inorganic constituents must be measured as totals (i.e., unfiltered with appropriate preservation) unless groundwater samples cannot be collected without adequately minimizing the influence of sampling disturbances, in which case filtering may be necessary prior to preservation. The intent of the field-filtration is only to eliminate or minimize sampling disturbances or interference. Any necessary filtration should be accomplished using a filter with a large enough pore size to allow naturally suspended particles to pass through the filter. Some preliminary testing may be required to determine the appropriate filter size. Site-specific conditions may require that both a filtered and unfiltered sample be collected to adequately evaluate the contaminant concentrations. Documentation for the use of filtration and the evaluation of appropriate filter sizes must be provided to the MDEQ with the data.

Collection of Organic Groundwater Samples

Samples to be analyzed for organic substances should not be filtered regardless of sample turbidity except as described in the next paragraph. When response action under Part 201 or Part 213 requires evaluation of the dermal contact with groundwater for contaminants listed in R 299.5750 footnote (AA) an additional set of groundwater samples should be collected for organic substances analysis which should be filtered for analysis of the dissolved phase. The groundwater contact criteria equation estimates the dermal adsorption of hazardous substances that are in the dissolved phase. Therefore, when analyzing for contaminants that strongly adsorb to soil particles, those samples should be filtered so that contaminants in the dissolved phase can be estimated. Filters of appropriate material should be used to ensure the filter does not absorb dissolved contaminants that are not attached to particulates. Glass filters with no binders are acceptable and recommended. Some preliminary testing may be required to determine the appropriate filter medium and pore size. Documentation of the evaluation of appropriate filter medium and size must be provided to the MDEQ with the data.

GENERAL QUALITY ASSURANCE AND QUALITY CONTROL

In order to insure that representative data is used to evaluate facilities, quality assurance and quality control (QA/QC) procedures must be implemented to assure that the precision, accuracy, and representativeness of the data are known and documented. This includes appropriate sample distribution to evaluate the extent of contamination; appropriate sample collection, preservation, shipping, and analysis methodology; collection and analysis of collocated, replicate and split duplicate samples for evaluation of precision; and collection and analysis of field, equipment, and trip blanks as well as matrix spike, matrix spike/duplicate, and laboratory spike samples for analysis of accuracy. Sample distribution and collection are more completely discussed in Operational Memorandum No. 4. Sample handling, preservation, and holding times are discussed in Attachment 4 of this Operational Memorandum. Collection of duplicate, blank and spike samples is discussed below.

Collection of Duplicate Samples to Evaluate Precision

Precision estimates the reproducibility of measurements under a given set of conditions and is reflected in the field duplicate samples and laboratory duplicates analysis. Overall precision for a sampling set is a mixture of field sampling techniques and laboratory techniques. Three types of duplicate samples are relevant to this document: collocated, replicates, and split samples. Collocated samples should be collected and used to estimate the overall precision of a data collection activity. Sampling error can be estimated by inclusion of both collocated and replicated versions of the same samples. Definitions of these samples are listed below:

- Collocated samples are independent samples collected at the same location and at the same time and, for the purpose of these site assessments, processed and analyzed by the same laboratory. Collocated samples are not mixed together and then split into two or more samples. They are two separate samples from an identical site location. They provide a good estimate of precision information for the entire system, including transportation, sampling technique, homogeneity of the site, and laboratory analysis. Examples of collocated samples are samples taken from a moving stream, side by side soil core samples (nesting), two air quality samples taken from one common sample manifold, and two water samples taken from essentially the same point in a lake or lagoon. Collocated samples are used to estimate the

overall precision of a data collection activity. Sampling error can be estimated by including a replicate sample with a collocated sample.

- Replicate samples are samples that have been divided into two or more portions at the same step in the measurement process. Examples of replicate samples include two samples taken from a single purged well, samples collected in a common container and then put into separate containers or a soil sample which is thoroughly mixed in a tray and divided into separate containers. Replicate samples are processed and analyzed by the same laboratory.
- Split samples are replicate samples divided into two portions, sent to different laboratories, and subjected to the same environmental conditions and steps in measurement process. They serve as an oversight function in assessing the analytical portion of a measurement system. Samples are often split between the MDEQ and a facility owner or liable party.

Collection of Blank and Spike Samples to Evaluate Accuracy

Accuracy estimates the bias in a measurement system. Accuracy is difficult to estimate for the entire data collection activity. Sources of error include: sampling procedure; field contamination; preservation handling; sample matrix; sample preparation; and analytical techniques. Sampling accuracy can be audited through field, equipment, and trip blanks, while analytical (or laboratory) accuracy can be audited through spike samples and the surrogate recovery results.

A field blank is prepared by pouring distilled/deionized water directly into sample containers. This preparation is performed in the area where sample handling and preservation operations occur. The field blank sample is handled and shipped in the same manner as other analytical samples. Field blank sample analytical results are used to evaluate sample handling, preservation, and shipping procedures.

An equipment blank can be prepared by pouring distilled/deionized water through or over a piece of sampling equipment and collecting rinsate in a sample container. Results of equipment blank analysis are used to evaluate field decontamination procedures and to determine the likelihood of cross contamination.

A trip blank, which normally applies only to volatiles, is a sample that is prepared before any sampling is performed. This sample is shipped from the warehouse to the field and then to the laboratory. Results of trip blank analysis are used to evaluate possible contamination of containers/samples from the time the sample containers are prepared through the field event to the time the samples are received and analyzed at the laboratory.

Laboratory blanks are used to estimate variabilities caused by technique, in-house contamination, and other laboratory problems. Laboratory blanks are prepared by the laboratory.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples and surrogates are samples that are spiked in the laboratory. MS/MSD samples for organic and inorganic water analyses require an extra sample volume. The actual MS/MSD sample is prepared by the laboratory to evaluate accuracy.

Field background, or upgradient samples may need to be collected on a site-specific basis and should be collected from a clean location and shipped with other samples from the site. These samples should be submitted to the laboratory as routine field samples and should not be defined as blanks.

To provide adequate QA/QC for site investigations, the following duplicate, blank and matrix spike samples should be taken. Duplicate and field blank samples should be taken at critical sampling locations, but not at the same location from which the matrix spike/duplicate sample is obtained. They should be sent to the laboratory as blind samples. Reduced QA/QC evaluations may be implemented on a case by case basis with approval of the MDEQ RRD Project Manager.

	Duplicate Samples[1]				**Blank Samples[1]**		
QA/QC Sample Type	**Collocated**	**Replicate**	**Split**	**MS/MSD**	**Field**	**Equipment**	**Trip**
Recommended Number of QA/QC Samples	1 per 10 or fewer samples per matrix[2] and analytical group[3], at least 1 per day	When used: 1 per matrix and analytical group per day	When used: 1 per 1 for samples that will be split	1 per 20 or fewer samples per matrix and analytical group, at least 1 per day	1 per 20 or fewer samples per matrix and analytical group, at least 1 per day	1 per 10 or fewer samples per matrix and analytical group, at least 1 per day	1 per every volatile organic sample shipping container
QA/QC Sample Collection	Individual samples taken from the same location not mixed together and then split.	One sample divided into two or more portions then analyzed by the same laboratory	Replicate samples sent to different labs for analysis	Water samples require double volumes. Samples should be taken at critical locations but different from the field blank.	Fill the sample containers with deionized or distilled water in the area where sample handling and preserving operations occur. Handle and ship the field blank sample as other samples.	Pour deionized or distilled water over or through the sampling equipment and collect rinsate in the sample container. Handle and ship the field blank sample as other samples.	Fill the sample container with deionized water. This in prepared before any sampling is performed and travels to the field and the laboratory with the other sample containers.

[1] Normally no blank or duplicate is required for samples of waste containers or other high concentration samples.

[2] soil, groundwater, surface water, sediment, or drinking water, etc.

[3] volatile organics, semi-volatiles. pesticides/PCBs, metals, cyanide, etc.

Note: Where method 8260+ volatile analysis for soils, sediments, sludges, and waste container samples is done, methanol blank samples should be collected by the laboratory for each methanol lot used. These lots should be tracked in the field and reported on the laboratory receipt form so laboratory correlations can be made.

SAMPLE CHAIN OF CUSTODY

An essential part of any sampling and analytical scheme is ensuring the integrity of the sample from collection to data reporting. The possession and handling of samples should be traceable from the time of collection through analysis and final disposition. This documentation, referred to as chain of custody, is particularly necessary if there is any possibility that the analytical data or conclusions based upon analytical data will be used in litigation. Regardless of the potential for litigation, these procedures are useful for routine control of sample flow.

A sample is under your custody if it is in your possession; is in your view, after being in your possession; was in your possession and you placed them in a secured location; or is in a designated secure area.

As few people as possible should handle the samples. The field sampler/sampling crew should track the chain of custody in the field on the individual sample data collection sheets and chain of custody tracking reports before shipment. Samples should be collected following the appropriate sampling procedures and documented on the sample data sheet. The equipment used to collect samples should be noted, along with the time of sampling, sample location, type and description, depth at which the sample was collected, and any other pertinent remarks. All bottles and jars should be properly labeled with sample number, date and time of collection, and location. Sample labels and tags should be affixed to the each sample container prior to or at the time of sampling. Sample seals should be used to detect any unauthorized tampering with samples from the time of sample collection to the time of analysis.

A record should be kept of data-collecting activities performed. A field logbook is a useful tool for keeping such records. Entries into the logbook may contain a variety of information such as site contacts, phone numbers, assigned laboratories, addresses, etc. Documentation of on site weather conditions and activities that take place during sampling events should be described in as much detail as possible so that persons going to the site can re-construct a particular situation without reliance on memory. The record for each sampling event should include the date, start time, names of all persons present, level of personal protection being used, and the signature of the person recording the information. Measurements made and samples collected should be recorded. All entries in field logbooks should be made in ink and no erasures made. If an incorrect entry is made, the information should be crossed out with a single strike mark. When a sample is collected, or a measurement is made, a detailed description of the location of sample collection (such as a map point which includes compass and distance measurements or Global Positioning System location information) should be recorded. Equipment used to make measurements should be identified, along with the date of calibration.

A chain of custody record should be filled out and should accompany every sample container shipped or delivered to the laboratory. This record becomes especially important if the sample data could be introduced as evidence in litigation. For each sample in the container, the chain of custody record should include the sample number, signature of the collector, date and time of collection, place and address of collection, sample matrix, and signature and inclusive dates of possession for each person involved in the chain of possession from the point of sample collection through sample analysis.

The following document is rescinded with the issuance of this attachment:

- Storage Tank Division Informational Memorandum 16, Policy regarding the appropriate use of saturated soil sampling results under the Leaking Underground Storage Tank (LUST) Program, dated October 21, 1998.

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS – ATTACHMENT 6
SAMPLING METHODS FOR VOLATILE ORGANIC COMPOUNDS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Contact time:	The time from when the sample was preserved with methanol to the time the aliquot was taken for analysis, or the time the sample was in contact with the methanol prior to analysis.
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
Method 5035A:	U.S.EPA Method 5035, "Closed-System Purge-and-Trap and Extraction for Volatiles Organics in Soil and Waste Samples," Test Method for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, USEPA, Office of Solid Waste and Emergency Response, Dec 1996, Third Edition.
Method 5021A:	U.S.EPA Method 5021A, "Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis", Test Method for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S.EPA, Office of Solid Waste and Emergency Response, Dec 1996, Third Edition.
Response Actions:	Includes "response activities" as defined by Part 201 and "corrective action" as defined by Part 213
Sonication:	The procedure for mixing the soil with methanol using sound waves.

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for the collection and preservation of soil samples using the procedures in U.S.EPA Methods 5035A and 5021A for analysis to determine concentrations volatile organic compounds (VOCs). This attachment is applicable for site assessments, site investigations, and response activities under Part 201, Part 211, and Part 213.

To produce reliable representative analytical results, the MDEQ implemented the use of the methanol preservation procedures for the preservation of soil samples collected for analysis to determine concentrations of VOCs on April 30, 1998.

INTRODUCTION

The requirements for collection and preservation of samples are based on the latest revisions of U.S. EPA Methods 5035A and 5021A. The applicable contaminants that can be measured are listed within the methods. Other contaminants may be included if method performance data exists for the contaminant that demonstrates the accuracy, precision and detection that can be measured.

Guidance on applicable target detection limits (TDLs) and available analytical methods are included in RRD Operational Memorandum No. 2, Attachment 1.

USE OF PROCEDURES WITHIN METHODS 5035A and 5021A

Method 5035A includes several procedures for the collection and preparation of soils for VOCs analysis. These include high concentration methods (methanol preservation), sealed samplers using soil coring devices, and the low concentration soil method using sealed containers for direct attachment to the analytical instrument. Method 5021A provides for the sample preparation of both waters and soils using sealed containers.

Method 5035A, High Concentration Method – Option 1, Methanol Preservation

The MDEQ accepts results generated using the high concentration soil method of Method 5035A for site assessment, site investigations, and response activities, provided the requirements listed below are followed and documented:

- Samples are preserved with methanol in the field using a procedure consistent with that provided in this document.
- At least ten grams of soil are collected.
- The ratio of methanol volume to soil weight is equal to or greater than one.
- Samples are sonicated for at least 20 minutes.
- An aliquot of methanol is taken immediately after sonication, and stored for analysis.
- The sample with methanol is not used for analysis of volatiles once the aliquot of methanol is taken.
- The laboratory standard operating procedures provide the information listed within this document's section entitled Laboratory Related Procedures and Documentation.
- Operational Memorandum No. 2, Attachment 1, Target Detection Limits and Available Methods direction has been followed.

Method 5035A, High Concentration Method – Option 2, Bulk Sampling

The bulk sampling procedure in Method 5035A does not produce a reliable representative sample because it is susceptible to volatilization and biodegradation. Therefore, the MDEQ does not accept results generated using bulk sampling procedures, unless acceptable justification is provided that documents the nature of the sample prevents sampling by the procedures described as acceptable in this document.

Method 5035A, Low Concentration Method

The MDEQ accepts results generated using the low concentration soil method of Method 5035A, for site assessment, site investigations, and response activities, provided the requirements listed below are followed and documented:

- The sealed containers are attached directly to the instrumentation.

- The preservation is applied correctly to the various soil types.
- Information that validates the use of the method with the appropriate type of soil is provided.
- Information that demonstrates the effectiveness of the sealed containers ability to prevent the exposure of the sample to environmental conditions is provided.

The low concentration preservation procedure may not be appropriate for all soil types. For example, calcareous soils cannot be sampled by the low concentration method when sodium bisulfate is used because a chemical reaction occurs that adversely affects the results. Soil samples must be tested in the field prior to collecting the samples for analyses, as discussed in Method 5035A, to determine if the acidic preservation for the low concentration procedure can be used. If the acidic preservation cannot be used, alternate procedures for preservation in Method 5035A should be used. The preferable alternate procedure is to extrude the samples into empty sealed vials and freeze on site to < -7 C°. Care must be taken to not freeze the vials below -20 C° to avoid potential problems with vial seals.

Method 5021A, Headspace Analysis using Sealed Containers

The MDEQ accepts results generated using the sample collection and preservation methods of Method 5021A for site assessment, site investigations, and response activities, provided the same requirements for Method 5035A, Low Concentration Method are documented. The preferred analytical method is Method 8260B (see RRD Operational Memorandum No. 2, Attachment 1). This sample and collection procedure is highly recommended for the analyses of contaminants that are very soluble in water.

Method 5035A, Soil Coring Devices (used to transfer samples to the laboratory)

The MDEQ requires the use of soil coring devices to evaluate the leaching of volatiles from soils, as provided in Operational Memorandum No. 2, Attachment 2, Soil Leaching Methods. The requirements in Attachment 2 must be met.

The MDEQ does not recommend the use of soil coring devices for initial site characterization where the objectives include establishing the contaminants of concern; or for response activities where the objectives are to demonstrate final compliance with cleanup criteria. The MDEQ may accept results using the soil coring devices, providing the following requirements are documented:

- Scientific studies exist that demonstrate the device to be effective for the use intended. The manufacturer of the device should be contacted regarding studies that prove them effective.
- The party proposing the use of the soil coring devices must demonstrate the effectiveness of the devices to retain volatile chemicals, for the specific chemicals of concern at the facility. Demonstration of the effectiveness of the devices proposed to be used can be accomplished using duplicate sampling. The demonstration must include duplicate samples collected using methanol preservation in the field. Duplicate samples must be collected for a minimum of one sample, or for at least one of every five samples collected.
- Written protocols must be established regarding the use of the devices to collect samples, and to preserve samples at the laboratory. These protocols must be provided to the MDEQ.
- Confirmation samples must be collected using methanol preservation in the field, equivalent to the standard operating procedure of this document. Confirmation samples must be collected for a minimum of two samples, or for at least two from every ten samples collected.
- All requirements of Method 5035A regarding the use of the samplers must have been met.

OXYGENATES

Oxygenates refer to methyl(tert)butylether (MTBE), t-Butyl alcohol (TBA), Di-isopropyl ether (DIPE), Ethyl(tert)butylether (ETBE), Ethyl alcohol, Methyl alcohol, and Tertiaryamylmethylether (TAME), and the oxygenated ethers refer to MTBE, DIPE, ETBE and TAME. When any of the oxygenated ethers are required for analysis, and high temperature purging is used in the analysis, samples collected must have the pH adjusted to > 10 in the field using Trisodium phosphate dodecahydrate (TSP), or two samples can be collected and the laboratory instructed to neutralize one prior to the analysis for oxygenated ethers. The laboratory should be contacted regarding its procedure for the analysis of oxygenated ethers to determine if high temperature purging is used. Methods 5035A and 5021A can be used for sampling for oxygenates, provided the requirements in this document are met. Method 5021A is highly recommended.

Questions concerning this document should be directed to Mr. A. Ralph Curtis, Toxicology Unit, RRD, at 517-373-8389, or email to mailto:mcurtisar@michigan.gov.

The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division procedure for the Collection and Methanol Preservation of Soils for Volatile Organics, dated May 1, 2000.
- Storage Tank Division procedure for the Collection and Preservation of Soil Samples for Volatile Organic Analysis, dated May 18, 2000.
- Storage Tank Division Informational Memo No. 13 "Implementation of Environmental Protection Agency (EPA) SW-846 Method 5035 Closed-System Purge and Trap and Extraction for Volatile Organics in Soils and Waste Samples", dated September 4, 1998.

APPENDAGE:

Standard Operating Procedure for Methanol Preservation in the Field

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This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

STANDARD OPERATING PROCEDURE for METHANOL PRESERVATION IN THE FIELD

SUMMARY

Soil samples are collected using conventional procedures, including auger and split spoon techniques. Sub-samples are then taken using syringe-type coring devices and immediately transferred into pre-weighed VOC vials containing reagent grade methanol sufficient to obtain an estimated ratio of 1:1 with the soil. The samples are transferred to the laboratory. Upon receipt at the laboratory, the following steps are taken as soon as is practical:

An accurate sample weight is determined.
The sample container is swirled gently to break up soil clumps.
The sample is sonicated for 20 minutes.
An aliquot taken and stored for analyses using Method 8260B.

Method 5035A uses a 2:1 ratio of methanol volume to soil weight. This ratio is acceptable contingent that the requirements in Operational Memorandum No. 2, Attachment 1, Target Detection Limits and Available Methods, are met.

LABORATORY RELATED PROCEDURES AND DOCUMENTATION

Procedures - The laboratory selected should have written standard operating procedures that address the provision of sampling supplies intended for methanol preservation of samples, sample receipt checks, sample preparation steps and documentation, sample collection requirements, and analyses. The laboratory should first be contacted regarding specific requirements. The laboratory's standard operating procedure governing the sample preparation should specify the contact time routinely applied, and when this time period is not met, this must be narrated with the results. The following documentation must be included:

- Copies of the certifications of the methanol used.
- Percent moisture in the samples (determined using separate vial/container with just soil).
- Dates samples were collected, and preserved if not immediately performed upon collection.
- Dates samples were received at the laboratory.
- Sample weights.
- Sample moisture (soils and sediments).
- Actual ratios of methanol to soil.
- Sonication dates/times.
- Minutes of sonications if different from 20 minutes.
- Dates/times aliquots were taken for analysis, if not taken immediately after sonification.
- The dates of the analysis.

MDEQ LABORATORY SPECIFICATIONS FOR SAMPLE COLLECTION

The following specifications apply for sample collection kit provided by the MDEQ laboratory. Other laboratories may have similar kits with specifications. Contact the laboratory selected.

Target Soil Weight = 10 grams
Allowed Weight = 9 to11 grams
Size of VOC Sampling Vials = 40 ml
Methanol Volume (provided in tubes) = 10 ml
Soil Coring Device (Syringe Sampler) Size = 10 ml
Green Sticker to Warn of Hazardous Waste
Wide Mouth Jars (4 oz. and 8 oz.)

HEALTH AND SAFETY

Material Safety and Data Sheets (MSDSs) providing health and safety data, and emergency procedures should accompany staff in the field. Methanol ampoules, tubes, and vials must be provided to field staff inside protective containers to hold any spillage. Methanol is a toxic and flammable liquid. Handle with proper safety precautions. Wear safety glasses and protective gloves. Nitrile Rubber or Viton gloves are recommended. Avoid inhalation. Store and handle in a ventilated area, away from sources of ignition and extreme heat. Store methanol in a cool place, preferably in sample coolers on ice. This is especially important for methanol in tubes, where pressure buildup due to extreme heat may result in rupture. Vials should be opened and closed quickly during collection. In the event of eye contact, immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately.

SHIPPING

The shipping of methanol is regulated by the U.S. Department of Transportation (DOT), Title 49 of the Code of Federal Regulations. The DOT number is UN 1230. The amount of methanol used for sample preservation falls under the exemption for small quantities. Requirements for shipment of samples by common carrier are as follows:

Maximum volume of methanol in a sample container cannot exceed 30 ml.
The sample container cannot be full of methanol.
Sufficient absorbent material must be used in the container to completely absorb sample content.
Each cooler must have less than 500 ml of methanol.
The cooler or package weight must not exceed 64 pounds.
Each cooler must be identified as containing less than 500 ml methanol.

APPARATUS AND MATERIALS NEEDED FOR SAMPLE COLLECTION

Absorbent Material – If the samples are to be shipped by common carrier, vermiculite or similar material, sufficient to completely absorb the methanol for each sample.

Calibration Weight - Near or equal to the target sample weight.

Certified Methanol – Methanol certified for purge and trap gas chromatography is analytically verified prior to sampling (by lot). In this procedure the methanol is provided in sealed ampoules. Some labs may provide methanol in the sampling vial.

Field Balance - Capable of holding sampling vial and syringe on the wide mouth jar used to prevent balance contamination, and measurement within + 0.2 grams.

Hazardous Waste Warning Label - Suitable vial labels to warn personnel of the presence of methanol as a preservative.

Methanol Sampling Kit/Method 5035A Sampling Kit:

Protective Wear - Nitrile rubber or Viton gloves. Splash proof safety goggles.

Plastic Bags - Air tight seals, capable of holding three sample VOC vials, and sub-coring device.

Protocol to be used for the collection of samples.

Sub-Coring Device - A syringe type device, whose material has been tested and found free of contaminants,. This device is used to sub-sample the targeted amount of soil, for transfer into methanol in the field.

Wide Mouth Jar (for holding methanol tubes) - Of suitable size to allow temporary storage and shipment of the methanol tubes.

Wide Mouth Jar (for preventing balance contamination) - Of suitable size to allow temporary storage of the syringe type sampler and VOC sample vial on the field balance.

Volatile Organic Compound (VOC) Syringe Labels - Methanol resistant labels.

VOC Vials - Vials with Teflon™ lined septa, pre-weighed, with methanol resistant labels.

SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

Containers - Sample containers are VOC Vials with Teflon™ lined septa of suitable size to hold the soil plus methanol, supplied with methanol resistant labels.

Preservation – Samples are preserved in the field approximately one to one ratio of soil weight to methanol volume, using pre-weighed vials and a field balance. The exact sample weights and ratios are determined at the laboratory. More methanol is added to make the ratio one to one when possible. When weights are less than the specified minimum, the reporting limit is increased. The maximum and minimum limits for the weights of soils specified by the MDEQ laboratory are provided in the section of this document entitled "Specifications for the Collection of Samples Using Methanol Preservation."

Holding Times - The maximum allowable holding time is 14 days from sample collection to analysis. If the maximum allowable holding time is exceeded, interpret the results as minimum concentrations of the measured compounds.

QUALITY CONTROL

Field Blanks

Use - Field blanks are used to determine sample contamination that may occur during the storage, transportation, sampling, and analysis of samples. A field blank is a sample vial containing a pre-measured quantity of VOC-free methanol, obtained from the laboratory or prepared in a contaminant free environment.

Frequency - The number of field blanks depends upon project objectives and the field activities being performed at specific locations. It is recommended that a field blank be created at each location where activities may result in significant VOCs released into the environment, or for every 20 samples, whichever is more.

Interpretation – Positive results may indicate contamination from the methanol, the sample container, from the air at the site, from diffusion of air containing volatiles into the blank during transport to the laboratory, or from the laboratory environment. Compare field blank results with trip blank results and laboratory method blanks to isolate the cause. Sample results that approach the field blank results may be unusable.

Trip Blanks

Use - Methanol trip blanks are used to determine if contamination is occurring from the methanol, storage, transportation, or the field.

Frequency - One trip blank should be used per cooler.

Interpretation – Positive trip blanks can be attributed to the methanol, sample vial material, and the environment in the cooler or sample transport container. Trip blanks should be prepared at, and provided by, the laboratory in order to make this interpretation. If consistent positive results are obtained, contact the laboratory and have a trip blank prepared at the laboratory and immediately analyzed to attempt isolation of the cause.

Methanol

Only purge and trap grade methanol verified to be suitable for methanol preservation should be used. Field staff should maintain documentation of the methanol lot numbers for all associated samples. If consistently high levels of compounds are measured in methanol field blanks associated with a specific lot number, request the laboratory to verify the quality of the methanol lot used to preserve the samples.

Contamination

Contamination by airborne VOCs in the air is possible by diffusion through the vial septum during shipment, storage, collection, and analysis. To control such contamination:

Use appropriate VOC sample vials.
Avoid sources that generate VOCs such as petroleum products, especially auto exhaust fumes.
Keep sample containers in coolers as much as possible.
Collect samples quickly.
Use methanol provided in sealed ampoules, tubes, or VOC vials.

Attempt to isolate the source of contamination and incorporate appropriate procedures to avoid similar circumstances.

FIELD BALANCE CALIBRATION CHECK

The field balance calibration should be checked prior to each sampling event, and whenever necessary because of handling in the field. Record this check in the field notebook.

CORRECTIONS FOR SAMPLES WITH HIGH WATER CONTENT

Concentrations of volatile compounds in soils must be reported on a dry weight basis, using the moisture content of the soil to adjust results. Routine procedures by the laboratories include this correction. Laboratories may not routinely correct results because of the effects due to the miscibility of the methanol with the water in the sample. The effects are to bias the results low, and if the moistures in the samples are high, these biases may be significant. The effects of this biases upon results should be considered when soils are sampled, and if necessary the laboratory instructed to correct results accordingly.

ELEVATED REPORTING LIMITS DUE TO HIGH MOISTURE

For samples with excess moisture, reporting limits may need to be elevated higher than levels routinely reported by the laboratory. Elevated reporting limits may be acceptable if they do not exceed applicable criteria. Historical site information and published information can be used to ascertain the range of moisture levels that can be expected. This can be used to determine if the biases are significant. Additional guidance regarding elevated reporting limits is available in RRD Operational Memorandum No. 2, Attachment 1.

OTHER METHANOL PRESERVATION PROCEDURES

Variations to the field procedure in this method may be used if approved in advance by the MDEQ. Important considerations are:

- Samples must be preserved in the field, a target ratio of 1:1 for the weight of the soil to the volume of methanol should be used.
- Samples must be sonicated for 20 minutes at the laboratory.
- A methanol aliquot must be taken and stored for analysis immediately after sonication that is sufficient for initial analysis, and analysis of any subsequent dilutions.
- Sufficient documentation to validate the data must be provided to the MDEQ.

FIELD SAMPLING PROCEDURE

1. Make arrangements with the laboratory to obtain appropriate Methanol Preservation Sampling Kits.
2. Record the tracking or lot number(s) for the methanol in the field notebook. If more than one lot is used, each lot must be associated with the samples for which it was used.
3. Prior to collection, check the calibration of the balance. See "Field Balance Calibration Check" on page 10 of this document.
4. Prior to collection prepare a temperature blank sample using tap water and a VOC vial.
5. Prior to collection prepare a sufficient quantity of methanol field blanks, i.e., at least one per cooler and one per methanol lot as follows:

   a) Select an area free of VOC sources.
   b) Remove a methanol tube from the wide mouth jar.
   c) Use scissors to cut off the top, and place the methanol into one of the pre-weighed sample vials.
   d) Place the cap on the vial and tighten it. Avoid over-tightening.
   e) Place a green sticker on the top of the cap.
   f) Record the identification of the vial as "Methanol Field Blank" on both the vial label and in the field notebook.

6. Calibrate the syringe to estimate the amount of soil needed to meet the target weight, and use that syringe as a comparison for how much sample is needed.

   Calibration is performed using steps 10 - 17 below, using the syringe only, and part of the soil that is to be collected. The soil used for calibration cannot be used as the sample. It must be extruded from the sampler and discarded at the site before collecting the sample. The sampler does not have to be cleaned between calibration using this step, and collection of the sample.

7. Place the wide mouth glass jar, used to prevent balance contamination, on the balance.
8. Record the location, date, and time of sampling in the field log book. Do not place any labels, stickers, tape, etc. on the pre-weighed sample vials.
9. For methanol field blanks, remove the cap from a methanol field blank which was prepared in Step 5 above, place the opened vial in the collection area for the approximate time it takes to collect a sample, and then cap the methanol field blank for storage and transport to the laboratory.
10. Place a pre-weighed VOC vial and syringe in the wide mouth jar on the balance.
11. Record the weight in the field log book. If the balance features re-zeroing, zero the balance.
12. Remove the syringe. If a cap is provided, remove the cap and place it in the jar.
13. Insert the open end of the syringe into a fresh face of undisturbed soil, and fill it as appropriate according to the calibration of the syringe (Step 6).
14. If necessary, use your gloved finger (decontaminate before next sample), or other appropriate instrument, and push the soil deeper into the syringe sampler.
15. If a cap was provided, immediately cap the end of the syringe.

16. Place the syringe in the jar on the balance. Read the weight, and if necessary, subtract the weight of the syringe, vial, and jar, as appropriate, to determine the weight of the soil.
17. If the weight of the sample is determined to be more than the maximum amount allowed, extrude enough soil to obtain the target amount within the specified tolerance, and re-weigh. See the table in this document, "Specifications for the Collection of Samples Using Methanol Preservation" for the applicable target sample size and tolerance.
18. If the weight of the sample is less than the minimum amount allowed, re-sample and repeat steps starting with Step 7.
19. Record the soil weight in the field notebook. DO NOT RECORD the weight on the sample vial label.
20. Remove the cap from the sample vial, and place it in the jar on the balance, with the septum upwards.
21. If the required amount of methanol is not included with the pre-weighed vial, immediately remove a methanol tube from the wide mouth glass storage jar, holding the tube upright use scissors to cut (plastic) off one end, and pour the methanol into the sample vial, taking care to avoid spillage.
22. Insert the open end of the syringe sampler into the mouth of the vial, and carefully extrude the soil, taking care to avoid spillage. Loss of several drops will not make a significant difference in the results. If a significant amount is spilled, a new sample must be collected, or the sample must be appropriately flagged to indicate estimated results.
23. Using a clean brush, paper towel, or other suitable material, thoroughly wipe excess soil particles from the threads and vial body. Particles left on the threads will prevent a good seal.
24. Place the VOC cap on the sample vial. The cap must be tight; however, over-tightening should be avoided.
25. Gently swirl the sample and methanol for about 10 seconds to break up the soil. DO NOT SHAKE.
26. Place the sample in a plastic bag on ice in a cooler.
27. Attach a green sticker on the plastic bag to indicate a hazardous waste.
28. Using the syringe sampler, take another sample from the soil.
29. Cap and label the syringe with the sample identification.
30. Place the syringe with the sample in the plastic bag. This sample is for dry weight determination.
31. Decontaminate the jar/balance using decontamination procedures appropriate for the type and level of contamination.
32. Unused methanol must be returned to the laboratory for disposal.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 7
LOW LEVEL MERCURY SAMPLING SPECIFICATIONS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 211:	Part 211, Underground Storage Tank Regulations, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides guidance for the collection of groundwater samples from monitoring wells for analysis using U.S. EPA Method 1631, Revision B; Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, U.S. EPA, Office of Water, EPA-821-R-99-005, May 1999, to evaluate mercury concentrations in groundwater venting to surface water and determine compliance with the groundwater to surface water interface (GSI) criterion. The GSI criterion is based on "total" mercury, i.e., all forms of mercury existing in the groundwater. This includes both inorganic and organic types, dissolved or attached to particulate present in the groundwater.

This attachment is applicable to site investigation and response activities under Part 201, and Part 213 of NREPA.

SUMMARY

The U.S. EPA Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, July 1996, U.S. EPA, Office of Water, Engineering and Analysis Division, Washington D.C., was used as a reference to develop this attachment. The two-person team approach, as described in Method 1669, "Dirty Hands," and "Clean Hands" sampling was adopted, and quality assurance and control requirements of that method have been incorporated.

Modifications of this method, and other methods, may be proposed and used if found adequate by the MDEQ to produce reliable results for sampling groundwaters for low level mercury. The presentations of information that validate the use of other methods or modifications of this method are the responsibility of the parties proposing their use. This attachment is not intended to be used in place of Method 1669 when the use of that method is required.

CONTACTS

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The following documents are rescinded with the issuance of this attachment:

- Environmental Response Division Procedure, "Groundwater Sampling from Monitoring Wells for Low Level Analysis of Mercury" dated April 13, 2001.

APPENDAGE:

Low Level Mercury Sampling and Analysis Specification

This memorandum and its attachment are intended to provide direction and guidance to foster consistent application of Part 201, Part 211, and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

LOW LEVEL MERCURY SAMPLING AND ANALYSIS SPECIFICATIONS

Summary

Sampling equipment, materials, and containers are cleaned using high purity chemicals and double bagged for protection from contamination during storage and transportation. Highly purified reagent water is provided to the field personnel for the decontamination of the equipment and collection of field blanks. High purity, diluted, hydrochloric acid (HCl) is also provided to field staff for preservation of the sample.

A two-person team, as described in Method 1669, is used for sample collection. One member of the two-person sampling team is designated as "Dirty Hands," and the second member is designated as "Clean Hands." The individual designated as "Clean Hands" will handle all operations involving contact with the sample bottle and transfer of the samples from the sample collection device to the sample bottle. "Dirty Hands" is responsible for the preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample. Sampling teams wear clean non-talc gloves as well as clean, lint-free, outer clothing to protect samples from contamination by lint and dust.

Special precautions are incorporated to minimize contamination. When possible the facility history and results showing previous results of mercury levels at specific locations are used to design the collection process, in order to minimize the chances of cross contamination. Where decontamination of the equipment is required, equipment blanks are taken before each sample. Sample collection is performed by a strict protocol designed to minimize contamination.

Because of the likelihood of positive blanks and the affect they have upon the results, staff should carefully evaluate blank levels before making regulatory decisions. For application to regulatory requirements, it is recommended that blank mercury levels be less than one-fifth of the mercury in the associated sample. This is the guideline recommended in Method 1631.

Definitions

1. Trace Metal Grade Reagents – Reagents that make no significant contribution of mercury to the sample.
2. Dirty and Clean Hands: All operations involving contact with the sample bottle, and transfer of the samples from the sample collection device to the sample bottle, are handled by the individual designated as "Clean Hands." An individual designated as "Dirty Hands" is responsible for the preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample.

Contamination and Interferences

The need to avoid contamination when collecting samples for extremely low level measurements cannot be over emphasized. Field collection personnel should be familiar with the potential sources of mercury contamination, and implement those steps necessary for adequate control. Field and equipment blanks are used to discover contamination problems during the collection steps.

1. Potential Sources of Mercury Contamination: These include metallic and metal-containing equipment, containers, lab ware, reagents, and de-ionized water, improperly cleaned, and stored equipment, as well as atmospheric sources such as dirt and dust, automobile

exhaust, laboratory workers, and cigarette smoke. Well construction materials, e.g., the gravel pack and well screen, may also be a source of contamination.

2. Potential Contamination from Well Construction Materials: Levels of mercury in groundwater samples can be a result of natural background, well construction material, or environmental contamination. To reliably distinguish the mercury contribution of both natural background and well construction materials from environmental contamination, measurements from up-gradient background wells, constructed in the same manner as down-gradient wells, are necessary. RRD Operational Memorandum No. 4 provides guidance on establishing background.
3. Use of Peristaltic Pumps: Peristaltic pumps have distinct advantages in controlling contamination, and should be used when possible. Most other pumps have metal parts that may come in contact with the sample; hence, pumps must be decontaminated. For peristaltic pumps, only the tubing is in contact with the sample: consequently, clean tubing is all that is necessary to minimize contamination.
4. Control: The best way to control contamination is to minimize exposure of the sample and sampling equipment to possible sources of contamination. When possible, prior knowledge of mercury levels at sampling locations is used for planning collection activities to minimize chances of contamination from high sources, cross contamination resulting from sequentially sampling locations of high and low levels, and cross contamination during storage and transportation. Appropriate equipment and field blanks are used to discover contamination.
5. Filtering: If filtering is determined necessary (see RRD Operational Memorandum No. 2, Attachment 5 for direction on filtering) it must be performed at the laboratory to prevent contamination.
6. Preservation: Preservation at the laboratory is optional for samples not requiring filtering. Unpreserved samples should be sent to the laboratory overnight.

Apparatus and Materials

1. Disposable Materials: Disposable materials such as gloves, storage bags, and plastic wrap, may be used new without additional cleaning unless the equipment blank results identify any of these materials as a source of contamination. If new disposable materials are found to be a source of contamination, then a different supplier must be obtained or the materials must be cleaned.
2. Sample Bottles: Fluoropolymer (FEP, PTFE) or borosilicate glass, 125 ml to 1 L, depending upon laboratory specifications with fluoropolymer or fluoropolymer lined caps, cleaned according to Method 1669/1631 procedures, with air tight cap. Containers are filled with 0.1 percent HCl (v/v), tightly capped, double bagged in new polyethylene zip-type bags until needed, and stored in cardboard boxes until use. Sample bottles are transferred to the facility with 0.1 percent HCl, or emptied and filled with reagent water for transportation.
3. Tubing for use with low-flow sampling pump: Use fluoropolymer tubing in lengths as required to reach the sampling point. Tubing must be cleaned by soaking in a 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water in a clean bench in a clean room, and drying in the clean bench by purging with mercury-free air or nitrogen. Tubing must be double-bagged in clear polyethylene bags, serialized with a unique number to identify it in case of contamination problems, and stored until use.
4. Peristaltic Pump: 115V A.C., 12V D.C. internal battery, variable-speed, single head, Cole-Palmer or equivalent, portable, "Masterflex L/S," Catalog No. H-07570-10 drive with Quick Load Pump head, Catalog No. H-07021-24, or equivalent.
   a. Tubing for use with peristaltic pump. Styrene/ethylene/butylene/silicone (SEBS) resin, approximately 3/8 in. internal diameter (i.d.) by approximately 3 ft., Cole-Palmer size 18,

Cat. No. G-06464-18, or approximately ¼ in. i.d., Cole-Palmer size 17, Catalog No. G06464-17, or equivalent. Tubing is cleaned and stored as provided above.

b. Tubing for connection to peristaltic pump as provided above. Fluoropolymer, 3/8 or ¼ in. outside diameter (o.d.), in lengths required to reach the point of sampling. Tubing is cleaned and stored as provided above. If necessary, more aggressive cleaning (e.g., concentrated nitric acid) may be used.

5. Bladder Pump: QED[1] model MP-SP-4P.
   a. Water Level Meter – Provided as part of the QED bladder pump equipment, QED part number MP30-150.
   b. Controller – Provided as part of the QED bladder pump equipment, QED part number MP-15.
   c. Bladders – QED Bladder Kit, part number 38360. Unless it is known, the bladders do not contribute to contamination, the bladders must be cleaned and stored as provided above.
   d. Spare CO2 Tank – QED part number 38304.
6. Water Quality Instruments: Use instruments capable of measuring temperature, hydrogen ion activity (pH), specific conductance, redox, dissolved oxygen, and turbidity to determine when formation water is entering the pump. With the equipment provided to staff, a separate meter is necessary for turbidity measurements.
7. Gloves: Clean, non-talc polyethylene, latex, vinyl, or polyvinylchloride (PVC): various lengths.
8. Gloves: PVC—Fisher Scientific Part No. 11-394-100B, or equivalent.
9. Wind Suit: Suitable to protect samples from contamination from lint and dust. Unlined, long sleeve wind suit consisting of pants and jacket constructed of nylon or synthetic fiber are suitable. Tyvek® suits are used in this procedure.
10. Storage bags: Clean, zip-type, non-vented, colorless polyethylene (various sizes). Large size bags are needed for storage of the pump during transportation between sampling locations.
11. Plastic Wrap: Clean, colorless polyethylene.
12. Cooler: Clean, nonmetallic, with white interior for shipping samples.
13. Ice: Use ice to keep samples chilled during shipment. Chemical packs are less effective.
14. Carboys: Dedicate one specific carboy for "Reagent Water."
15. Plastic Decontamination Tubs: Containers of various sizes to immerse the submersible pump, sampling tubing, and the wetted parts of the water level meter and multi-parameter monitor. Four tubs are needed, one for a soap solution, one for tap water rinse solution, one for reagent water rinse, and one to hold the reagent water for obtaining field blanks.
16. Pipette: Automatic pipette, capable of dispensing 10.0 ml and automatic tip ejector.
17. Pipette Tips: Colorless, 10 ml, for use with automatic pipette. Pipette tips must be cleaned and stored as described under tubing above.

Reagents

1. Reagent Water: Ultra pure deionized water, starting from a pre-purified (distilled, reverse osmosis, etc.) source, 18 Megaohms minimum, provided in a carboy suitable to prevent mercury contamination. The water should be tested at the laboratory for suitability for sampling. The quantity needed depends on the amount of water needed for each decontamination cycle and the number of wells sampled. The laboratory should provide this water.
2. Preservative: Hydrochloric acid (HCl), 6 N (normal) made from Trace Metal Grade acid and reagent water, and tested to contain less than 0.5 ng/L of mercury. The laboratory should provide this reagent.

3. Soap: Alconox [2] CITRANOX®, suitable for cleaning instruments for low level mercury sampling. Prepare a 2 percent solution as per the manufacturer's instructions.

Site Sampling Plans and Sample Delivery Strategies to Minimize Contamination

1. Sample Collection Strategy: Sample collection activities should be designed that will minimize the potential for cross contamination.
   a. If possible, use previous facility data showing mercury levels at the locations to be sampled. If mercury data is not available, use other information to make a judgement whether the mercury level is suspected to be high or low. For example, if data is available for other metal levels, the relative levels of these metals may be a good indicator of whether high or low mercury levels are suspected.
   b. Arrange the sampling sequence in order of their known or expected levels of mercury. Collect samples starting from locations known to have the lowest and approximate same levels of mercury, and proceed to those of higher levels. In this manner, if decontamination procedures fail to remove all residual mercury, the effect on samples will be minimized.
   c. Group samples so that samples of high and low levels are separately grouped in storage and transportation. For purposes of separating samples based on expected concentration levels, samples believed to have concentrations more than 200 ng/L of mercury should be identified as high level samples, and low level samples less than or equal to 200 ng/L.
2. Sample Information Provided to the Laboratory: Laboratory areas and instrumentation used for low level analysis of mercury are extremely clean and designed to prevent mercury contamination from outside sources. Processing a sample with an extremely high level of mercury in these areas can result in contamination of the area and instrumentation, resulting in delays and additional expense. Using the evaluation described above, provide information to the laboratory regarding the known or expected levels of mercury for each location sampled. Information useful to the laboratory and recommended to be provided is as follows:

Mercury (Hg) Level	**Provide to Laboratory**
Hg levels not known and high levels expected.	Expected > 200 ng/L
Hg levels not known and low levels expected.	Expected < 200 ng/L
Hg levels previously found	Provide Data
Hg levels and expectations not known	Not Known

Sample Collection, and Handling Considerations

Sampling precautions should be taken as follows:
1. Use low-flow rates (0.5 L/min.) during both purging and sampling to maintain minimal draw-down in the well.[3]
2. Place the sampling pump intake at the proper sampling point.
3. Minimize disturbance of the stagnant water column above the screened interval during water level measurement and sampling device insertion.
4. Make proper adjustments to stabilize the flow rate as soon as possible.
5. Monitor water quality indicators during purging.
6. Collect unfiltered samples to represent contaminant loading and transport potential in the subsurface system.

7. Filtering (if necessary): If it is not feasible to collect samples representative of the water flowing in the aquifer, and filtering is determined necessary, (see RRD Operational Memorandum No 2 – Attachment 5 for direction on filtering), collect duplicate samples and identify one of these to be filtered and preserved upon receipt at the laboratory. Appropriate arrangements must be made with the laboratory to ensure the filtering and subsequent preservation is accomplished for identified samples immediately upon receipt. Arrangements with the laboratory to utilize appropriate filters should be made well in advance of sample collection, so that immediate filtering and preservation at the laboratory can be accomplished upon receipt of samples.
8. Water samples should not be taken immediately following well development. Sufficient time should be allowed for the groundwater flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on facility conditions and methods of installation but often exceeds one week.
9. Well purging is nearly always necessary to obtain samples of water flowing through the formation associated with the screened interval. The required purging procedure relies on the stabilization of several water quality parameters to determine when formation water is being pumped. The pH, specific conductance, redox, dissolved oxygen, and turbidity are monitored for this purpose. Temperature is also measured and recorded during this process but is not used as an indicator for formation water. Data on pumping rate draw-down, not to exceed 0.1 meter, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.
10. Water Level Measurements and Monitoring: Well depth should be obtained from the well logs. Since measuring to the bottom of the well casing will cause re-suspension of the settled solids and require longer purging times for turbidity equilibration, measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point, which is surveyed relative to ground elevation.

Sample Collection using Bladder Pumps

1. Upon arrival at the sample location, one member of the two-person sampling team is designated as "Dirty Hands," and the other as "Clean Hands."
2. An area, expected or known to be free of high levels of mercury, is selected.
3. The team removes the bags containing the pump, monitoring instruments, tubing, carbon dioxide (CO2) cartridges, gloves, plastic wrap, and wind suits, from the coolers or storage containers in which they are packed.
4. The team puts on Wind Suits and PVC gloves.
5. The team generates the Initial Equipment Blank, following the steps listed under Decontamination and Initial Equipment Blank.
6. The team proceeds to the sampling location.
7. The team opens the well.
8. The team changes gloves.
9. Keeping both bags together, Dirty Hands opens the outer bag containing the pump.
10. Clean Hands opens the inner bag and removes the pump.
11. Clean Hands lowers the submersible sampling pump into the monitoring well. Lower the pump slowly and carefully to the middle of the screened interval or slightly above the middle. This should minimize excessive mixing of the stagnant water above the screen with water in the screened interval and minimize suspension of solids from the bottom of the well.
12. Dirty Hands opens bag containing static water level meter. Clean Hands removes water level meter. Clean Hands sets up the water level meter.

13. Clean Hands connects the multi-meter flow through cell to the pump outlet.
14. Dirty Hands turns on the submersible pump, sets the pump for the allowable water level draw-down (not to exceed 0.1 meters), and slowly pumps the water while monitoring the water level to assure that that the pumping rate does not result in draw-down of the water level. With the QED bladder pump in this standard operating procedure (SOP), the pump will turn off automatically if this level is exceeded. As the well is pumped, water quality parameters are monitored to determine when formation water is flowing through the pump. Formation water is considered to be flowing, if three consecutive measurements of the water quality parameters, conducted at 3-5 minute intervals, meet the following requirements:
    a. Turbidity, within ± 10 percent.
    b. pH, within ± 0.1 pH units.
    c. Specific conductance, within 3 percent.
    d. Redox, within ± 10 millivolts
    e. Dissolved oxygen, within ± 10 percent. If dissolved oxygen is used for comparison to criteria or a mixing zone calculation, the dissolved oxygen calibration must be corrected for local barometric pressure and elevation. The equipment in this procedure (YSI multi-parameter meter) automatically corrects the dissolved oxygen for these conditions.
15. After stabilization, Clean Hands disconnects the meter.
16. The team changes gloves.
17. Dirty Hands retrieves the sample containers required, and unzips their outer bags. Retrieve two sample containers if filtering is required, for duplicate samples, or for field blanks. If split samples are to be generated a larger size container is required, at least twice the size of normal samples.
18. Dirty Hands prepares the label(s).
19. Clean Hands opens the inner bag, removes the sample container, and reseals the inner bag.
20. Clean Hands removes the cap for the sample being collected, and while holding the cap upside down, discards the diluted acid into a waste carboy, or empties the reagent water onto the ground.
21. If a field blank is being generated, proceed as follows:
    a. Clean Hands opens the inner bag and places the emptied sample bottle and its cap in its inner bag. This bottle is to be identified as the field blank.
    b. Clean Hands obtains another sample bottle from its inner bag, removes and, discards its cap.
    c. Clean Hands retrieves the field blank bottle, and pours the contents of the sample bottle into the field blank bottle.
    d. Skip to step 27 below.
22. Clean Hands rinses the sample bottle and cap three times with the formation water flowing from the pump, and collects the sample from the flowing tube.
23. Clean Hands caps the sample, opens the inner bag, and places the sample in its inner bag.
24. If filtering is required or a duplicate sample is to be taken, Steps 18 through 23 are repeated to immediately take another sample.
25. For samples required to be filtered or preserved at the laboratory, skip to step 27 below.
26. Preserve each sample taken as follows:
    a. Dirty Hands opens the outer bag containing the preservative, pipette, and tips.
    b. Clean Hands opens the inner bag, opens the preservative, retrieves the pipette, and prepares it for dispensing.

c. Use the information included in Sample Preservation and Holding Time for the correct amount of preservative. Clean Hands pipettes the required amount of preservative into the sample container(s), ejects the pipette tip into the waste container, places the pipette back into its inner bag, recaps the preservative, and seals the inner bag.
d. Dirty Hands seals the outer bag for the preservative.

27. Clean Hands caps the sample(s), opens the inner bag(s) for the sample(s), places the sample bottle(s) into the inner bag(s), and seals the inner bag(s).
28. Dirty Hands seals the outer bag(s), writes sample identification information in permanent ink on the outside of the plastic bag, places the sample(s) in the cooler (on ice), and closes the cooler.
29. Dirty Hands measures and records the depth to the bottom of the well.
30. Dirty Hands records the sample number(s) in the sampling log, water quality parameters, and notes any unusual observations.
31. Clean Hands removes the equipment from the well, removes the water level meter, and places them into bags for transportation.
32. Both Dirty and Clean Hands move to the decontamination area with the equipment.
33. Decontamination Between Sampling Locations steps are used to decontaminate the equipment.
34. Generating the Equipment Blank steps are used to collect an equipment blank.
35. If other samples are to be taken at the facility, the team proceeds to the next sampling location, and collects another sample beginning with step 6 above.
36. If samples are to split, proceed as follows:
    a. The team selects a suitable place for splitting samples.
    b. The team changes gloves.
    c. Dirty Hands opens the cooler, removes the bag containing the sample to be split. The volume of this sample must be at least twice the volume of normal samples.
    d. Dirty Hands removes two bags with sample containers, and unzips their outer bags. These containers will hold the split samples.
    e. Dirty Hands prepares the label(s).
    f. Clean Hands opens the inner bags holding all containers, removes the containers, removes the caps of all containers and places them in their respective inner bags.
    g. Clean Hands discards the diluted acid from the two sample containers, into a waste carboy, or empties the reagent water onto the ground.
    h. Clean Hands pours from the container holding the sample to be split, into each of the sample containers.
    i. Clean Hands discards the container that held the sample to be split.
    j. Clean Hands retrieves the caps, seals the samples with their respective caps, places the samples into their inner bags, and seals the inner bags.
    k. Dirty Hands seals the outer bag(s), writes sample identification information in permanent ink on the outside of the plastic bag, places the sample(s) in the cooler (on ice), and closes the cooler.
    l. Equipment blanks associated with the respective samples must be provided to both parties receiving split samples.
    m. Repeat steps for each additional split sample.
    n. Information specific for splitting samples must be documented. If others request split samples, use the MDEQ Laboratory's chain of custody sheet. If the MDEQ is requesting the split sample, and a chain of custody is not forthcoming from the sampler, use the MDEQ chain of custody, fill out information, sign it, and request this be signed by the provider of the samples.

Sample Collection using Peristaltic Pumps

1. Upon arrival at the sample location, one member of the two-person sampling team is designated as "Dirty Hands," and the other as "Clean Hands."
2. The team opens the well to be sampled.
3. An area, expected or known to be free of high levels of mercury, is selected. Sampling should proceed from lowest to highest expected level of contamination.
4. The team removes the bags containing the pump, batteries, monitoring instruments, SEBS resin tubing, gloves, plastic wrap, and wind suits, from the coolers or storage containers in which they are packed.
5. The team puts on Wind Suits and PVC gloves.
6. Dirty Hands removes the pump from its storage bag and opens the bag containing SEBS resin tubing.
7. Clean Hands installs the tubing in the well. Lower the tubing slowly and carefully to the middle of the screened interval or slightly above the middle, to minimize excessive mixing of the stagnant water above the screen with water in the screened interval, and to minimize resuspension of solids from the bottom of the well.
8. Clean Hands installs tubing on the pump.
9. Dirty Hands opens bag with water level meter.
10. Clean Hands removes water level meter and lowers it into the well.
11. Clean Hands connects the multi-parameter meter flow through the cell to the pump outlet.
12. Dirty Hands turns on the peristaltic pump and slowly pumps the water while monitoring the water level to assure that that the pumping rate does not result in excessive draw-down of the water level (not to exceed 0.1 meters). As the well is pumped, water quality parameters are monitored to determine when formation water is flowing through the pump. Formation water is considered to be flowing if three consecutive measurements of the water quality parameters, conducted at 3-5 minute intervals, meet the following requirements:
    a. Turbidity, within ± 10 percent.
    b. pH, within ± 0.1 pH units.
    c. Specific conductance, within 3 percent.
    d. Redox, within ± 10 mv.
    e. Dissolved oxygen, within ± 10 percent. If dissolved oxygen is used for comparison to criteria or a mixing zone calculation, the dissolved oxygen calibration must be corrected for local barometric pressure reading and elevation. The equipment in this procedure (YSI multi-parameter meter) automatically corrects the dissolved oxygen for these conditions.
13. After stabilization, Clean Hands disconnects the meter.
14. The team changes gloves.
15. Dirty Hands opens the cooler containing the sample bottle, and unzips the outer bag containing the sample container. If the sample is to be split, a larger size container is required at least twice the size of normal samples. If filtering is necessary, a field blank is being generated, or a duplicate sample is to be taken, Dirty Hands unzips the outer bag of another sample container.
16. Dirty Hands prepares the sample label(s).
17. Clean Hands opens the inner bag, removes the sample container, and reseals the inner bag.
18. Clean Hands unscrews the cap, and while holding the cap upside down, discards the diluted acid into a waste carboy, or empties the reagent water onto the ground.
19. If a field blank is being generated, proceed as follows:

a. Clean Hands places the sample bottle and its cap in its bag. This is to be identified as the field blank.
b. Clean Hands obtains another sample bottle from its bag, unscrews and discards the cap.
c. Clean Hands retrieves the field blank bottle, and pours the contents of the other bottle into the field blank bottle, discards this other bottle, retrieves the cap of the field blank and caps the field blank.
d. Skip to step 22 below.

20. Clean Hands rinses the sample bottle and cap three times with the formation water, and collects the sample from the flowing tube.
21. Clean Hands caps the sample.
22. Clean Hands places a label on the sample container, and places it in its inner bag.
23. If filtering is required, or a duplicate sample is to be taken, steps 17 through 22 are repeated to immediately take another sample.
24. For samples required to be filtered, and samples requiring preservation at the laboratory, skip to step 26 below.
25. Preserve sample as follows:
    a. Dirty Hands opens the outer bag containing the preservative, pipette, and tips.
    b. Clean Hands opens the inner bag, opens the preservative, retrieves the pipette, prepares it for dispensing, and pipettes the required amount of preservative into the sample container(s). Use the information included in Sample Preservation and Holding Time for the correct amount of preservative.
    c. Clean Hands ejects the pipette tip into the waste container, places the pipette back into its inner bag, and seals the inner bag.
    d. Clean Hand caps the preservative, places it in its inner bag, and seals the inner bag.
    e. Dirty Hands seals the outer bags for the pipette and preservative.
26. Clean Hands caps the sample(s), opens the inner bag(s) for the sample(s), places the sample bottle(s) into the inner bag(s), and seals the inner bag(s).
27. Dirty Hands seals the outer bag(s), writes sample identification information on the outer bag, places the sample(s) in the cooler (on ice), and closes the cooler.
28. Dirty Hands measures and records the depth to the bottom of the well.
29. Dirty Hands records the sample number(s) in the sampling log, water quality parameters, and notes any unusual observations.
30. Clean Hands removes the equipment from the well, removes the water level meter, and places them into bags for transportation.
31. Both Dirty and Clean Hands move to the decontamination area with the equipment.
32. Decontamination Between Sampling Locations steps are used to decontaminate the water level meter and multi-parameter meter. The SEBS resin tubing is replaced prior to sampling each new monitoring well.
33. If other samples are to be collected, the team proceeds to the next sampling location, and collects another sample beginning with the step 1.
34. If samples are to be split, follow the steps in Sample Collection Using Bladder Pumps, starting with step 36.

Decontamination and Initial Equipment Blank

1. Dirty Hands prepares the decontamination solutions.
2. Dirty Hands opens outer bag containing tubing and pump bladder.
3. Dirty Hands opens bags containing pump and water level meter.
4. Dirty Hands removes the pump.

5. Dirty Hands holds the pump while Clean Hands removes the bladder from the inner bag and places the bladder on the pump. Clean Hands removes tubing from the inner bag and installs tubing on pump and controller.
6. Dirty Hands lowers pump into tub 1 containing the soap solution.
7. Dirty Hands turns on controller and pumps three volumes of soap solution through the pump and tubing.
8. Clean Hands moves the pump to tub 2 containing tap water.
9. Dirty Hands turns on controller to pump three volumes of tap water through the pump.
10. Clean Hands moves the pump to tub 3 and pumps three volumes of reagent water.
11. Clean Hands places the pump in tub 4 containing reagent water.
12. An equipment blank is taken following steps in Generating the Equipment Blank.
13. Clean Hands removes the water level meter from its storage bag, decontaminates the water level meter by successively cleaning with solutions from tub 1, 2, and 3, and places the meter into a clean storage bag.

Decontamination Between Sampling Locations

1. The team changes gloves.
2. Dirty Hands prepares the decontamination solutions.
3. Dirty Hands lowers pump into tub 1 containing the 2 percent Alconox/tap water solution.
4. Dirty Hands turns on controller and pumps three volumes of Alconox solution through the pump.
5. Clean Hands moves the pump to tub 2 containing tap water (fresh tap water should be used between each sampling location.)
6. Dirty Hands turns on controller to pump three volumes of tap water through the pump.
7. Clean Hands moves the pump to tub 3 and pumps three volumes of reagent water (fresh reagent water should be used between each sampling location.)
8. Clean Hands changes gloves.
9. Dirty Hands opens outer bag containing tubing and pump bladder.
10. Dirty Hands changes gloves.
11. Dirty Hands removes the pump from tub 3.
12. With Dirty Hands holding the pump, Clean Hands removes the bladder from the inner bag and places the bladder on the pump. Clean Hands removes tubing from the inner bag and installs tubing on pump and controller.
13. Clean hands places pump in reagent water in tub 4.
14. The team changes gloves.
15. An equipment blank is taken following steps in Generating the Equipment Blank.
16. Clean Hands places the pump in the storage bag or proceeds to place pump in monitoring well.
17. Clean Hands removes the water level meter from its storage bag, decontaminates the water level meter by successively cleaning with solutions from tub 1, 2, and 3, and places the meter back into a clean storage bag or into the monitoring well.
18. Clean Hands changes gloves.

Generating the Equipment Blank

1. One equipment blank is generated for each location sampled.
2. With the submersible pump in tub 4 holding the fresh reagent water, Dirty Hands turns on the pump and allows several volumes of reagent water to be pumped.
3. The team changes gloves.

4. Dirty Hands opens the box or cooler containing the sample bottles, and unzips the bag containing a sample container. If a split sample is scheduled to be taken, Dirty Hands unzips another bag containing a sample container.
5. Clean Hands opens the inner bag, removes the sample container, and reseals the inner bag.
6. Dirty Hands reseals the outer bag.
7. Clean Hands unscrews the cap, and while holding the cap upside down, discards the diluted acid into a waste carboy, or empties the reagent water on the ground.
8. As reagent water is flowing through the pump, Clean Hands collects the sample by emptying the solution from the sample bottle, rinsing the sample bottle and cap three times with the flowing reagent water, and collecting the sample from the flowing tube.
9. If preservation is performed at the laboratory, skip to step 11.
10. Preserve sample(s) as follows:
    a. Dirty Hands opens the outer bag holding the automatic pipette and preservative.
    b. Clean Hands opens the inner bag containing the preservative and automatic pipette, opens the preservative bottle, and pipettes 10 ml of the preservative into the sample bottle.
    c. Clean Hands recaps the preservative bottle, removes the pipette tip, and places the preservative and pipette back into its bag.
    d. Clean Hands seals the inner bag holding the preservative and pipette.
    e. Dirty Hands seals the outer bag.
    f. Clean Hands opens the inner bag for the sample, places the sample bottle into the inner bag, and seals the inner bag.
11. Dirty Hands seals the outer bag, opens the sample cooler, places the equipment or field blank in the cooler (on ice), and closes the cooler.
12. Dirty Hands records the sample in the sampling log as the "Equipment Blank".
13. If the scheduled sample to be taken is a split sample, follow the steps in Sample Collection Using Bladder Pumps, starting with step 36.
14. Clean Hands removes the pump from the tub, places it in a clean protective bag, and seals the bag.

Sample Preservation and Holding Time

1. Preservation: Samples are transported on ice during shipment to the laboratory. Samples are preserved in the field using 10 ml/L 6N HCl per liter of sample. If filtering and preservation is required at the laboratory, equivalent amounts of HCl per liter of sample can be used.
2. Laboratory Processing of Filtered/Preserved Samples: If filtering and preservation is to be performed at the laboratory, make arrangements with the laboratory for receipt of samples well in advance. If special filters are necessary, these must be provided to the laboratory prior to sample collection activities or arrangements made with the laboratory to ensure they are available upon sample receipt. It is not advisable to plan sampling immediately proceeding non-working days for the laboratory. Upon shipment of samples to a laboratory, it is good practice to immediately contact the laboratory. If the laboratory is not advised of these arrangements, extra effort and expense must be incurred to ensure necessary filtering and preservation.
3. Sample analysis must be performed within 28 days of sample collection.

Quality Assurance/Quality Control

Equipment Blank: The equipment blanks are used to verify the equipment is free from contamination prior to the collection of the sample. (See Decontamination and Initial Equipment Blank and Generating the Equipment Blank)

1. Frequency of Collection: Collect one initial equipment blank, and an equipment blank per monitoring well sampled.
2. Evaluation Criteria: If the mercury concentration in the blank is greater or equal to 0.5 ng/L, or greater than one-fifth of sample concentration, whichever is higher, the associated sample result is an estimate and may be unusable for regulatory application.
3. Corrections: If the initial equipment blank indicates contamination, above 0.5 ng/L, review the process used for cleaning, and have reagents replaced as appropriate.

Field Blanks: The purpose of field blanks is to assess the suitability of the container, preservative, and sample handling. The field blank is generated by simply pouring the solution provided in one of the sample containers into another sample container whose contents have been emptied at the facility. (See Sample Collection Using Bladder Pumps step 21 and Sample Collection using Peristaltic Pumps step 19)

1. Frequency of Collection: One per facility, per day, or one per sampling event, whichever is greater.
2. Evaluation: If the mercury concentration in the blank is greater or equal to 0.5 ng/L, or greater than one-fifth of sample concentration, whichever is higher, the associated sample result is an estimate and may be unusable for regulatory application.

Field Duplicates: The purpose of field duplicates is to assess the precision for the field sampling and analytical process. A field duplicate is collected by filling a second sample container, in rapid succession after the first sample, from the outlet of the sampling stream.

1. Frequency of Collection: Collect duplicates minimally for every 10 samples collected, or at the frequency specified in the project objectives. If possible, select a location with detectable amounts of mercury.

Split Samples: Split samples are used to independently confirm results of the laboratory performing the analysis. Typically a laboratory known to produce valid, unbiased results, is selected as the laboratory to which the split samples are sent.

1. Collection: Split samples are created by dividing one sample collected in the field into two aliquots. This requires the collection of at least twice the volume of sample normally collected, properly preserved if field preservation is performed. Because of the influence that equipment blanks may have upon the use of the data, an equipment blank associated with the sample should be provided along with the split sample. This will require the generation of two equipment blanks prior to the collection of the sample to be split.

Footnotes

1. QED, P.O. Box 3726, Ann Arbor, MI 48160.
2. Alconox, Inc., 30 Glenn Street, Suite 309, White Plains, NY, 10603.
3. Puls, R. W. and Barcelona, M. J. 1996 Low-Flow (Minimal Draw Down) Ground-Water Sampling Procedures, EPA Ground Water Issues, U.S. EPA Office of Research and Development, EPA/540/S-95/504.

Disclaimer

Mention of specific manufacturers and associated instruments does not constitute endorsement by the MDEQ RRD of that manufacturer and equipment.

This SOP is intended to be a performance-based method. Acceptance of results using modifications of this procedure, and using other procedures, will depend upon the demonstration of equivalent performance.

October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS – ATTACHMENT 8
SITES CONTAMINATED WITH PETROLEUM PRODUCTS

Key definitions for terms used in this document:

NREPA:	The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended
Part 201:	Part 201, Environmental Remediation, of NREPA
Part 213:	Part 213, Leaking Underground Storage Tanks, of NREPA
MDEQ:	Michigan Department of Environmental Quality
RRD:	Remediation and Redevelopment Division
U.S. EPA:	United States Environmental Protection Agency
BTEX:	Refers to benzene, toluene, ethyl benzene and xylene isomers
Criteria or criterion:	Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)
Facility:	Includes "facility" as defined by Part 201 and "site" as defined by Part 213
GSI:	Groundwater to surface water interface
Response Actions:	Includes "response activities" as defined in Part 201 and "corrective action" as defined in Part 213
TMBs:	Refers to 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene

PURPOSE

This attachment to RRD Operational Memorandum No. 2 is intended to promote consistency in the selection of potential contaminants and appropriate analytical methods to be used in characterizing facilities contaminated with petroleum products released from underground storage tanks systems for response actions under Part 201 and Part 213. If a release at a facility is not solely the result of a release or threat of release from an underground storage tank system, response actions may be performed for the facility pursuant to Part 201. This guidance is also applicable for characterization of petroleum releases not associated with an underground storage tank system at Part 201 facilities. This document must be used in coordination with other applicable operational memoranda. Sampling strategies are discussed in RRD Operational Memorandum No. 4. Cleanup criteria are provided in RRD Operational Memorandum No. 1. Target detection limits and designated analytical methods are provided in RRD Operational Memorandum No. 2, Attachment 1.

SITE CHARACTERIZATION

Table 1 of this document identifies designated methods that should be used to characterize a facility with known or suspected releases of petroleum products. The contaminants referenced in Table 1 should be considered minimum analytical requirements. In addition to the methods designated in Table 1, Method 4030 for petroleum hydrocarbon compounds and Method 4035 for polyaromatic hydrocarbons are acceptable for screening purposes to determine the general extent of contamination. Method 8261, which is identified in Table 1 is acceptable to generate screening or quantitative results, from the field or at a fixed laboratory location.

All contaminants identified in the site characterization which exceed generic residential cleanup criteria are contaminants of concern. Once the contaminants of concern at a facility are known, methods can be used that target those specific contaminants. All contaminants of concern must be evaluated to determine if remediation is necessary.

Adequate site characterization must document no other hazardous substances have been released (e.g., PCBs) and that there has been no reaction from the petroleum release that results in additional hazardous substances contaminating groundwater. Reactions may include biodegradation or the mobilization of other contaminants due to the interaction of the petroleum release with soil and groundwater chemistry in native soils and in industrial filled areas. Groundwater contaminated from a petroleum release that vents to surface water must be adequately characterized for hazardous substances and water quality characteristics that may result from the release including the biodegradation of the petroleum release or reactions as described above. Specific contaminants of concern that require remediation may be identified from the characterization.

OXYGENATES

Oxygenates refer to any compound that exists in, or may be added to, petroleum products to increase octane ratings. Examples are methyl(tert)butylether (MTBE), t-Butyl alcohol (TBA), Di-isopropyl ether (DIPE), Ethyl(tert)butylether (ETBE), Ethyl alcohol, Methyl alcohol, and Tertiaryamylmethylether (TAME). Those that are oxygenated ethers include MTBE, DIPE, ETBE and TAME. All evaluations of gasoline contaminated facilities that were in operation after 1980 must include analyses for MTBE. Analyses for other regulated oxygenates should be conducted if they are known or suspected to be present.

Oxygenates sample collection and preservation requirements are contained in RRD Operational Memorandum No. 2 - Attachment 6. Method 8260B and similar GC/MS methods are preferred for the determinative analyses for oxygenates as they provide confirmations. Other methods may misidentify some oxygenates due to co-elution of hydrocarbons. Because of the limited number of laboratories that measure all oxygenates in samples, when oxygenates other than MTBE are required to be analyzed, laboratory selection should include a review and acceptance of the method performance data.

Acid preserved samples are used to measure volatiles in waters; however, high temperature purging of acidic samples can cause oxygenates that are ethers to degrade which may result in underreporting. When samples are collected for the analyses of volatiles that include gasoline oxygenate compounds, it is recommended that the acid preserved samples be neutralized prior to analysis. Trisodium phosphate dodecahydrate (TSP) has been determined to be effective and safe for this purpose. Alternately, two samples for volatiles may be taken in the field, and the one intended for oxygenate analyses preserved using TSP to adjust the pH to > 11.

FREE PRODUCT

Free product from releases that have not been in the environment long, such as spills, can be qualitatively and semi-quantitatively identified. Gasoline Range Organics and Diesel Range Organics results, discussed below may help establish whether the material sampled at a facility is a gasoline or diesel fuel product. Similar analytical methods are capable of qualitatively identifying some types of products, by a comparison of the pattern of hydrocarbons found in the sample with the patterns from known petroleum products, a process known as hydrocarbon fingerprinting. While petroleum products may have very specific patterns, the identification of specific petroleum products in the environment is complicated by environmental processes that alter these patterns, such as evaporation, biodegradation, or the presence of more than one type of petroleum product. When there is free product available from the source, this may be used by the laboratory to calibrate instruments and then perform analyses on samples to determine the extent of the contamination from that product.

AESTHETICS

There are no numeric criteria for soil which address aesthetics. Soils which are in compliance with the appropriate health-based, chemical-specific criteria yet still exhibit adverse aesthetic impacts must be addressed. Consideration should be given to the intended use of the property, the depth of the impacted soils, the source of the contamination, and the specific adverse characteristics exhibited in the soil.

EVIDENCE OF PETROLEUM HYDROCARBON COMPOUNDS

Soil or groundwater sampled at petroleum contaminated sites often contains contaminants without established cleanup criteria, and occasionally the concentrations of regulated contaminants are not above criteria but aesthetic impact to soil and/or groundwater is evident from visual or olfactory observations. If a contaminant is identified that has no generic cleanup criteria established, the MDEQ should be contacted. If there is insufficient data to assess the toxicity of the substance, the person implementing the remediation must supply the necessary data for the department to establish a criterion. If specific contaminants are not identified or do not exceed criteria but impact is evident, it may be useful to analyze soils using methods that measure a group of non-specific petroleum hydrocarbon compounds in the soil or groundwater. The term "total petroleum hydrocarbons" was used previously to report these measurements; however, this term is misleading as there are no methods that measure the total petroleum hydrocarbons. It is recommended clearer terms be used for reporting results and the use of the term "total petroleum hydrocarbons" be discontinued. The results in petroleum hydrocarbons should be reported as recommended for the methods used for the measurements. Table 2 identifies designated methods for analysis of petroleum hydrocarbons. This is further discussed in the following paragraphs.

Interpretations of Results for Non-specific Petroleum Hydrocarbon Compounds

The measurements of petroleum hydrocarbons in contaminated soil or groundwater, by the designated methods, are gross quantities without identification of specific contaminants and do not substitute for contaminant-specific cleanup criteria. The results of petroleum hydrocarbon analyses cannot be used to determine compliance with criteria or in making risk-based decisions. The amounts of petroleum hydrocarbons measured may be useful in evaluating the magnitude of petroleum contamination and aesthetic concerns at a facility. The groups of petroleum hydrocarbons measured by these non-specific methods are entirely method-defined, and hence results depend entirely on the method. Once petroleum hydrocarbon materials are characterized using specific methods, those same methods must be used to provide comparable data. It is not appropriate to attempt comparisons of results from different methods.

Methods to Measure Amounts of Hydrocarbons in Petroleum Material

Commonly used methods to measure petroleum hydrocarbons include:

- Methods Based on Petroleum Hydrocarbons Extractable using Hexane - Hexane Extractable Material (HEM)
- Method Based on Petroleum Hydrocarbons Extractable using Supercritical Carbon Dioxide and Infrared Measurements
- Methods Based on Number of Carbons on Petroleum Hydrocarbon Compounds

Specific designated methods are listed in Operational Memorandum No. 2, Attachment 1, and are included in Table 2, Methods Used for Petroleum Products or Petroleum-Type Materials. Summaries of the methods and their application to petroleum-type materials are provided below. Other methods than provided in this document can be used if accepted by the

department. Additional guidance is available from the appropriate MDEQ district office where the facility is located.

Methods Based on Petroleum Hydrocarbons Extractable using Hexane - Hexane Extractable Material (HEM)

Method 1664 (waters) – Request both HEM Polar Material and HEM Non-polar Material. Polar material includes relatively non-volatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related materials. Non-polar material includes petroleum products other than polar materials. This method is not applicable to measurement of materials that volatilize at temperatures below approximately 85 degrees centigrade. Lighter petroleum hydrocarbons (e.g., gasoline, #2 fuel oil) may be partially lost in the solvent removal operation used in this method. Some crude oils and heavy fuel oils contain a significant percentage of materials that are not measured because of their insolubility in n-Hexane. This method is capable of measuring polar hydrocarbons and non-polar hydrocarbons in the range of 5 to 1000 mg/L, and may be extended to higher levels by analysis of a smaller sample volume collected separately. The method detection limit (MDL) is 1.4 mg/L and the minimum level of quantitation (ML) is 5.0 mg/L. Results should be reported as Petroleum Hydrocarbons, HEM Polar Material, or Petroleum Hydrocarbons, HEM Non-Polar Material. Common abbreviations are HEM Polar, and HEM Non-Polar.

Method 9071B (soils) – Request HEM Material. The material sampled should be amenable to chemical drying and solvent extractions with hexane using Soxhlet apparatus. Method 9071B is suitable for extracting relatively non-volatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, biological lipids, and related materials. Method 9071B is not recommended for measuring materials that volatilize at temperatures below 85 degrees centigrade. Lighter petroleum hydrocarbons (e.g., gasoline, #2 fuel oil) may be partially lost during the solvent removal process. Some crude oils and heavy fuel oils may contain materials that are not soluble in n-hexane, and recovery of these materials may be low. Results should be reported as HEM Material.

Method Based on Petroleum Hydrocarbons Extractable using Supercritical Carbon Dioxide and Infrared Measurements

Method 8440 is used for the measurement of the group of petroleum hydrocarbons referred to as total recoverable petroleum hydrocarbons (TRPHs). This group represents those petroleum hydrocarbons extracted with supercritical carbon dioxide using Method 3560, where interferences are removed with silica gel, and measurements made using infrared (IR) spectroscopy. Method 8440 is not applicable to the measurement of gasoline and other volatile petroleum fractions, because of evaporative losses. Method 8440 can detect TRPHs at concentrations of 10 mg/L in extracts. This translates to 10 mg/Kg in soils when a 3 g sample is extracted by SFE (assuming 100 percent extraction efficiency), and the final extract volume is 3 mL. Determination of TRPHs is a measure of mineral oils only, and does not include the biodegradable animal greases and vegetable oils captured in oil and grease measurements. These non-mineral-oil contaminants may cause positive interferences with IR analysis, if they are not completely removed by the silica gel cleanup. Results should be reported as TRPH.

Methods Based on Number of Carbons on Petroleum Hydrocarbon Compounds

Gasoline Range Organics (GRO) and Diesel Range Organics (DRO) – Gas chromatography (GC) is used to separate petroleum hydrocarbon compounds based essentially on the number of carbons on the compounds. Gasoline products have highly volatile hydrocarbon compounds with about 6 to 10 carbons that cover a boiling range of approximately 60 to 170 degrees centigrade. Diesel type products have relatively lower volatile hydrocarbon compounds with

about 10 to 28 carbons that cover a boiling range of approximately 170 to 430 degrees centigrade. Instruments are calibrated for these separate carbon ranges. All compounds from the environmental sample that are measured within the 6-10 carbon calibrated range are then quantified as a group and reported out as gasoline range organics, or GRO. Similarly all compounds from the environmental sample that are measured within the 10-28 carbon calibrated range are then quantified as a group and reported out as diesel range organics, or DRO.

Although GRO and DRO analyses are not required and they cannot be used to determine compliance with criteria or in making risk-based decisions, GRO results may be another tool to use in evaluating releases of petroleum solvents, gasoline, kerosene, #2 fuel oil and aviation type fuels and DRO results may be useful for evaluating releases of products such as fuel oils, diesel fuels, and lubricating oils.

INDICATOR CONTAMINANTS

The appendix to this document identifies contaminants that have historically been found at facilities contaminated with petroleum products. These contaminants can be used to indicate the types of products released at the facility. Because of the complicated mixtures of compounds in petroleum products, the probability of several products being released at a facility, and the risk of inaccurately determining a facility meets cleanup criteria using insufficient characterization information, it is inappropriate to assume these indicator contaminants are the only contaminants necessary to be investigated. Table 1 of this document identifies methods and contaminants that should be analyzed in facility characterization. Table 4 of this document identifies contaminants likely to be present in common petroleum products. This table is not all-inclusive for contaminants that are possibly present, and other analyses may be required.

Questions concerning this operational memorandum should be addressed to the appropriate MDEQ project manager or district supervisor responsible for the area where the facility is located. A monitoring plan that has been submitted as part of an approved Corrective Action Plan (CAP) may not be changed unless an amended monitoring plan is submitted to the RRD project manager.

The following documents are rescinded with the issuance of this attachment:

- Storage Tank Division Operational Memorandum 14, Analytical Parameters and Methods, Sample Handling, and Preservation for Petroleum Releases dated June 12, 1998
- Storage Tank Division General Guidance for Evaluating and Characterizing Petroleum Releases, except for Section 10 "Risk-Based Corrective Action Overview". dated September 15, 1999

APPENDAGES:

Table 1 – Designated Methods for Characterization of Petroleum Contaminated Sites
Table 2 – Designated Screening Methods for Petroleum Products or Petroleum-Type Material
Table 3 – Metals for Site Characterization
Table 4 – Contaminants Likely to be Present in Common Petroleum Products
Support Document: Common Petroleum Products

This memorandum and its attachments are intended to provide direction and guidance to foster consistent application of Part 201 and Part 213 and the associated administrative rules. This document is not intended to convey any rights to any parties or create any duties or responsibilities under the law. This document and matters addressed herein are subject to revision.

Table 1 - Designated Methods for Characterization of Petroleum Contaminated Facilities

Contaminants	Methods	Targeted Contaminant List
Volatile Organics	8260B [1]	MDEQ Lab 8260 List
	8261	See SW-846 8261 List
1,2-Dibromomethane (Ethylene Dibromide, EDB)	8011 504.1 8260B [2]	Not applicable
Oxygenates	8260B [1]	MTBE, Project Specific
Semi-Volatiles, including PAHs	8270C	MDEQ Lab BNA List
Polyaromatic Hydrocarbons (PAHs) [3]	8270C 8310	MDEQ PAH List
Polychlorinated Biphenyls (PCBs)	8082	MDEQ Lab PCB 8082 List
Mercury, Total, Low Level [4]	1669/1631E	Not applicable
Mercury [4]	245.7 200.8	Not applicable
Metals (solids)	6010, 6020 200.7, 200.8	See Table 3 below
Metals (waters)	6020, 200.8	See Table 3 below

Table 2 - Designated Screening Methods for Identifying the Presence of Petroleum Products or Petroleum-Type Material

Contaminant	Method
Gasoline Range Organics	GRO (Wisconsin Modified)
Diesel Range Organics	DRO (Wisconsin Modified)
Hydrocarbon Patterns	Method 8015
TRPH, Infrared (soils)	8440
Petroleum Hydrocarbons, HEM (soils)	9071B
Petroleum Hydrocarbons, HEM Non-Polar Material (waters)	1664
Petroleum Hydrocarbons HEM Polar Material (waters)	1664

[1] See RRD Operational Memorandum No. 2, Attachment 6, Sampling Methods for Volatiles.
[2] This method can not be used for site investigation. EDB cannot be measured by this method at the levels required when the GSI pathway is relevant. For response activity under Part 201 or Part 213, if the GSI pathway has been appropriately documented to be "not relevant", this method can be used, contingent upon requirements in RRD Operational Memorandum No. 2 - Attachment 1 being met.
[3] Method 8270C is preferred.
[4] Appropriate methods in RRD Operational Memorandum No. 2, Attachment 1 should be used. For response activity under Part 201 or Part 213, if the GSI pathway has been appropriately documented to be "not relevant", low level mercury collection and analysis are not required.

Table 3 - Metals for Site Characterization

Metals	CAS/ID	Metals	CAS/ID	Metals	CAS/ID
Antimony	7440360	Chromium (total)	7440473	Nickel	7440020
Arsenic	7440382	Iron	7439896	Selenium	7782492
Barium	7440393	Lead, Total	7439921	Silver	7440224
Beryllium	7440417	Lead, Fine Fraction	PB_FINE	Thallium	7440280
Cadmium	7440439	Lead, Coarse Fraction	PB_ COARSE	Vanadium	7440622
Cobalt	7440484	Mercury, Total	7439976	Zinc	7440666
Copper	7440508	Molybdenum	7439987		

Table 4 - Contaminants Likely to be Present in Common Petroleum Products

Contaminants	Leaded Gas	Un-leaded Gas	Petroleum Solvents	Light Distillate Oils	Residual Oils	Used Motor Oils	Waste Oils
Applicable Footnote	1	2	3	4	5	6	7
BTEX and TMBs	X	X	X	X		X	X
Oxygenates (includes MTBE)		X					
1,2-Dibromoethane (EDB)	X					X	X
1,2-Dichloroethane (EDC)	X					X	X
Polynuclear Aromatics (PNAs)			X	X	X	X	X
Naphthalene	X	X					
2-Methylnaphthalene	X	X					
Volatile Halocarbons (solvents)						X	X
PCBs					X		X
Metals	X	X				X	X
Lead	X						

Table 4 Footnotes:

1. This category includes leaded gasoline and leaded aviation gasoline.
2. This category includes aviation gasoline, regular, mid-grade, and premium unleaded fuels, or any fuel blend containing MTBE.
3. Petroleum solvents include petroleum spirits, mineral spirits, varnish maker's and painter's naphthas and stoddard solvent.
4. Light distillate oils include fuel oils No. 1, No. 2, diesel oils No. 1-D, No. 2-D, kerosene, Jet A and Jet Propellants (JP) No. 4, No. 7, and No. 8.

5. Residual oils include residual fuel oils No. 4, No. 5, and No. 6 (Bunker C), lubricating oils and hydraulic fluids. Most of these fluids are mineral oil based and can be measured by methods identified above. However, some hydraulic fluids are synthetic or water-based and will not be detected by these methods.
6. Used oil is any oil that has been refined from crude or synthetic oil and as a result of use, becomes unsuitable for its original purpose due to loss of original properties, or presence of impurities. Used motor oils may be suitable for further use and may be economically recyclable. Used motor oils include spent motor oils, other lubricating oils, and hydraulic oils from the servicing of automotive vehicles which are not contaminated by halogenated solvents.
7. Waste oil is defined as "used oil" that has been contaminated by spilling, or by mixing with other waste, hazardous or otherwise.

SUPPORT DOCUMENT

COMMON PETROLEUM PRODUCTS

CONTENTS

		PAGE
1.0	INTRODUCTION	10
2.0	PETROLEUM AND PETROLEUM PRODUCTS	10
2.1	Petroleum Fractions	10
2.2	Major Petroleum Products	10
2.2.1	Natural Gas	10
2.2.2	Petroleum Ethers	11
2.2.3	Gasoline and Gasoline Additives	11
2.2.4	Stoddard Solvent and Other Petroleum Solvents	11
2.2.5	Kerosene and Jet Fuels	12
2.2.6	Fuel Oils	12
2.2.7	Diesel Fuels	13
2.2.8	Hydraulic Fluids	13
2.2.9	Lubricating Oils	14
2.2.10	Asphalts and Tars	14
2.2.11	Used Oil and Waste Oil	14
3.0	CONTAMINANTS	14
3.1	Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	14
3.2	Trimethylbenzene (TMB)	15
3.3	Oxygenates	15
3.4	Ethylene Dibromide (EDB, 1,2-Dibromomethane)	16
3.5	1,2-Dichloroethane (1,2-DCA)	16
3.6	Polynuclear Aromatic Hydrocarbons (PNAs/PAHs)	16
3.7	Cadmium	17
3.8	Chromium	17
3.9	Lead	17
3.10	Volatile Halocarbons	17
3.11	Polychlorinated Biphenyls (PCBs)	18
4.0	LIGHT NONAQUEOUS PHASE LIQUIDS (LNAPL)	19
5.0	FATE AND TRANSPORT	20
5.1	Petroleum Hydrocarbons	20
5.2	Metals	22
5.2.1	Lead and Tetraethyllead	22
5.2.2	Cadmium	22
5.2.3	Chromium	23

Table 2A - Fractions of Petroleum Distillations. 10

Table 3B - Chemical and Physical Properties of Selected Organic Petroleum Constituents in Order of Increasing Molecular Weight. 18

Table 3C - Contaminants Likely to be Present in Common Petroleum Products 19
Table 3C Footnotes 19

1.0 INTRODUCTION

The purpose of this document is to promote understanding of petroleum products, including potential constituents, fate and transport; and to assist in the selection of appropriate analytical parameters for the investigation and cleanup of petroleum hydrocarbon releases.

2.0 PETROLEUM AND PETROLEUM PRODUCTS

A basic understanding of the major components of petroleum products is necessary to properly select appropriate analytical methods for monitoring or measurement of various petroleum products and to follow them as they move, partition or degrade in the environment. The following section provides information concerning the major components of these products.

2.1 Petroleum Fractions

Petroleum is separated by distillation into various fractions, each of which may be formulated to be used as petroleum products. Because of the relationship between boiling point and molecular weight, this amounts to a rough separation according to carbon number. Each fraction is a complicated mixture containing a range of carbon numbers and molecular structures. The use that each fraction is put to depends on its volatility or viscosity. Examples of fractions separated by distillation are listed in the table below. This table is also useful to illustrate the petroleum products that may be measured using the gasoline range organics method (GRO) with 6 – 10 carbons and diesel range organics method (DRO) with 10 – 28 carbons, or similar methods that measure carbon ranges.

Table 2A Fractions of Petroleum Distillations

Fraction	Dist. Temp. (°C)	Carbon Number/Main Constituents
Natural Gas	< -88	C_1-C_2
Liquefied Gas	< 1	C_3-C_4
Petroleum Ether	20 to 60	C_5-C_6, cycloalkanes
Gasoline	40 to 205	C_5-C_{10}, cycloalkanes
Napthas, Stoddard Solvents, Thinners	100 to 200	C_5-C_{13}, cycloalkanes, and aromatics
Kerosenes	175 to 325	C_{12}-C_{18}, and aromatics
Fuel Oils	275 to 345	C_{12}-C_{20} and higher alkanes
Lubricating Oils	345 to 540	C_{20}-C_{34} paraffinic and cycloparaffinic based oils
Asphaltic Residue	> 540	Bitumen or Asphaltenes (large polycyclic compounds)

2.2 Major Petroleum Products

2.2.1 Natural Gas

Natural gas contains the smaller and more volatile alkanes consisting mainly of methane and progressively smaller amounts of ethane, propane, isobutanes, butanes,

isopentane, and n-pentane. Natural gas is used chiefly for heating. Propane and butane are liquefied in tanks and sold as Liquefied Petroleum (LP) Gas.

2.2.2 Petroleum Ether

Petroleum ether is composed mainly of C_5 and C_6 compounds including pentane, 2-meth ent 3-methylpentane, cyclopentane, 2,2-dimethylbenzene, 2,3- and isopentane. Petroleum ether is used as a universal solvent and r chemicals, fats, waxes, paints, varnishes, and furniture polishes.

2 Gasoline and Gasoline Additives

Gasoline is a variable and complex blend of distillation temperature fractions to meet a wide variety of engine designs and operating conditions. Gasoline is blended for the ly temperature and altitude of the area where it is used. It is also made in different ratings to meet the needs of different internal combustion engines. between companies, refineries, and even between batches from the Gasoline contains 11-25 percent C_3-C_{12} straight chain alkanes, 18-57 percent C_4-C_{10} branched alkanes, 0.7-2.6 percent C5-C8 cycloalkanes, 2.3-3.5 percent C4-C7 straight chain alkenes, 3.3-4.0 percent C_5-C_7 branched alkenes, 11-56 percent s, and 0.1 to 0.5 percent C_{10}-C_{12} polynuclear aromatic

clude various anti-knock compounds, dyes, corrosion inhibitors, antioxi s, oct boosters, oxygenates and icing inhibitors. Prior to 1996, the primary ad comp und used as an additive to leaded gasoline to increase the octane ratings tetraethyl lead and was permitted under U.S. EPA regulations up to 1,100 mg/l a ead compounds used within the last 10 years include tetramethyl imethyl lead, and methyltriethyl lead. Organic lead compounds in e now restricted to 13 mg/l as lead. The use of organic lead ne has been greatly reduced in recent years. The last producer of anic lead es in the United States stopped making them in early 1991. 1,2-dichloroethane (1,2-DCA) and Ethylene Dibromide (EDB) were added to leaded gasoline to keep organic lead combustion products volatile for discharge with exhaust gases instead of being deposited in the engine combustion chamber. The amount of added 1,2-DCA or EDB is proportional to the amount of organic lead.

Leaded aviation gasoline, because of its higher octane rating, will contain up to double the amount of lead and lead scavengers (1,2-DCA or EDB) contained in leaded automotive gasoline. In 1990, six percent of all gasoline produced in the U.S. was leaded gasoline. After December 31, 1995, use of leaded gasoline as a motor vehicle fuel was prohibited as per Section 211 of the Clean Air Act Amendments of 1990. Methanol, ethanol, t-butyl alcohol (TBA), methyl-tert-butylether (MTBE), ethyl(tert)butylether (ETBE), and tertiaryamylmethylether (TAME) were added as blending agents to increase octane ratings of unleaded gasoline. These oxygenated compounds were also required in Clean Air Act carbon monoxide non-attainment areas to reduce carbon monoxide emissions. Toluene and xylene were also added as blending agents to increase octane ratings.

2.2.4 Stoddard Solvent and Other Petroleum Solvents

Stoddard Solvent, also called white spirits, is a mixture containing hydrocarbons from C_5 to C_{13} with the majority of hydrocarbons in the C_9-C_{11} range, and with a boiling point

range of between 155-200 ^{0} C. There are several different formulations, but in general the hydrocarbons composing stoddard solvent are 30-50 percent alkanes, 30-40 percent cycloalkanes, and 10-20 percent aromatics. Specific compounds and amounts measured in some formulations and appearing on U.S. EPA regulatory lists, or listed in analytical methods include: acenaphthenes (0.4 percent), n-propylbenzene (2.0 percent), 1,2,4-trimethylbenzene (0.9 percent), naphthalene (0.2 percent), and acenaphthalenes (0.3 percent). Stoddard solvent is a multipurpose petroleum solvent. Industrial uses include paint vehicles; thinning agents for paints, coatings, and waxes; printing inks; adhesives; solvents in liquid photocopier toners; and as degreasers in machine and automotive repair shops.

Other petroleum solvents include petroleum spirits, mineral spirits, varnish maker's and painter's (VM&P) naphthas. These products are general-purpose thinners and solvents for paint and varnish. The chemical composition is similar to stoddard solvent, but the range of boiling points in this category of products is broader.

2.2.5 Kerosene and Jet Fuels

Kerosene is used for heating and as aviation turbine fuel (Jet A and B). Kerosene for heating purposes is available as a special low sulfur grade for use in non-flue connected kerosene burner appliances, and as a regular grade for use in flue connected burner appliances.

Jet fuels are made by blending and refining crude oil petroleum products such as naphtha, gasoline, or kerosene to meet specific military or commercial specifications. JP-4 and JP-7 are military specifications; Jet A and Jet A-1 are commercial or civilian specifications.

JP-4 is intended for use in advanced supersonic aircraft and is a naphtha-type fuel made by blending straight-run kerosene streams and lower boiling streams to fit the composition containing approximately (by weight) 43 percent C_4-C_{14} alkanes, 11 percent C_6-C_{10} cycloalkanes, 12 percent C_6-C_{10} alkylbenzenes, and 2 percent C_{10}-C_{12} naphthalenes. It is known as a wide-cut fuel made from distillation products obtained over a wide range of temperatures, and has a broad spectrum of individual compounds with chain lengths ranging from C_4-C_{16}.

JP-7 is made by blending kerosene distillates to achieve a product containing a maximum of 5 percent aromatics by volume and a maximum of 0.1 percent sulfur by weight. One example of JP-7 contained approximately (by volume) 97.4 percent C_{10}-C_{17} alkanes, 0.4 percent C_{10}-C_{11} cycloalkanes, 1.6 percent C_{10}-C_{12} alkylbenzenes, and 0.6 percent C_{10}-C_{11} naphthalenes.

Jet A and Jet A-1 are kerosene-type fuels, used in commercial jet aircraft. Jet A-1 is similar to Jet A, except that the freezing point is lower for long duration international flights. Jet A-1 is the military equivalent of JP-8.

2.2.6 Fuel Oils

Fuel oils are classified as distillates or residuals based on production methods. The distillates consist of overhead or distilled fractions. The residuals are bottoms remaining from distillation. Grades No. 1 and 2 are distillates, and grades No. 4 to 6 are usually residuals (Grade No. 3 is no longer produced). Grade No. 1 is a light distillate,

consisting of hydrocarbons in the C_9-C_{16} range, and intended for use in burners of the vaporizing type in which the oil is converted to a vapor by contact with a heated surface or by radiation. High volatility is necessary to ensure that evaporation proceeds with a minimum of residue. Grade No. 2 is a heavier distillate, usually blended, consisting of hydrocarbons in the C_{11}-C_{20} range, and intended for use in atomizing type burners, which spray the oil into a combustion chamber where the tiny droplets burn while in suspension. This grade is used in most domestic burners and in many medium capacity commercial-industrial burners. Grade No. 4, 5, and 6 (Bunker C) are progressively heavier residuals intended for burners designed to handle their associated viscosity ranges. In the heavier residuals, preheating may be necessary to atomize the fuel or pump the fuel from the storage tank.

The individual PNA compounds and levels present in fuel oil grades are variable. For comparison, PNAs present in fuel oil No. 1 include naphthalenes (2.8 percent) and acenaphthenes (0.4 percent); PNAs present in No. 2 fuel oil include naphthalenes (8.2 percent), acenaphthenes (2.6 percent), fluorenes and acenaphthylenes (1.4 percent), and phenanthrenes (1.4 percent).

2.2.7 Diesel Fuels

Diesel fuels contain predominantly a mixture of C_{10}-C_{19} hydrocarbons and are available in three grades based on volatility, ignition quality, viscosity, and other characteristics. Grade No. 1-D is the class of volatile fuel oils containing kerosene to intermediate distillates. Fuels within this grade are applicable for use in high-speed engines in services involving frequent and relatively wide variations in loads and speeds as well as abnormally low temperatures. Grade No. 2-D includes the class of distillate gas oils of lower volatility. These fuels are applicable for use in high-speed engines in services involving relatively high loads and uniform speeds or engines not requiring high volatility or properties of Grade No. 1-D. Grade No. 4-D covers the class of more viscous distillates and blends of these distillates with residual fuel oils. These fuel oils are applicable for use in low and medium speed engines employed in services involving sustained loads at substantially constant speed. Octyl nitrate is added to some diesel fuels as an ignition improver (as measured by cetane number) at 0.1 percent to 0.2 percent by volume.

2.2.8 Hydraulic Fluids

Hydraulic fluids are a very diverse group of products and include automatic transmission fluid, brake fluid, shock absorber fluid, power steering fluid, floor hoist, and hydraulic jack fluids, as well as fluids for various hydraulic machinery, earth moving equipment, high-lows, and other heavy industrial and construction equipment. This group also includes industrial cutting oils and cooling oils.

Hydraulic fluids are of three types:

- Mineral oil based fluids which make up over 90 percent of all hydraulic fluids.
- Fire-resistant hydraulic fluids which are of four types: high water-based (99-96 percent water), water-in-oil emulsions (mineral oil based, 40 percent water), water-glycol solutions (35 percent water), and water-free pure chemical fluids of which phosphate esters are the most common.
- Synthetic fluids of four main types: synthesized hydrocarbons (composed of olefin oligomers, alkalated aromatics, polybutenes, and cycloaliphatics), organic esters, polyglycols, and phosphate esters.

2.2.9 Lubricating Oils

Lubricating oils contain predominantly a mixture of C_{20}-C_{34} hydrocarbons. They are made from the more viscous portion of the crude oil which remains after removal of gas oil and lighter fractions by distillation. Many petroleum derived hydraulic oils are similar, but are discussed separately as hydraulic fluids. These generally range from low viscosity oils with molecular weights as low as 250 to very viscous lubricants with molecular weights as high as 1000. The types of hydrocarbon compounds present in lubricating oils include normal (n-), and iso-alkanes, cycloalkanes, aromatics, and mixed alkane, cycloalkane, and aromatic ring compounds. These include SAE viscosity engine oil grades 5W through 50 and gear, axle, and manual transmission lubricant grades 75W through 250.

To minimize variation and produce lubricating oils that provide consistent performance, crude oils are selected and segregated according to principle type. The oil is distilled to achieve the appropriate boiling point range; undesirable constituents are removed; and oils are blended with other oils to attain the appropriate physical characteristics. Crude oil stocks are categorized as paraffinic and cycloparaffinic. Cycloparaffinic crude oil contains no wax, has a low pour point (-46°C), and is most desirable for the range of temperatures in automotive engines. Paraffinic stock requires dewaxing to reduce its pour point from approximately 27 to -18°C, and is less desirable for use in automotive engines. Lubricating oils may contain up to 30 percent additives including pour point depressants, viscosity index improvers, defoamers, oxidation inhibitors, antiwear compounds, and friction reducing compounds. A discussion of the various refining processes; cracking, upgrading, hydrotreating, chemical treatments, and lube oil additives necessary to yield the final product is beyond the scope of this guidance.

2.2.10 Asphalts and Tars

Asphalt and tar building materials include binders for asphalt pavement, hot road surface oils, joint fillers, roofing tars and asphalts, dust laying oils, water proofing tars for building foundations, and similar products.

2.2.11 Used Oil and Waste Oil

Used oil means any oil that, as a result of use, has become contaminated by physical or chemical impurities. Typical examples are motor oils, metal cutting oils and hydraulic fluids. Waste oil means oil that is discarded/spilled before use. Each of these products should be analyzed for metals and, all except used motor oil, for PCBs.

3.0 CONTAMINANTS

Contaminants commonly found at sites of known petroleum contamination are tabulated in the tables at the end of this document. Table B identifies chemical and physical properties of selected organic constituents of petroleum products. Contaminants likely to be present in common petroleum products, which when found at sites may serve as indicator contaminants for a release of the source petroleum product are identified in Table C. These contaminants are further discussed below.

3.1 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

BTEX compounds are important for the investigation of gasoline releases to groundwater due to their abundance in gasoline (benzene (0.1-3.5 percent), toluene (2.7-21.8 percent), ethylbenzene (0.4-2.9 percent), and xylenes (3.2-8.5 percent)), the

risk posed by these compounds, especially benzene, and the solubility of these compounds in groundwater. BTEX compounds are also useful for evaluating gasoline releases to soil. However, these compounds (especially benzene) tend to move into the aqueous phase more rapidly and are more susceptible to microbial degradation than most other gasoline components. As a result, historically contaminated soil may not contain measurable quantities of benzene and certain other BTEX compounds. Leach testing of soils consistent with RRD Operational Memorandum No. 2, Attachment 2, may be used, in conjunction with individual concentrations, for determining the allowable soil concentrations for the soil leaching to groundwater migration pathway.

3.2 Trimethylbenzene (TMB)

The TMB isomers (1,2,3-TMB, 1,2,4-TMB and 1,3,5-TMB), and iso- and n-propylbenzenes are constituents of leaded, unleaded, and aviation gasolines, kerosene, JP-4, diesel fuel, and No. 2 fuel oil. These compounds are often present in petroleum products at greater concentrations than the BTEX compounds. While the MDEQ has not established criteria for 1,2,3-TMB; the concentration of 1,2,3-TMB should be compared to the more restrictive of the criteria for 1,2,4-TMB and 1,3,5-TMB. Leach testing of soils consistent with RRD Operational Memorandum No. 2, Attachment 2 may be used in conjunction with individual concentrations, for determining the allowable soil concentrations for the soil leaching to groundwater migration pathway. The TMB isomers generally fall between xylenes and naphthalene in terms of their volatility and mobility in the soil and groundwater. The TMB isomers and isopropylbenzene are unlikely to be of concern for the inhalation and direct contact exposure pathways. The TMB isomers may have the most restrictive criteria for the soil leaching to groundwater and groundwater drinking water ingestion pathways when benzene is not present above its criteria. Because the criteria for isopropylbenzene are not more restrictive than the BTEX compounds, it is unlikely to have the most restrictive criteria at a Part 213 release facility.

The TMB isomers and isopropylbenzene are generally considered to be less amenable to biodegradation than the BTEX compounds. They may be present in the soil and/or groundwater above their respective criteria after the BTEX compounds have biodegraded. Because of their lower volatility, they may still be present above their criteria after the BTEX compounds have been remediated by an air-based remediation system (e.g., soil vapor extraction and air sparging).

3.3 Oxygenates

Oxygenates are added to gasoline to increase octane ratings. The most prevalent oxygenate found in the environment is MTBE. MTBE is added to gasoline at concentrations from 2-7 percent to 15 percent by volume. MTBE is blended into regular, unleaded, and unleaded premium grades to increase octane ratings. The highest levels are found in the higher octane unleaded gasolines (premium unleaded). At 4.3 percent solubility in water, it is among the most water soluble compounds present in gasoline. Since adsorption to soils is inversely proportional to solubility, MTBE is one of the first gasoline constituents to leach out of soil. It also separates in groundwater, and moves ahead of other gasoline components in groundwater. MTBE is, therefore, a potentially valuable monitoring parameter, and precursor of gasoline contamination since it may form a "halo" along the leading edge of the plume.

Identification of the presence and concentration of MTBE may also be important for remedial design. For these reasons, MTBE is a required analytical parameter for investigation and cleanup of gasoline contaminated groundwater and soil. Leach testing of soil consistent with RRD Operational Memorandum No. 2, Attachment 2, accompanied by total MTBE concentrations, is an acceptable option for establishing site-specific concentrations that are protective of the soil leaching to groundwater pathway.

3.4 Ethylene Dibromide (EDB, 1,2-Dibromomethane)

EDB is a leaded gasoline additive and former pesticide. In the 1970s and early 1980s, it was used as a soil fumigant to protect fruits, vegetables and grain crops from insect pests and nematodes. It was also used as a soil fumigant on turf grass, and particularly on golf courses. In 1984, the use of EDB as a soil and grain fumigant was banned. Since the use of leaded gasoline has been greatly reduced, less EDB is made for addition to leaded gasoline. EDB is very mobile in the soil and groundwater and can be found at the leading edge of a contaminant plume. It is very toxic and has extremely low criteria. If detected, EDB is likely to be above the soil and groundwater direct contact criteria. Leach testing of soils consistent with RRD Operational Memorandum No. 2, Attachment 2, may be used in conjunction with EDB concentrations, for determining the allowable soil concentrations for the soil leaching to groundwater migration pathway.

3.5 1,2-Dichloroethane (1,2-DCA)

1,2-DCA is currently used as a chemical intermediate, such as in the synthesis of vinyl chloride, vinylidine chloride, and other compounds, and as a scavenger compound for addition to leaded gasoline. Former uses include use in varnish and finish removers; in soaps and scouring compounds; in dry cleaning solvents; in metal degreasers; in paints, coatings, and adhesives; and as a grain, household, and soil fumigant. 1,2-DCA in soil may leach to groundwater since the compound does not adsorb to soil particles unless the organic content of the soil is high. 1,2-DCA is expected to undergo little or no biological degradation in aquatic systems. The lifetime of 1,2-DCA in groundwater is on the order of days to years. 1,2-DCA in soil is expected to volatilize or leach to groundwater before undergoing significant abiotic transformation. The rate of biodegradation in soils is unknown. 1,2-DCA is very mobile in the groundwater and may be found at the leading edge of a contaminant plume. Leach testing of soils consistent with RRD Operational Memorandum No. 2, Attachment 2, may be used in conjunction with 1,2-DCA concentrations, for determining the allowable soil concentrations for the soil leaching to groundwater migration pathway.

3.6 Polynuclear Aromatic Hydrocarbons (PNAs/PAHs)

PNAs are a group of chemicals composed of from two to five fused benzene rings that are formed during the incomplete combustion of coal, gas, wood, and other organic substances. PNAs can be man-made or naturally occurring. They are ubiquitous products of combustion from common sources such as motor vehicle exhaust and exhaust from other internal combustion engines, wood burning stoves, cigarette smoke, and industrial smoke or soot. There are more than 100 different PNA compounds. They can be found in substances such as crude oil, coal, coal tar pitch, and road and roofing tar. PNAs are ubiquitous in soil. The concentrations of individual PNAs are usually less than 100 ppb in rural soils, generally less than 200 ppb in agricultural soil, and may be in the range of 100 ppb to 100 parts per million (ppm) in urban soils. Cleanup based on site-specific background levels may be appropriate on rural, agricultural, and urban sites. PNAs are present at 1-2 percent by weight in crude oils. Certain compounds may also be found in refined petroleum products including gasoline, kerosene, diesel oil, some heating oils, and motor oil. Leach testing of soils consistent with RRD Operational

Memorandum No. 2, Attachment 2, may be used in conjunction with individual concentrations, for determining the allowable soil concentrations for the soil leaching to groundwater migration pathway.

3.7 Cadmium

Analysis of cadmium is required in the evaluation of used motor oils and waste oils. Collection of groundwater samples must be consistent with specifications provided in RRD Operational Memorandum No. 2, Attachment 5. In soils, cadmium may be measured as either total cadmium or leachable cadmium using a soil leaching procedure consistent with RRD Operational Memorandum No. 2, Attachment 2. Total metal samples should be collected along with leachable metal samples to allow for a direct comparison between the total and leachable concentrations.

3.8 Chromium

Analysis of chromium is required in the evaluation of used motor oils and waste oils. Chromium may be measured as total chromium, or as hexavalent and trivalent chromium. If only total chromium is measured, then hexavalent chromium cleanup values must be used. Total chromium cleanup values (target detection levels or default background values) may be used if hexavalent chromium levels are below target detection limits based on measurement of representative soils. If trivalent and hexavalent chromium are measured, their respective cleanup limits apply. Trivalent chromium may be determined by subtraction of hexavalent chromium from total chromium.

Collection of groundwater samples must be consistent with specifications provided in RRD Operational Memorandum No. 2, Attachment 5. The recommended method of sample filtration is to use an in-line cartridge filter. In soils, chromium may be measured as either total chromium or leachable chromium using a soil leaching procedure consistent with RRD Operational Memorandum No. 2, Attachment 2. Total metal samples should be collected along with leachable metal samples to allow for a direct comparison between the total and leachable concentrations.

3.9 Lead

Lead is a required monitoring contaminant for releases involving leaded gasoline (or unknown gasoline), used motor oil, and waste oils. The lead in gasoline is present as organolead compounds at concentrations ranging between 13 and 1100 mg/l as lead. Lead is also present in used motor oil and in some waste oils. Collection of groundwater samples must be consistent with specifications provided in RRD Operational Memorandum No. 2, Attachment 5. For comparison to the soil criteria protective of groundwater, lead may be measured as either total lead or leachable lead using a soil leaching procedure consistent with RRD Operational Memorandum No. 2, Attachment 2. Total metal samples should be collected along with leachable metal samples to allow for a direct comparison between the total and leachable concentrations. For comparison to direct contact criteria both fine and coarse fraction lead analysis must be performed. For comparison to the particulate inhalation criteria, fine fraction lead analysis must be performed.

3.10 Volatile Halocarbons

Volatile halocarbons analyses are necessary for the investigation and cleanup of used oil and waste oil releases since volatile halocarbon solvents are contained in many products used to clean or service automobile parts. These solvents may also be mixed into waste oils from a variety of sources. Other VOCs should also be evaluated whenever there is reason to believe that other non-petroleum VOCs might be present.

3.11 Polychlorinated Biphenyls (PCBs)

PCBs analyses are necessary for the investigation of waste oil releases since transformer and capacitor fluids containing PCBs, and PCBs from other sources, have been commonly associated with waste oils. PCB analysis may be performed as individual aroclors (1016, 1221, 1232, 1242, 1248, 1254, and 1260), or as total PCBs. Isomer specific concentrations of all Aroclors found at a facility must be added together for comparison to the criteria. See Part 201 R 299.5750 footnotes (J) and (T).

Table 3B Chemical and Physical Properties of Selected Organic Petroleum Constituents in Order of Increasing Molecular Weight

Compound	Molecular Weight	Boiling Point (C)	Water Solubility (ug/L)	Octanol/Water Partition Coefficient (Kow)
Benzene	78.11	80.1	1,800,000	135
MTBE	88.0	55	46,800,000	10
Toluene	92.14	110.6	530,000	620
1,2-Dichlorethane	98.98	83.47	8,500,000	30
Ethylbenzene	106.17	144.4	170,000	2,200
p-xylene	106.17	138	190,000	1,761
m-xylene	106.17	139	190,000	792
o-xylene	106.17	144.4	190,000	792
n-propylbenzene	120.9	159.2	NA	4898
1,2,4-trimethylbenzene	120.19	169.3	55,890	NA
1,3,5-trimethylbenzene	120.2	165	61,150	3162
Naphthalene	128.17	218	31,000	1,950
Acenapthene	154.21	279	4,200	9,600
Acenapthylene	152.2	270	3,900	5,300
Anthracene	178.2	226.5	43	28,000
Phenanthrene	178.2	340	1,000	28,000
Ethylene Dibromide	187.86	132	4,200,000	86
Fluoranthene	202.26	375	210	79,000
Pyrene	202.3	393	140	80,000
Benzo(a)anthracene	228.29	415	9.4	410,000
Chrysene	228.3	448	2	410,000
Benzo(b)fluoranthene	252.3	Unknown	1.5	1,150,000
Benzo(k)fluoranthene	252.3	480	0.8	1,150,000
Benzo(a)pyrene	252.3	495	1.6	1,150,000
Benzo(ghi)perylene	276.34		0.26	3,200,000
Indeno(1,2,3-cd)pyrene	276.3	530	0.022	3,200,000
Dibenzo(a,h)anthracene	278.3	Sublimes	1	6,900,000
Tetraethyllead	323.45	200	NA	NA
Aroclor 1245	328.5		45	1,100,000

Table 3C –Contaminants Likely to be Present in Common Petroleum Products

Contaminants	Leaded Gas	Un-leaded Gas	Petroleum Solvents	Light Distillate Oils	Residual Oils	Used Motor Oils	Waste Oils
Applicable Footnote	1	2	3	4	5	6	7
BTEX and TMBs	X	X	X	X		X	X
Oxygenates (includes MTBE)		X					
1,2-Dibromoethane (EDB)	X					X	X
1,2-Dichloroethane (EDC)	X					X	X
Polynuclear Aromatics (PNAs)			X	X	X	X	X
Naphthalene	X	X					
2-Methylnaphthalene	X	X					
Volatile Halocarbons (solvents)						X	X
PCBs					X		X
Metals	X	X				X	X
Lead	X						

Table 3C Footnotes:

1. This category includes leaded gasoline and leaded aviation gasoline.
2. This category includes aviation gasoline, regular, mid-grade and premium unleaded fuels, or any fuel blend containing MTBE.
3. Petroleum solvents include petroleum spirits, mineral spirits, VM and P naphthas and stoddard solvent.
4. Light distillate oils include fuel oils No. 1, No. 2, diesel oils No. 1-D, No. 2-D, kerosene, Jet A and Jet Propellants (JP) No. 4, No. 7, and No. 8.
5. Residual oils include residual fuel oils No. 4, No. 5 and No. 6 (Bunker C), lubricating oils and hydraulic fluids. Most of these fluids are mineral oil based and can be measured by methods identified above. However, some hydraulic fluids are synthetic or water- based and will not be detected by these methods.
6. Used oil is any oil that has been refined from crude or synthetic oil and as a result of use, becomes unsuitable for its original purpose due to loss of original properties, or presence of impurities. Used motor oils may be suitable for further use and may be economically recyclable. Used motor oils include spent motor oils, other lubricating oils and hydraulic oils from the servicing of automotive vehicles which are not contaminated by halogenated solvents.
7. Waste oil is defined as "used oil" that has been contaminated by spilling, or by mixing with other waste, hazardous or otherwise.

4.0 LIGHT NONAQUEOUS PHASE LIQUIDS (LNAPL)

Petroleum products have many LNAPLs, which should be taken into account when planning sample collection activities. Some of the most common chemicals are Methyl Ethyl Ketone, 4-Methyl-2-Pentanone, Tetrahydrofuran, Benzene, Ethyl Benzene, Styrene, Toluene, m-Xylene, o-Xylene, and p-Xylene. Some of the most common petroleum products are Automotive gasoline, No. 2 Fuel Oil, No. 6 Fuel Oil, Jet Fuel (JP-4), and Mineral Base Crankcase Oil. For technical information see the groundwater issue paper: http://www.epa.gov/ahaazvuc/download/issue/lnapl.pdf.

5.0 FATE AND TRANSPORT

An understanding of the fate and transport mechanisms and contaminant pathways associated with contaminant releases to the environment is necessary to develop a monitoring program, or collect the necessary information leading to remedial action. This is particularly true in the case of petroleum and its products since they are complex mixtures of many different components and additives. These components have different chemical and physical characteristics which control their behavior in releases to soil and water.

Persistence of organic compounds depends on their chemical structure and several environmental factors, including soil organic matter, total precipitation and intensity, temperature, sunlight, and soil texture. Organic chemicals in soil are subject to one or more of seven possible fates: adsorption, volatilization, microbial degradation, photodecomposition, translocation to plants, chemical degradation, and leaching to groundwater. In the case of petroleum products released from underground tanks, adsorption, microbial degradation, and leaching to groundwater are usually very important; volatilization and chemical degradation are generally less important; and photodecomposition and plant uptake are usually unimportant.

The persistence and fate of organic compounds in soil depends on temperature, moisture, and soil texture. The greater the temperature, the greater the volatility, the more active the microbial population, the more rapidly concentrations of organic contaminants will be reduced. Soil moisture affects microbial activity. Microbial activity is reduced if a soil is either too wet or too dry. Volatility is also affected by moisture content; the nature of the effect depends on the solubility of the chemical. The total amount, intensity, and frequency of rainfall affect movement of chemicals in soil. The amount of soil organic matter (organic carbon content) is directly influenced by the soil texture. Coarse sandy soils will normally contain little organic matter. Therefore, water percolation will be rapid and leaching potential of chemical compounds will be high regardless of octanol/water or octanol/carbon partition coefficients. The opposite is true for heavy (i.e., clayey) soils. Water solubility of organic contaminants has the greatest affect on persistence and mobility of organic chemicals. The higher the molecular weight, the lower the solubility; and the higher the degree of halogenation, the lower the water solubility.

Table 3B contains boiling points, water solubilities, and octanol/water partition coefficients for some common petroleum constituents and additives used for monitoring and regulating petroleum product losses. Boiling point can be used as an indication of the kind of petroleum products (based on product distillation temperature) the compounds may be found in. Water solubilities and octanol/water partition coefficients are relative indicators of a compound's ability to partition into water. Benzene has an

octanol/water partition coefficient of 135; meaning that if benzene were added to a mixture containing equal parts octanol and water, 135 parts of benzene would partition into the octanol and 1 part of benzene would partition into the water. In general, the lower the water solubility, the higher the octanol/water, and octanol/carbon partition coefficients.

5.1 Petroleum Hydrocarbons

Upon a release to the environment, the hydrocarbon components selectively partition to the atmosphere, soil, or water according to their physical and chemical properties.

Gasoline, for example, can exist as a free moving liquid, adsorbed to soil particles, dissolved in groundwater, and as a vapor. When a hydrocarbon is released from an underground storage tank, it percolates down through the interconnected pores of the soil as a result of gravity, capillary effects, adsorption, and leaching with precipitation. Liquid gasoline, as a result of its lower than water viscosity, will move through the unsaturated zone 2-3 times faster than water. As it moves downward through the unsaturated zone, it also spreads laterally due to capillary effects and irregularly as a result of the heterogeneity in the soil. Product within the unsaturated zone is partitioned between the water, particulate and air components. The most water insoluble components tend to adsorb to the soil particles; water soluble components dissolve in the suspended pore water; and the volatile components partition to the pore spaces. The speed with which the product moves and the amount of product or product constituents that remain in the unsaturated zone or move to the groundwater depends on the amount of product released, the characteristics of the product, the characteristics of the soil, and other related factors. If the amount of product released is large relative to the depth to groundwater, soil retention capacity may be exceeded and bulk fluid transport to the groundwater may occur.

As the product enters the transitional zone between the saturated and unsaturated zones, known as the capillary zone, it migrates laterally. As it migrates, it can re-enter the unsaturated zone above the capillary zone by surface wetting or wicking. The wicking effect, plus vertical groundwater fluctuation, also affects the distribution of the product within the capillary zone. As the product reaches the groundwater, the soluble components partition into and migrate with groundwater, and the insoluble components float on the water surface as a "pancake" or lens shaped mass. In the case of gasoline, this floating layer migrates at slightly more than half the groundwater velocity. The heavier the product, the slower the movement. The soluble components in the groundwater also experience a chromatographic effect which cause the more soluble components to travel at greater velocities than the less soluble components.

Gasoline will undergo "weathering" over time that will result in change in the relative concentrations of constituent hydrocarbons. In the case of BTEX compounds "weathering" results in reduction of the lighter, more soluble, more degradable BTEX compounds so that the relative concentration is shifted to heavier and more persistent BTEX compounds. Where soils are exposed to the atmosphere, low molecular weight hydrocarbons (such as C_5-C_9 alkanes and aromatics) are more likely to volatilize from soil surfaces, rather than be biodegraded. Reduction of higher molecular weight aliphatic and aromatic constituents will occur by both slow volatilization and by biodegradation. Biodegradation rates will be preferential, with the rate being fastest for low molecular weight aromatics and slower for aliphatic (alkanes, alkenes, dienes and alkynes) hydrocarbons that are branched or cyclic or that contain 10 or more carbons. Some hydrocarbons may not degrade. Bacteria appear to be the most important microbes in the degradation of petroleum hydrocarbons in soil. Normal alkanes, normal

alkylaromatics, and aromatics in the C_{10}-C_{12} range are the most readily degradable hydrocarbons. Normal alkanes, alkylaromatics, and aromatics above C_{22} are generally not available for metabolism by soil microbes because of their limited water solubility and solid physical state. Higher molecular weight hydrocarbons adsorbed to soil particles are generally unavailable for metabolism by microorganisms. Hydrocarbons in the C_5-C_9 range are biodegradable only at low concentrations since at higher concentrations they exhibit toxicity to soil microbes and are generally removed by

volatilization. Polynuclear aromatic hydrocarbons (PNAs) and cycloalkanes are relatively resistant to biodegradation. The rate of biodegradation is highly dependent upon several site-specific factors including temperature, oxygen content, moisture content, nutrient content, salinity, and pH.

PNAs can be placed in four general categories based on their octanol/water partition coefficients (Kow) and tendencies to adsorb to soil. The naphthalenes with Kow values near 2,000 have low adsorption capacity to soils relative to other PNAs. Acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene have Kow values in the range of 10,000 to 30,000 indicating a moderate potential to be adsorbed to soil. Fluoranthene and pyrene have Kow values in the 80,000 range indicating a high potential for soil adsorption; and the high molecular weight compounds (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene) have Kow values in the range of 400,000 to 700,000, indicating a very high potential to adsorb to soil.

5.2 Metals

The fate of metals in soil is dependent on the characteristics of the individual metallic salts and other metallic compounds and complexes (especially solubility), the properties of the soil (pH, cation exchange capacity, texture, organic composition), and the characteristics of the leaching fluid (amount and pH). The relative retentions of metals in soil are in the order of lead > antimony > copper > chromium > zinc > nickel > cobalt > cadmium.

5.2.1 Lead and Tetraethyllead

The downward movement of lead from soil to groundwater by leaching is very slow under most natural conditions except for highly acidic situations. The conditions that induce leaching are: the presence of lead in soil at concentrations that either approach or exceed the cation exchange capacity of the soil; the presence of materials in soil that are capable of forming soluble chelates with lead; and a decrease in the pH of the leaching solution (e.g., acid rain). Leaching of soluble lead from contaminated soils into groundwater may be minimized by the presence of lead carbonate in the soil, and by maintaining a soil pH of 8-10. Limited data indicate that tetraethyllead and tetramethyllead are converted to water soluble lead compounds in soil. Although tetraethyllead and tetramethyllead are not expected to leach significantly through soil, their highly water-soluble metabolites, trialkyl lead oxides, may be subject to leaching. The concentration of lead in topsoil varies widely due to deposition and accumulation of atmospheric particulates from man-made sources. Levels of lead in the upper layer of soil (top six inches) along roadsides may be 30-2,000 mg/kg higher than natural levels. These levels drop exponentially up to 25 meters from the roadway.

5.2.2 Cadmium

Phosphate fertilizers are a major source of cadmium input to agricultural soils. The natural cadmium concentration in phosphate fertilizers ranges from 3 to 100 mg/kg. Mean levels in uncontaminated topsoil in the United States are approximately

0.25 mg/kg. Topsoil levels are often more than twice as high as subsoil levels as a result of atmospheric fallout. Cadmium is also released through tire wear.

Cadmium is more mobile in aquatic environments than most other heavy metals. Cadmium concentration in water is inversely related to the pH and the concentration of organic material in the water. Important factors affecting transformation in soil include the cation exchange capacity, the pH, and the content of clay minerals, carbonate minerals, oxides, organic matter, and oxygen. Cadmium in soils may leach to water especially under acidic conditions.

5.2.3 Chromium

The important valence states of chromium are II, III, and VI. Elemental chromium (0) does not occur naturally. The divalent state is relatively unstable and is readily oxidized to the trivalent state (or chromic state). Chromium compounds are stable in the trivalent state and occur naturally in ores such as in ferrochromite. Hexavalent chromium (VI or chromate) is the second most stable state. However, hexavalent chromium is usually associated with man-made sources and rarely occurs naturally.

Trivalent chromium compounds, with the exception of acetate, hexahydrate of chloride, and nitrate salts are generally insoluble in water. Some hexavalent chromium compounds, such as chromium (VI) oxide (or chromic acid), and the ammonium and alkali salts (e.g., calcium and strontium) of chromic acid are less soluble in water. The zinc and lead salts of chromic acid are practically insoluble in cold water. The hexavalent chromium compounds are reduced to the trivalent form in the presence of oxidizable organic matter. However, hexavalent chromium compounds are more stable in natural waters where there is a low concentration of reducing materials. Chromium released into the environment from combustion of natural gas, oil and coal is present mainly as chromium (III) oxide. Dust from asbestos brake linings (asbestos may contain approximately 1,500 mg/kg of chromium), and emissions from chromium based catalytic converters are other sources of chromium associated with automobiles, but are minor in comparison to chromium from combustion of fossil fuels. Chromium in soil is mostly present as insoluble carbonate and chromium (III) oxide; and will therefore not be mobile in soil. The solubility of chromium in soil and its mobility may increase due to the formation of soluble complexes with soil organic matter. A lower soil pH may facilitate formation of soluble complexes. The sorption of chromium to soil depends primarily on the clay content of the soil and to a lesser extent, on Fe2O3 and the organic content of soil. Chromium that is irreversibly adsorbed to soil, for example in the interstitial lattice of goethite, FeO (OH), is not leachable or otherwise available. Organic matter in soil is expected to convert soluble chromate, chromium (VI), to insoluble chromium (III) oxide, Cr2O3. Soluble and unabsorbed chromium (VI) and chromium (III) complexes in soil may leach into groundwater. The leachability of chromium (VI) in the soil increases as the pH of the soil increases. On the other hand, lower pH present in acid rain may facilitate leaching of acid soluble chromium (III) and chromium (VI) compounds in soil.

RRD OPERATIONAL MEMORANDUM NO. 2
FREQUENTLY ASKED QUESTIONS
February 2005

OPERATIONAL MEMORANDUM (OpMemo) NO. 2 CONTACTS:

Questions on the applicability of the OpMemo to specific site conditions should be directed to the MDEQ project managers or to Patty Brandt, brandtp@michigan.gov 517-373-4710.

Questions regarding the applicability of OpMemo 2 to Baseline Environmental Assessments may be directed to Rhonda Klann, klannr@michigan.gov 989-686-8025 extension 8302 or, Jeanne Schlaufman, schlaufj@michigan.gov 734-953-1527.

Questions regarding target detection limits and designated methods may be directed to A. Ralph Curtis, curtisar@michigan.gov 517-373-8389.

Questions regarding MDEQ Laboratory Standard Operations Procedure #213 for Fine and Coarse Lead Soil Sampling may be directed to Sandra Gregg, greggs@michigan.gov 517-335-9800.

GENERAL APPLICABILITY OF THE OPMEMO

The OpMemo provides direction for response activities pursuant to Part 201, corrective action pursuant to Part 213, and site assessments pursuant to Part 211. The answers provided in this document apply to all programs unless specified otherwise. Terms defined in the OpMemo have the same meaning when used in this document.

How will this new OpMemo affect projects that are ongoing (e.g., investigation or monitoring) as of the date that this OpMemo becomes effective?

OpMemo No. 2 contains the MDEQ's published list of analytical target detection limits (TDLs) for certain hazardous substances and available analytical methods that are capable of achieving the target detection limits in accordance with R 299.5103(l). The effective date of the OpMemo was extended to February 1, 2005, to allow 90 days for laboratories to prepare and sampling plans to be adjusted for changes in methods and detection limits.

OpMemo No. 2 also designates consistent collection, sampling, and analysis protocols for certain substances and circumstances. While other protocols may be acceptable, the OpMemo designates protocols that are acceptable without further MDEQ approval. While RRD recommends discussions with RRD project managers prior to the use of other protocols, nothing in the Operational Memorandum prohibits a party from undertaking response actions without prior approval. However such action does not relieve the person of liability for further response actions if upon review the MDEQ determines further actions are required.

The TDLs are established under rule provisions. Achieving the TDLs is critical for Part 211 site assessment and Part 201 and Part 213 site investigation activities where the objective is the characterization of the nature and extent of contamination and or compliance with cleanup objectives. The sampling and analysis specifications identify acceptable protocols to facilitate gathering the information necessary for the department to determine compliance with applicable

provisions of Part 201, Part 211, and Part 213. The representativeness of data from previously conducted investigation or monitoring activities may require verification if protocols other than those contained in the OpMemo were used.

Is this OpMemo applicable to due diligence performed as part of the BEA process?

The OpMemos were developed with the emphasis on the statutory requirements to define the nature and extent of contamination at a Part 201 or Part 213 facility, to determine relevant exposure pathways, compliance with applicable criteria, and appropriate response actions to remediate an existing release. Part 201 defines a BEA as "an evaluation of environmental conditions which exist at a facility at the time of purchase, occupancy, or foreclosure that reasonably defines the existing conditions and circumstances at the facility so that in the event of a subsequent release, there is a means of distinguishing the new release from existing contamination." This is not the same objective as the OpMemo.

Data collected for due diligence, and BEAs must be capable of supporting the conclusions that are being drawn from the sample results. Generally, a data set is collected for these purposes to provide answers to the following fundamental questions:

1) Is the property a facility?
2) Are the hazardous substances the new owner/operator will use already present on the property?
3) How will a new release be differentiated from existing contamination?

When a data set is collected to determine whether a property is a facility, or whether any hazardous substances that may be utilized by the owner/operator in the future are currently present on the property, it must be representative of the conditions at the site and be compared to generic residential criteria. The data do not need to define the nature and extent of a release or determine whether an existing release has been remediated. However, if the data used to make these determinations do not follow the protocols in Op Memo 2, and evidence of contamination is found in the future, the data may or may not be sufficient to support the defense from liability. For example, if a party is investigating a former service station property and does not look for oxygenates, metals or PCBs and these compounds are found to be present in the future, reliance on liability protection through due diligence or a BEA may be jeopardized. Data collected to differentiate a new release from existing contamination must be sufficient to support the methodology established in the BEA, which is entirely different from other purposes discussed, and must be tailored to meet the specific needs of that BEA. Data used to evaluate compliance with Due Care obligations should follow Op Memo 2 guidelines. Additionally, if different protocols are used, it may affect a party's ability to use the data for other purposes.

TARGET DETECTION LIMITS (TDLs) & DESIGNATED METHODS (ATTACHMENT 1)

If a party has historically sampled for a compound using the previous TDLs, must ongoing sampling be revised to meet the current TDLs?

If monitoring is on-going to determine compliance with cleanup criteria current TDLs must be met for new samples.

Table 1, Footnote 13 for lead soil sampling references the MDEQ Laboratory SOP #213, is this document available?

It is posted on the MDEQ Web at:
http://www.deq.state.mi.us/documents/deq-rrd-OpMemo_2_AttachmentSoilFractionsPrepForLead.pdf

The MDEQ Lab SOP #213 seems to indicate reference sample analysis for both Standard Reference Materials (SRMs) is necessary. Can you clarify this?

Only one SRM is needed for analysis. The SOP has been revised to include the following description of the current MDEQ Designated Reference Samples:

> All sites, those expected to have soils contaminated with lead bearing materials and those not expected to have soils contaminated with lead bearing materials, are required to use National Institute of Standards & Technology, Standard Reference Material, NIST SRM 2586 as the designated reference sample.

Can other SRMs be used?

Other SRMs cannot be used. The SRM chosen is at the regulatory level of 400 ppm and was the only SRM identified with widespread use. Widespread use adds to the validity of the SRM simply because of the numerous results that are obtained. Additionally, the MDEQ has determined this SRM is traceable and similar information is not available regarding others.

Additional questions regarding the necessity of fine and coarse lead sampling are contained under the heading Sample Collection (Attachment 5).

Table 1, Footnote 21, indicates Selected Ion Monitoring (SIM) analyses must be conducted when no detections are found in the full scale mode. Could you clarify this?

Selected ion monitoring refers to a mode of analysis. SIM analysis allows a GC/MS to be selectively tuned or programmed to detect only specific compounds. This focuses all of the instrument's sensitivity and allows the instrument to achieve lower detection levels, often 10 to 1000 times lower.

To clarify the direction regarding the use of SIMs the footnote has been revised to read:

> Achieving the TDL is critical for site assessment and site investigation activities where the objective is the characterization of the nature and extent of contamination. If GC/MS methods (8260B and 8270C) can not meet the TDL, alternate methods must be used to achieve the TDL. All contaminants identified in the site characterization which exceed generic residential cleanup criteria are contaminants of concern. Once the contaminants of concern are identified at a facility, methods and TDLs can be used to target those specific contaminants. For situations where reporting limits are elevated refer to the previous discussion regarding the use of elevated reporting limits (page 3).

Some methods in Attachment 1 and Attachment 4 have different revision numbers. Which methods are to be used?

The most recent revisions should be used. Attachment 1 designates the available analytical methods the MDEQ has determined capable of achieving the TDLs. Methods in the table of Attachment 4 are listed primarily to clarify the type of method used for environmental samples and preservation used for associated contaminants.

Method 300.1 is listed for chloride and sulfate. Is method 300.0 acceptable?

Attachment 1 (page 2) provides a list of alternative acceptable analytical methods for which prior written approval for their use is not required. Method 300.0 is a method promulgated for use under the Federal Safe Drinking Water Act, and prior written approval is not required.

The method for cyanide is listed as 9019B. Should this reference be 9010B?

This is a typo error. Method 9010B is the correct method and the document has been corrected.

Can method 8270 be used to report 1, 2, 4-Trichlorobenzene?

Method 8270 should not be used to report 1,2,4-Trichlorobenzene. The U.S. EPA has indicated that 1,2,4-Trichlorobenzene results from Method 8270 are lower than results compared to Method 8260, and attributes the difference in the results to volatilization of the contaminant during processing.

Can method SM 4500 for ammonia also be used for waters?

Yes. Method SM 4500 (Standard Methods SM 4500) is promulgated for use under the Federal Clean Water Act and can be used without prior written approval. SM 4500 has several ammonia methods, each specifying the type of matrix and water sources that can be utilized for each method. The methods can be used for those matrix and water sources.

The methods in Standard Methods are severely lacking in quality control specifications and should not be used without including the quality control necessary to validate the data. One of the more recent methods proposed for use by the Clean Water Act that has the required quality control and can be used as a template for quality control applicable to other methods, is: METHOD 350.1, DETERMINATION OF AMMONIA NITROGEN BY SEMI-AUTOMATED COLORIMETRY, Edited by James W. O'Dell, Inorganic Chemistry Branch, Chemistry Research Division, Revision 2.0, August 1993, ENVIRONMENTAL MONITORING SYSTEMS LABORATORY, OFFICE OF RESEARCH AND DEVELOPMENT, U.S. ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OHIO 45268

How will the regulators use estimated (J) values when the applicable criterion is lower than the estimated value?

This question implies a situation where the TDL is greater than the risk based criterion. In such a situation Attachment 1, page 2, states that laboratories should report results below the TDL down to the laboratories limits of detection, if concentrations are detected. Appropriate codes must be used to indicate that the results are below the TDL. The results will be interpreted as provided in R 299.5742.

Will reporting of "J" flagged values (estimated concentrations greater than the MDL, but less than the TDL) be acceptable when matrix interference requires that samples be diluted?

Such values should be "J" flagged. Appropriate codes must be used to indicate that the results are below the TDL. The determination that interferences are present may indicate that the sample is contaminated to the extent that no reliable determinations can be made as to whether cleanup criteria are met.

SOIL LEACHING METHODS (ATTACHMENT 2)

When is soil leaching testing required?

Leach testing is <u>not</u> required to demonstrate compliance with applicable criteria if soil concentrations do not exceed the applicable generic groundwater protection criteria. If concentrations exceed applicable soil criteria, additional leach testing may be conducted on select soil samples to determine the potential of contaminants in the soils to leach to groundwater above the most restrictive groundwater criteria.

If a site-specific leach test indicates soils will not likely leach above generic groundwater criteria is it classified as a Tier 1 or Tier II Part 213 closure?

Assuming the leach test is conducted consistent with the specifications provided in this Attachment, a Part 213-closure would be classified a Tier 2 closure based on the site specific leach testing.

What is the "20X rule" referenced in the requirement that TCLP must be used to determine if a waste is characteristically hazardous?

TCLP must be used to determine if there may be Part 111 implications that must be addressed. The Attachment 2 reference to "based upon the 20X rule" (page 2) has been removed from the document because there may be various reasons for considering waste may be characteristically hazardous. There is a 20X rule of thumb for dilution in analysis for determining whether a material that is 100 percent solid has the potential to leach constituents above the TCLP regulatory hazardous thresholds. The 20X dilution provisions are included in the TCLP method (Section 2.2).

A 25 gram coring device to sample volatiles for TCLP is referenced, is there such a device? If not, can multiple coring devices be used?

EnCore™ and others make such a sampling device. Multiple coring devices may be used to collect the 25 gram sample.

Additional questions and answers regarding volatile sampling are contained under the heading Methanol Preservation (Attachment 6).

SAMPLE PRESERVATION, HANDLING, AND HOLDING TIMES (ATTACHMENT 4)

Attachment 4 (page 9) for Chromium VI includes a reference to dry and high moisture soil, for which there are separate holding times. How do we determine what is a dry soil?

Saturated soil and sediment should be treated as high moisture soils. If you are uncertain whether the soil is saturated, then treat it as dry soil.

SAMPLE COLLECTION (ATTACHMENT 5)

SOILS

Laboratories indicate that they can analyze total lead samples and if the totals do not exceed criteria, fine and coarse fraction sampling is not necessary, is that acceptable?

Testing the total sample and comparing to direct contact or soil particulate inhalation criteria is not appropriate. To address lead contamination in Michigan, various governmental agencies were called upon to take action to ensure that steps were being taken to reduce lead poisoning. The State of Michigan's Childhood Lead Poisoning Prevention: A Call to Action directed the MDEQ to review the most recent toxicological and other pertinent data to determine if the current Part 201 residential cleanup criterion is protective and to determine the most appropriate method of soil sampling. The MDEQ as part of the charge to determine the most appropriate method of soil sampling for lead reviewed existing studies and data. EPA's review of lead data from CERLA sites demonstrated that the lead concentrations in the fine fraction often exceed the lead concentrations in the total soil samples. A similar review of Michigan specific data demonstrated the same. The fine fraction is also the portion of the soil most likely to adhere to skin or be inhaled. A potential for the coarse fraction to contain a higher concentration than the fine or total sample also exists. Therefore, the MDEQ Laboratory's standard operating procedure states that both fine and coarse fractions are required to be tested for lead concentrations where lead exposures are evaluated for MDEQ regulatory programs.

The original version of SOP #213 allowed for a "total" analysis and a "fine" analysis with the coarse fraction calculated from the difference. The current version requires analysis of both the fine and coarse fractions with a calculation for total. What was the technical reason for the change?

Sieving the entire sample, weighing and analyzing both the fine and coarse fractions, and reconstructing the total soil concentration using weighted averages is considered more representative of the actual concentrations. To sample for total lead and calculate the coarse

fraction could underestimate or overestimate values by using a select portion of the sample or using a separate sample for the total analysis.

How are laboratories to know when the lead protocols for fine and coarse sample are required?

The OpMemo states that for response actions under Part 201 and Part 213, the fine and coarse fractions must be analyzed separately unless the direct contact and particulate inhalation criteria have been appropriately documented to be not applicable. If the laboratories do not receive any indication of the requirements for the facility, they will need to contact the client and obtain those requirements.

If I indicate I need analysis of the "Michigan 10" metals will the labs automatically do fine and coarse lead samples?

No, the specific lead tests for fine and coarse sampling must be requested from the laboratory. The Michigan 10 metals list is not intended for site investigation and should not be the default for metal analysis. Metal analysis requests should be developed based on site specific conditions.

Are both fine and coarse fractions needed for borings at depth?

It is necessary to analyze both the fine and coarse fractions because the direct contact and particulate inhalation pathways both apply throughout the soil column because of the potential for subsurface soils to be brought to the surface.

Is it necessary to do fine and coarse fractions for verification sampling?

It is necessary to compare the fine and coarse fractions in verification samples for direct contact criteria and particulate soil inhalation criteria.

GROUNDWATER

The OpMemo implies that low flow sampling is to be used for all groundwater sampling unless it can be demonstrated that an alternate method (e.g., properly conducted bailing that purges three well volumes before sampling) produces comparable data. Does this reflect RRD's position regarding groundwater sampling; i.e., is low flow sampling to be used all the time?

The OpMemo provides a sample collection protocol that if documented to have been properly conducted will allow RRD to accept the sample results as representative of site conditions without further justification. Low flow sampling methods are preferred because the method provides the most representative, consistent and defensible groundwater sampling data. The specification of low flow sampling does not preclude the use of other protocols, but does set the expectation that when other groundwater sample collection methods are used they will require further documentation to determine the results are representative of site conditions. Some sampling methods, while acceptable for one situation, may not be acceptable for others. It is important to consider the purpose of the sampling event when determining sample methods to be used. Parties considering the use of alternative groundwater sampling protocols are strongly advised to consult with RRD project managers in advance.

Is low flow sampling going to be required even for routine monitoring, where acquisition of data for assessment of long-term trends does not generally warrant the same level of accuracy and precision as would be critical for proper plume delineation, compliance monitoring or verification sampling?

On a case-by-case basis it may be determined that another method can be substituted for part of a sampling program even if the method is not demonstrated to produce comparable results. For example, if site conditions warrant, it may be acceptable to allow samples to be collected with an alternative method to document decreasing concentrations if the sample results are not

necessary to document compliance with criteria for a relevant pathway. It would not be acceptable to utilize the samples obtained by an alternative method to demonstrate compliance with criteria without additional justification. Prior consultation with a RRD project manager is advised.

What is RRD's position on the use of Geoprobe groundwater sampling results to make a determination if the site is a "Facility"? Similarly, what about the use of alternate groundwater sample collection devices like the Simul-Probe sampler?

Data collected to determine whether a property is a facility must be representative of the conditions of the site. These data do not need to be capable of defining the nature and extent of the release or determining that an existing release has been remediated. However, the use of different protocols may affect a party's ability to use the data for other purposes.

Additional questions regarding applicability of the OpMemo to BEAs are contained under the headings General Applicability and Petroleum Site Characterization.

Are Geoprobe or Simul-Probe methods of groundwater sampling acceptable for site characterization without a demonstration of comparability to standard low flow methodology?

Samples collected with Geoprobe and Simul-probe methods should be used for field investigative purposes and for selecting locations for monitor well placement. Geoprobe/Simul-probe data can be useful for site characterization, however, permanently installed monitor wells allow for repeatability of sampling; geophysical logging; determining aquifer hydraulic characteristics, which are major components of proper site characterization.

Will low flow sampling be required for groundwater sampling utilizing Geoprobing groundwater profiling equipment and/or screened augers?

Generally groundwater characterization objectives, such as to determine compliance with applicable criteria may differ from the objectives of profiling contamination utilizing a geo-probe, "casing pull back", or screened auger. For example, if the characterization objectives are to profile the contamination for the purpose of optimal well screen placement, or screening for the presence or absence of contamination, low flow sampling is not required; however the low flow sampling for collection of samples for comparison to generic cleanup criteria is required unless other methods can be shown to produce similarly representative results.

The Geoprobe is commonly used to collect groundwater samples from borings using a milled slot steel screen or retractable screen device. Because of the small diameter of the Geoprobe drive rods and space occupied by the peristaltic pump tubing inside the rods, it is typically not possible to also lower a water level measuring probe inside the Geoprobe rods during the groundwater purging process. Since a person cannot quantitatively monitor the drawdown inside the rods during the purging, it would seem to prohibit the ability to document that low flow sampling was performed or attempted. Will such samples be considered valid if reviewed by RRD?

The collection of groundwater samples from the borings alone would not be considered representative for samples collected for comparison to generic cleanup criteria. However, in accordance with rule provisions, the GSI pathway may be determined to be not relevant without the installation of permanent monitoring wells if sufficient information is available otherwise. Sufficient information may be provided with an adequate geo-probe investigation, if temporary monitoring wells that allow low flow sampling (i.e., 2") are utilized. The same type of investigation could provide sufficient information for the other groundwater pathways.

When only stab/hand auger/geoprobe points are used for soil and groundwater sample collection for Initial Assessment Report (IAR) investigations and nothing is found in the soils or groundwater, is that acceptable for a Part 213 closure, or do they need to go

back, install permanent wells and low flow sample prior to submission of a Closure Report?

The OpMemo's emphasis is on the statutory requirements to define the nature and extent of the contamination at a Part 201 or Part 213 facility to determine relevant pathways, compliance with applicable criteria, and appropriate response actions to remediate an existing release. The question poses a scenario where the initial site investigation indicates there is no soil or groundwater contamination above applicable criteria. It may not be necessary to install permanent wells and perform low flow sampling if sufficient information regarding the history of the facility is documented, consistent with the provisions of Section 21308a of the NREPA, to determine that the data gathered are an adequate demonstration that the release did not and will not contribute to a groundwater plume that requires additional delineation of the extent of contamination. Specific documentation should include, at a minimum, the following:

- groundwater flow direction has been determined and sample locations are appropriately downgradient and at an appropriate depth to intercept likely contamination.
- no contamination is found in the soil above applicable criteria and the source is abated (tank and soil excavation, etc.) with verification (VSR) samples below applicable criteria
- groundwater samples collected from temporary or stab borings are below all relevant groundwater criteria
- no aesthetic (e.g., odor) impact remains

What if the well fails the low flow assumptions, i.e., there is not enough sampling depth to maintain sufficient water levels above and below the pump intake, stabilization does not occur before the water is lowered below the well screen, or the well is purged dry?

Low flow must be used when possible. The method referenced for low flow discusses options when re-charge is very slow. When these options are not practical, the RRD project manager should be contacted, preferably during the sampling plan development for acceptable options.

What will RRD accept for documentation that another methodology is acceptable? Will site-specific data be required for comparison of low flow results with the result of the proposed alternate methodology, or will RRD accept references to scientific/technical studies that provide general support for the proposed alternate methodology?

Site specific data generally will be necessary to document the alternative methodology is representative. RRD experience with scientific or technical studies that provide general support for alternate methods has been that unacceptable variability in actual applications to differing site conditions preclude accepting them without further site specific justification.

How is data qualified if the low flow methodology can not be or was not used?

It is prudent to discuss options with the RRD project manager before the sampling event to establish the appropriate documentation that will be included in the applicable report. If that has not occurred the report will need to include adequate justification for RRD's concurrence of why the sampling conducted is representative.

The EPA low flow groundwater sampling procedures states that turbidity should be used as one of the standard field measurements to document groundwater stabilization. As the OpMemo discusses, the stabilization of turbidity can be difficult. In consideration of this potential problem, would <10 percent difference for three consecutive readings, or any value below 20 NTUs if the other field parameters have stabilized be acceptable?

Yes, turbidity less than 20 nephelometric turbidity units (NTUs) may be acceptable as long as all other field parameters have stabilized. The low flow, low-level mercury sampling protocol uses turbidity within ± 10 percent for three consecutive measurements conducted at 3 to 5 minute intervals.

Can a subset of the parameters be used for determining stabilization in the procedure for low-flow sampling?

The standard parameters used to determine when formation water is flowing are turbidity, pH, specific conductivity, oxidation-reduction (redox) potential, temperature and dissolved oxygen. Except for the options for turbidity, no subset of these parameters or deviation of stabilization will be accepted.

Are peristaltic pumps acceptable to use for low flow sampling? The U.S. EPA protocol referenced seems to indicate that these types of pumps are not favored due to the potential for degassing of volatiles from samples.

Peristaltic pumps will be acceptable for low flow sampling in circumstances when the site conditions are amenable to its use. The RRD recommends the use of a continuous flow pump to avoid the concerns of agitation for volatiles, and to allow sampling of groundwater depths greater than 20 feet. When peristaltic pumps are used and volatiles are a concern the sampling plan should assure drawdown rates and the pump intake placement minimize degassing potential. The use of inertial lift foot-valve type samplers is inappropriate.

Is Teflon/Teflon lined tubing required for low flow sampling systems? The referenced procedures imply this. Can less expensive tubing be used if it is discarded between sampling points?

Teflon or Teflon lined tubing is preferred if the tubing is intended to be reused because of its ease for decontamination. If tubing is intended to be disposed between sampling points the use of chemically inert disposable tubing is acceptable.

Why is low flow sampling and total analysis necessary for metals?

A low flow sampling technique for analysis of metals minimizes turbidity. When turbidity is minimized the sampler can reduce and or avoid the entrainment of suspended materials which are not representative of the actual mobile chemical constituents in the formation. Also, when filtering metal samples to obtain dissolved metals data, most of the naturally entrained colloidal particles in the groundwater are removed. This inappropriately results in a lower concentration of mobilized metals. Further explanation can be found in Ground Water Sampling for Metals Analyses by Robert W. Puls and Michael J. Barcelona, EPA/540/4-89/001, March 1989.

Why are total concentrations used for criteria compliance and dissolved concentrations for MNA determinations? STD previous guidance included only dissolved samples?

Groundwater criteria are based on total concentrations. It is correct that dissolved iron concentrations are necessary to document monitored natural attenuation (MNA). In an anaerobic natural attenuation process, the bacteria uptake ferrous iron (dissolved iron) more readily than ferric iron (particulate iron). Therefore, it is necessary to sample for both total iron and dissolved iron if MNA is the remedy for the site.

If filtering is necessary should the filtering occur in the field or at the lab?

Filtering should not be a fix for poor well construction or poor sampling techniques. If filtering is determined appropriate for sampling a specific well, the filtering should occur in the field prior to preservation and transportation. In-line filtration is recommended.

The OpMemo does not indicate a standard filter size (e.g., 0.45 microns)?

Attachment 5 states any necessary filtration should be accomplished using a filter with a large enough pore size to allow naturally suspended particles to pass through the filter, and that some preliminary testing may be required to determine the appropriate filter size. Historically a 0.45 micron filter has been used, but it may in many cases remove naturally suspended particles and conditions may require larger or smaller sized filters. In specific cases where the concentration of contaminants listed in R 299.5750 footnote (AA) is to be compared to groundwater contact

criteria, a sample should be collected for dissolved contaminant analysis and should be filtered, generally using a .45 or smaller filter (page 5).

For the contaminants that have groundwater contact criteria (GCC) based upon dermal absorption of the dissolved phase (R 299.5750 footnote (AA)), if concentrations from totals do not exceed GCC would dissolved samples be required? Can filtered samples be collected but not analyzed unless totals exceed the criteria?

Total samples may be used as a screening tool to determine if dissolved concentrations would be expected to exceed criterion. Subsequent analysis of filtered samples for dissolved concentrations can occur so long as holding times are not exceeded.

For the GCC contaminants where filtering is required, the OpMemo indicates that filters of appropriate materials should be used to ensure the filter does not absorb dissolved contaminants that are not attached to particles, and that glass filters with no binders are acceptable and recommended. Are glass filters available?

There are manufacturers of glass filters with no binders, although the minimum pore size for many is 1 micron. If needed, a 0.45 micron pore size glass filter with no binder is available from Whatman GMF filter.

What is the standard method for abandoning groundwater monitoring devices?

The manner satisfactory to MDEQ for the abandonment of monitoring wells, piezometers, boreholes, and other monitoring devices that present potential for contaminant migration are the procedures as described in ASTM Standard D 5299-92 (Standard Guide for Decommissioning Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and other Devices for Environmental Activities).

QUALITY ASSURANCE AND QUALITY CONTROL

Is QA/QC required to validate BEA data?

QA/QC data are needed to determine whether the analytical results are representative of site conditions. False positives, false negatives, and otherwise inaccurately reported concentrations are possible. In the case of a site assessment for BEAs or 'facility' determinations, it may be possible to use such data as it does not have to be capable of defining the nature and extent of contamination or determining that an existing release has been remediated. For data that will be used to differentiate a new release from existing contamination, QA/QC data will be necessary for comparison to future data sets. The future use of BEA data collected without QA/QC data would be very limited if the data can not be determined to be representative of site conditions, and may not be sufficient to support the defense from liability.

Additional questions regarding applicability of the OpMemo to BEAs are contained under the headings General Applicability and Petroleum Site Characterization.

Is the MS/MD QA/QC acceptable from a batch at the laboratory or must it be specific to a site?

The matrix spike/matrix spike duplicate QA/QC samples must be specific to the site. The matrix spike measures the ability of the laboratory and method to recover the correct concentration from the media being sampled. This could vary from site to site.

Do equipment blanks need to be collected if dedicated sampling equipment is used; e.g., where dedicated tubing has been installed for sampling with a peristaltic pump? Some clients have opted to go with dedicated equipment, in part, to avoid these associated costs.

No, if it is verified that all equipment that may come in contact with the sample is dedicated to the sample location then no equipment blank is necessary. However, equipment blanks are required when the equipment used for the collection of the samples are used, cleaned and then re-used, or simply re-used for the collection of other samples. With peristaltic pumps, unlike most other pumps that have metal parts that may come in contact with the sample, only the tubing comes into contact with the sample. When the tubing is dedicated to a sampling location there is no need for an equipment blank sample. When the tubing is used for one sample and then disposed, information that documents that the tubing is chemically inert will need to be included with the sampling results. Collecting equipment blank samples during a sample event can provide this information if it is not otherwise readily available.

Is RRD requiring the collection of field blanks for every project, every sampling event, or only when environmental conditions could potentially affect the samples? In addition, it seems that collection of field blanks is not warranted for all analytical parameters.

Field blanks are required for each matrix and each analytical group for every sampling event, unless waste containers or other high concentrations are being sampled. Minor ambient concentrations of contaminants can affect sample results, even if samples are handled properly at all times. Since all conclusions and recommendation for a facility rely on the data results, field blanks must be collected and analyzed for each sampling event to assure the quality and integrity of the data.

Will RRD be requesting information regarding QA/QC data (expiration dates, batch numbers, etc.) for containers, preservatives etc., from laboratories involved in projects as part of consultants reports?

Reports must contain standard laboratory reporting on the analysis results for the QA/QC samples (including recovery sheets) but don't typically need to include the documentation on expiration dates, batch numbers, etc., or field logs. However, if there is some other indication that there may be a concern, then all pertinent QA/QC information must be provided for MDEQ review. More direction on what QA/QC documentation must be provided within Part 213 reports, and what must be available if the MDEQ requests, is being developed.

Will RRD be requesting documentation of calibration for instrumentation as part of the consultants reporting process?

A brief description of the sampling methods used and instrument calibration should be included in the text of reports; however, other documentation does not necessarily need to be included. Other documentation, including field notes and instrument logs, must be available if requested by the MDEQ.

METHANOL PRESERVATION (ATTACHMENT 6)

Are the use of EnCore™ sampler or similar soil coring samplers no longer allowed?

RRD does not recommend the use of soil coring devices for collection and transportation of samples for initial site characterization where the objectives include establishing the contaminants of concern or for response activities where the objectives are to demonstrate final compliance with cleanup criteria. However, the EnCore™ sampler and similar soil coring devices may be used as long as the samples are immediately preserved in the field (methanol preservation or low level samplers). The RRD may accept results using the soil coring devices to transport samples to the laboratory, providing the requirements listed in Attachment 6 (page 3) are documented.

In reviewing options for evaluating the leachability of volatiles to groundwater, soil coring devices, while not an ideal solution, were determined the best available option. Using methanol preserved soil samples may overestimate volatile concentrations due to methanol being an aggressive extractant. Transporting the leaching solution to the field, or filling the soil jar with water would not ensure preservation. Using the soil coring device, transporting with proper precautions, and extracting the soil from the coring device directly into the leaching solution within 48 hours of collection is considered the best available option. Therefore, soil coring devices should be used for transporting samples to the laboratory for soil collected to determine volatiles leachable to groundwater. The requirements for transporting these samples are listed in Attachment 3, page 3.

Attachment 6 has requirements for confirming results when soil coring devises are used. Do these requirements apply to EnCore™ samplers and similar soil coring devices?

The documentation necessary for RRD to accept results from using soil coring devices applies to the EnCore™ sampler and any other similar soil coring sampling device that is used to transport samples to the laboratory. The US EPA has indicated they have not thoroughly evaluated the use of soil coring devices for suitability in transportation of samples to the laboratory. There is literature available that demonstrates suitability for use in specific situations and for specific compounds. However, uncertainty regarding the appropriateness for all instances requires the submission of specific documentation to show that the results are acceptable.

Can the syringe type samplers be used to collect samples for preservation in the field?

As previously stated this use is still allowed.

Can you clarify the use of sealed containers when performing low concentration analyses?

Attachment 6 (page 3) describes the requirements for the performing low concentration analyses. There are no requirements for the specific types of sealed containers, other than they must be appropriate for attachment directly to the instrumentation. Some laboratories may use vials and introduce the required chemicals into the vials without exposing the soil to the atmosphere, while others may use containers customized to fit onto the instruments directly without exposing the soil to the atmosphere. Either option is acceptable.

LOW LEVEL MERCURY SAMPLING (ATTACHMENT 7)

Protocols are included for the use of bladder and peristaltic pumps, when should bladder or peristaltic pumps be used?

Bladder pumps should be used when the depth to groundwater is greater than the depth that peristaltic pumps are effective.

What are the specifications for knowing whether the water from a well is formation water?

The standard parameters used to determine when formation water is flowing are turbidity, pH, specific conductivity, oxidation-reduction (redox) potential, and dissolved oxygen. The specifications are included on pages 8 (number 14) and page 10 (number 12).

What field quality control methods should be used?

Quality assurance and quality control protocols are provided on page 14.

PETROLEUM SITE CHARACTERIZATION (ATTACHMENT 8)

CHARACTERIZATION GENERALLY

NOTE: This attachment does not apply to Part 211 site assessments, former STD IM-3 remains guidance for such assessments.

Why has the list of potential contaminants of concern been expanded for petroleum site characterization?

Note: This document is being revised to better reflect the intent of identifying the minimum analytical requirements to identify contaminants of concern, and the designated analytical methods.

Audit results indicate that defining the nature and extent of contamination at leaking underground storage facilities is frequently deficient. As a first step in providing clear and concise guidance to assure adequate site characterization, the minimum analytical requirements to identify potential contaminants of concern have been expanded to reflect statutory requirements for defining the nature and extent of contamination. Volatile organic compounds (VOCs) have been added beyond BETX, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenze, naphthalene, 2- methylnaphthalene and MTBE. Analysis of these additional contaminants are necessary to adequately characterize known constituents of gasoline (e.g., oxygenates, trimethylbenzenes and propylbenzenes) and contaminants known to be commonly used at service stations to clean or service auto parts. PCBs were added for analysis of residuals oils because of the potential for their existence in hydraulic fluids, industrial cutting oils, and cooling oils.

Furthermore, groundwater contamination must be adequately characterized to assess reactions from the petroleum release that result in additional hazardous substances from the soil matrix contaminating groundwater (R 299.5716(3)). Analysis of metals has been expanded to address the concern that the biodegradation of petroleum contaminated plumes can result in the mobilization of metals from the soil matrix.

The initial site characterization will need to consider the potential contaminants of concern as minimum analytical requirements. All contaminants identified in the site characterization which exceed generic criteria are contaminants of concern. Once the contaminants of concern at a facility are known, methods can be targeted to those specific contaminants.

Is it acceptable to reduce the list of VOCs for a gas station and convenience store where no service station operations ever occurred?

Yes, but only under specific circumstances. Sampling may be reduced if sufficient documentation is provided regarding the history of the facility to demonstrate there is no likelihood of a petroleum release commingling with any release of non-petroleum VOCs. Reports in such instances must include documentation of the information that was the basis for limiting the analytical list.

Is the additional metal analysis required for work performed as part of a Phase I ESA, Phase II ESA and BEA process?

No. The additional groundwater metal characterization is specific to defining the nature and extent of the groundwater contamination, not the presence of contamination to determine if the property is a facility. However, if any of the additional metals are included in hazardous substances to be used in the future by the new owner or operator, then analyses of those metals used will be required to support the conclusion of the BEA.
Additional questions regarding applicability of the OpMemo to BEAs are contained under the headings General Applicability of the Guidance and Sample Collection.

Is GRO or DRO now required to be sampled?

No. The OpMemo states GRO and DRO analyses are not required and cannot be used to determine compliance with criteria or in making risk-based decisions. The analyses may be useful in evaluating releases and interpreting other data.

VOLATILE ORGANIC COMPOUNDS (VOCS) CHARACTERIZATION

Can you clarify which VOC parameters must be analyzed to assess the contamination at a former gasoline station?

Either the MDEQ Lab 8260 list or SW-846 8261 may be used for initial site investigation. Once the site is adequately characterized and the chemicals of concern are identified, methods can be used that target the specific contaminants.

METAL CHARACTERIZATION

Except for lead for leaded gasoline releases and lead, chromium, and cadmium for waste oil releases, what is the rationale for including the remaining metal parameters?

To determine if there is a leaded gasoline release sampling only for lead is appropriate, but to determine the nature and extent of any petroleum product release it is necessary to sample for additional metals. The need for additional metal characterization is not necessarily based upon an expectation that sufficient quantities are included within petroleum fractions, but on the basis that the chemical and biologic processes that lead to the breakdown of petroleum hydrocarbons can chemically transform naturally occurring minerals (e.g., arsenic, iron, manganese) in the soil and aquifer matrix to forms that are more mobile and/or more toxic than the original materials. For waste oil or used motor oil releases there may be sufficient quantities of these metals in the release to contaminate soil and groundwater and therefore the metals must be characterized.

If the rationale for adding the additional metal parameters is based on concerns regarding leaching due to changes in redox conditions, is metals analysis for soils required for characterization?

Soils analysis for the additional metal parameters may not be required depending on the historical use of the property and the potential for waste or used motor releases on the site. The need for metal analysis is based primarily upon the contaminants leaching from soil into groundwater due to conditions that result during biodegradation of the contamination. Metal analysis for soils alone would not provide any clear indication of the conditions necessary for leaching to occur under redox conditions, and so would not be required for characterization.

Can characterization of metal impacts at a facility be conducted separately from and parallel with characterization of hydrocarbon impacts?

Yes, in some cases, it may be acceptable to conduct the characterization separately.

What options are available for a facility that might otherwise be considered eligible for closure but the groundwater has not been characterized for metals?

Review of conditions on a site-by-site basis may allow closure without further metal characterization. If the groundwater pathways that would be affected by metal concentrations above generic criteria are not relevant or are otherwise restricted, further characterization would not be necessary. If relevant pathways exist, evaluation of the potential for metals leaching from soils due to the site conditions may result in a decision that further characterization is not required. The RRD project manager should be contacted to discuss options for sampling for redox potential or indicator metals based upon applicable specific conditions for the site.

OXYGENATES

There is some discussion about oxygenates in the new OpMemo No. 2. Is the inclusion of oxygenates other than MTBE due to new regulations?

Oxygenates are added to gasoline to increase octane ratings. To adequately characterize the nature and extent of the release known additives must be characterized. While MTBE is the prevalent oxygenate that has been found in wells throughout the country other oxygenates have been used in Michigan and sampling only for MTBE will not provide sufficient characterization. To determine whether specific oxygenates would <u>not</u> need to be characterized there would have

to be documented historical records of when the release occurred and of all suppliers use of oxygenates in order to demonstrate there was no potential for the contaminant to be released.

Oxygenates have specific preservation requirements. Does this mean separate samples must be taken when MTBE is requested?

There are several oxygenated ethers that require characterization including MTBE. According to the EPA, oxygenated ethers preserved in an aqueous solution will break down when exposed to high temperatures. Attachment 4, page 3, provides further information to address this issue. If high temperature purging is not used by the laboratory, acid preservation is appropriate and separate samples are not necessary. If high temperature purging is used, separate samples must be taken, one acid preserved and one basic preserved as described in Attachment 4. The MDEQ laboratory and the MDEQ contract laboratories do not use high temperature purging, so there currently are no changes in how RRD staff and its contractors should collect samples for oxygenates if these laboratories are being used. When other laboratories are being used, it should be determined what purging methods are being utilized by the laboratories in order to develop site specific sampling plans.

Regarding the high temperature for purging volatile organics, specifically for MTBE, what temperature is considered high temperature purging?

High temperature would be significantly higher than 40 degrees Centigrade.
SW846, Method 8260B states:

> 7.1.2.1 Traditionally, the purge-and-trap of aqueous samples is performed at ambient temperature, while purging of soil/solid samples is performed at 40 C, to improve purging efficiency.
>
> 7.1.2.2 Aqueous and soil/solid samples may also be purged at temperatures above those being recommended as long as all calibration standards, samples, and QC samples are purged at the same temperature, appropriate trapping material is used to handle the excess water, and the laboratory demonstrates acceptable method performance for the project. Purging of aqueous samples at elevated temperatures (e.g., 40 C) may improve the purging performance of many of the water soluble compounds which have poor purging efficiencies at ambient temperatures.

If the pH is > 11 for samples collected for analysis of the oxygenate ethers, i.e. MTBE and others, the purging efficiency of the early internal standard and surrogates goes way down. Could a client collect a water sample in an unpreserved vial and analyze it within seven days?

Samples must be preserved. Attachment 4 (page 3) states that samples collected for the analysis of volatile organic compounds must be acid preserved, and samples collected for oxygenates that will be analyzed with high temperature purging, preserved with TSP to ph > 11. Samples must then be stored and transported at 4° C. The intent is to not to use high temperature purging on acid preserved samples for analysis of the ether oxygenates, as the combination of acid and high temperatures can break down the ethers. (See http://nwql.usgs.gov/Public/pubs/MTBE.fact.sheet.html) Consistent with that intent, if a laboratory can demonstrate acceptable method performance for the oxygenate ethers using acid preserved volatile samples and analyses as routinely done (not high temperature purging), then it is unnecessary to collect separate samples for the oxygenates for preservation at pH > 11.

RRD OPERATIONAL MEMORANDUM NO. 2
FREQUENTLY ASKED QUESTIONS
July 2005 Addendum

This document is an addendum to the RRD Operational Memorandum No. 2 Frequently Asked Questions of February 2005. Terms defined in the Operational Memorandum have the same meaning when used in this document.

Chromium VI (Hexavalent Chromium)

The MDEQ has reviewed alternative methods available for analyzing hexavalent chromium (other than those already designated in RRD Operational Memorandum No 2, Attachment 1). The MDEQ has concluded that the following methods are considered appropriate for hexavalent chromium analysis, and are approved, provided that analysis conforms to the provisions/stipulations discussed in the following paragraph:

- For water, methods 7196A chromium, hexavalent (colorimetric), and 7197 chromium, hexavalent (Chelation/Extraction)

- For soil, methods 3060A/7196A and 3060A/7197

The approval for method 7196A chromium, hexavalent (colorimetric) is based upon the provision of method 7196A that addresses the concern of interference. The method of standard additions (see Method 7000, Section 8.7) must be used for the analysis of all extracts, on all analyses. Sections 7.3, 7.4, and 7.5 of method 7196a provide specific direction regarding interferences. However, if interference persists after sample dilution, a different method must be used.

It should be noted that because of the limited preparation and holding times for hexavalent chromium analysis (24 hours for waters, and 24 hours after extraction for soils), collection of additional samples may be needed if interferences render the initial alternative analytical method unusable. If this does occur, a different method must be used for future sampling at the facility.

The prior approval for method 7197 chromium, hexavalent (Chelation/Extraction) is based on equivalent methodologies used in the U.S. EPA Contract Lab Program (CLP), and methods promulgated for use in the CLP are acceptable alternative methods.

Lead Fractions

The MDEQ has reviewed concerns raised regarding soil fraction sampling for lead and the associated difficulties with sieving dried "clay" soils. This problem has been evaluated to determine if total lead analysis of clay soils, in lieu of separate fine and coarse fraction analysis, is acceptable for comparison to direct contact and soil particulate inhalation criteria. The MDEQ acknowledges that clay soils often consist primarily of fine materials, and therefore has determined that the use of the total lead concentration is acceptable for comparison to direct contact and soil particulate inhalation criteria, if the following conditions are met:

1. The dried soil sample cannot be sieved (as prescribed in the SOP) to separate out any fraction and/or the volume derived from any fraction is too small for analysis (less than one gram); and

2. The field data/sampling information adequately documents that the soils are, in fact, composed primarily of clay.

It should be noted that if the field sampling information documents a clay mixture, another sample may need to be collected to provide a representative sample. In addition, if total lead concentrations are used for comparison to criteria, explanation must be provided to the MDEQ as to why fraction analysis could not be conducted.

Elevation of Reporting Limits

The MDEQ has reviewed elevated reporting limits to provide guidance as to when elevated reporting limits may be acceptable versus when the use of alternative methods to assure the TDLs are achieved becomes necessary. For numerous contaminants standard methods of analysis may not achieve the designated TDLs. In such situations, the applicability of the resulting data needs to be considered in evaluating whether or not it is necessary to achieve the TDL. If it is determined that the TDL must be achieved, sufficient information must be provided to the laboratory to assure the sampling necessary to achieve the TDL will be implemented.

Examples of common site contaminant where standard methods 8260 or 8270 may not achieve the TDLs include: ethylene dibromide (EDB), 1, 2-dibromo-3-chloropropane, pentachlorophenol, hexachlorbutadiene and hexachlorbenzene. Of these, EDB, which has an extremely low Part 201 criterion and Part 213 Risk-Based Screening Level (RBSL) for residential drinking water (0.05 ppb), is probably the most common contaminant that is confronted where standard analytical methods do not achieve the TDLs. This contaminant was widely used from approximately 1940 to 1988 as a "lead scavenger" additive to leaded gasoline. (For additional information see "The Potential for Ground Water Contamination by the Gasoline Lead Scavengers Ethylene Dibromide and 1,2-Dicholorethane," Ronald W. Falta, Ground Water and Remediation Volume 24, No.3/Summer 2004)

The following includes examples of scenarios/situations where achieving the TDL would not likely be necessary:

- The contaminant is not likely to have been released at the subject facility. For example, if a release of gasoline was known to have occurred after 1988, or is otherwise known to be an unleaded gasoline release, achieving the TDL for EDB would not be necessary.

- The pathway or pathways with low-level TDLs are not relevant. For example, if the drinking water pathway is not applicable or otherwise restricted, the GSI pathway would become the most restrictive criteria and a detection limit for EDB that is greater than 0.05 ppb, but less than the GSI criterion (0.2 ppb) for a surface water that is not a drinking water source, may be acceptable (Note: The GSI criterion for the Great Lakes or an inland drinking water source is the same value as the drinking water standard). Similarly, if the GSI pathway is documented not applicable, an acceptable TDL for hexachlorobutadiene and pentachlorophenol would revert to the drinking water RBSLs for these contaminants. It should be noted that whether or not a pathway is deemed applicable does not preclude the necessity of delineating the extent of contamination to residential criteria.

- The purpose of the sample is to identify and/or define source areas, and the source area can otherwise be identified and/or defined by other contaminants. Frequently, source areas contain multiple contaminants that can interfere with the detection of specific contaminants to the applicable TDLs, or otherwise mask the presence of a contaminant, even when alternative methods are used. In the case of EDB, for example, the presence of BTEX and other hydrocarbons, especially in concentrations typically found in source areas, would interfere with the detection of EDB such that it may not be possible to detect EDB with any method.

The following includes examples of scenarios/situations where achieving the TDL would likely be necessary:

- The purpose of the sample or samples is to delineate the extent of contamination to residential criteria or RBSLs. For example, to define the leading edge of dissolved-phase plume from a leaded gasoline release, it is necessary to achieve the low-level TDL for EDB. However, for such circumstances, there should not be interferences from high concentrations of other hydrocarbons and the low-level TDLs should be achievable.

- The samples are for closure verification. Similar to delineation samples, at the point where closure verification samples are collected, concentrations of other contaminants should have diminished to the point where the TDLs would be achievable. Of course, for pathways that are not applicable or otherwise restricted, it may not be necessary to achieve the low-level TDL.

- The contaminants of concern (CoCs) for a facility cannot be identified by means other than chemical analysis. For example, if it were unknown whether contamination was from a leaded or unleaded gasoline release, it may be necessary to achieve the TDL for EDB to determine whether EDB is a CoC for this particular facility.

- Routine monitoring at the leading edge of a plume or sentinel monitoring. Although it may not be necessary to achieve TDLs for routine monitoring within source areas or within the interior of a plume, it is critical that TDLs be obtained in situations where the purpose of the sample is to monitor the leading edge of a plume or sentinel monitoring of a specific receptor.

It is important to recognize that if the TDL must be achieved there may be different collection requirements for an alternative method. Sample collection, preservation, handling, and holding time specifications should be carefully reviewed.

Op Memo No. 2 also addresses instances where elevated reporting limits may not be acceptable for contaminants when the TDLs are greater than the most restrictive risk-based criteria. These contaminants are included in Table 6 of Attachment 1. In this situation there are not alternate methods designated to achieve the TDLs and the cause for elevated reporting limits must be carefully evaluated. This may require further actions to reduce interferences (e.g., sample cleanups performed in the laboratory), modifications to lab or field methods, or other actions appropriate to the site conditions.

Soil Coring Devices

The MDEQ has reviewed documentation submitted for the EnCore™ sample device. The MDEQ acknowledges that there have been scientific studies conducted that demonstrate that the use of this device can result in accurate analytical results for specific volatile organic compounds (VOCs). The MDEQ also acknowledges that there are established procedures for using the device (ASTM D 4547-98).

Nevertheless, it is the MDEQs position that if the device is used, site-specific documentation (duplicate or confirmation samples) should be provided to show that the analytical results for samples stored in the Encore™ device are equivalent to results from samples that are methanol preserved immediately in the field. In particular, this applies if the sample results are used for characterizing the nature and extent of the contamination or for demonstrating compliance with cleanup criteria. (see Operational Memorandum No 2, Attachment 6 page 3 for further details).

The MDEQ arrived at this position after reviewing site-specific analytical data that was developed at sites where corrective action was or is being conducted by the MDEQ. This data documents significant discrepancy in analytical results between the two soil sample collection methods referenced above. Accordingly, the MDEQ believes that this requirement is necessary to assure that analytical results are as representative as possible of actual soil contaminant concentrations.

APPENDIX D

MDEQ LABORATORY QUALITY ASSURANCE MANUAL PROGRAM PLAN AND STANDARD OPERATING PROCEDURES

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION

QUALITY ASSURANCE PROGRAM PLAN

May 5, 2003
Version 2.0, rev 0

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Quality Manual Signature Page
MDEQ Laboratory Services Section
Version 2.0 Revision: 0

LABORATORY SERVICES SECTION QUALITY ASSURANCE PLAN
FOR
MICHIGAN DEPRATMENT OF ENVIRONMENTAL QUALITY
Version 2.0 REVISION 0

EFFECTIVE DATE
May 5, 2003

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TABLE OF CONTENTS

1.0 POLICY STATEMENT
1.2 Authority
1.3 Program Description

2.0 ORGANIZATION AND RESPONSIBILITIES
2.1 Organization Chart
2.2 Laboratory Director
2.3 Quality Assurance Officer
2.4 Technical Director for Chemical Analyses
2.5 Technical Staff
2.6 Training
2.7 Laboratory Capabilities

3.0 QUALITY ASSURANCE OBJECTIVES
3.1 Precision
3.2 Accuracy
3.3 Method Detection Limits (MDL) and Reporting Limits (RL)

4.0 SAMPLING PROCEDURES
4.1 Environmental Sampling
4.2 Drinking Water Sampling

5.0 SAMPLE HANDLING
5.1 Sample Tracking
5.2 Sample Acceptance Policy
5.3 Sample Receipt Protocols
5.4 Storage Conditions
5.5 Chain of Custody
5.6 Sample Disposal

6.0 CALIBRATION PROCEDURES AND FREQUENCY
6.1 Traceability of Calibration
6.2 Reference Standards
6.3 General Requirements
6.4 Analytical Support Equipment
6.5 Instrument Calibration

7.0 TEST METHODS AND STANDARD OPERATING PROCEDURES
7.1 SOPs for Sample Management
7.2 Reagent/Standard Preparation
7.3 General Laboratory Techniques
7.4 SOPs for Test Methods
7.5 Equipment Calibration and Maintenance

8.0 INTERNAL QUALITY CONTROL CHECKS
8.1 Laboratory Quality Control Samples
8.2 Method Detection Limits and Reporting Limits
8.3 Selectivity
8.4 IDOC

9.0 DATA REDUCTION, REVIEW, REPORTING AND RECORDS
9.1 Data Reduction and Review
9.2 Report Format and Contents
9.3 Records
9.4 Document Control System
9.5 Confidentiality

10.0 PERFORMANCE AND SYSTEM AUDITS AND FREQUENCY
10.1 Internal Laboratory Audits
10.2 Managerial Review

11.0 FACILITIES, EQUIPMENT, REAGENTS, AND PREVENTATIVE MAINTENANCE
11.1 Equipment and Reference Materials
11.2 Documentation and Labeling of Standards and Reagents
11.3 Computers and Electronic Data Related Requirements
11.4 Preventative Maintenance
11.5 Inspection/Acceptance Requirements for Supplies and Consumables

12.0 SPECIFIC ROUTINE PROCEDURES USED TO EVALUATE DATA QUALITY
12.1 Laboratory Control Samples
12.2 Matrix Spikes/Matrix Spike Duplicates
12.3 Surrogate Recoveries
12.4 Method Blanks

13.0 CORRECTIVE ACTION

14.0 SUBCONTRACTING AND SUPPORT SERVICES AND SUPPLIES
14.1 Subcontracting Laboratory Services
14.2 Outside Support Services and Supplies

15.0 REFERENCES

APPENDIX A: Initial Demonstration Of Capability

APPENDIX B: List Of Sop's

APPENDIX C: Sample Bottle and Preservation Form

APPENDIX D: Annual Accuracy and Precision Statements

APPENDIX E: Drinking Water Laboratory Test Listing

APPENDIX F: Drinking Water Sampling Procedures Manual

APPENDIX G: Laboratory Certification Program for Chemical and Microbiological Analysis of Drinking Water

TABLES AND FIGURES

Table 1 MDEQ Environmental Laboratory Capabilities and Reporting Limits

Figure 2-1 Organization chart

1.0 POLICY STATEMENT

1.1 This Quality Assurance Manual summarizes the policies and operational procedures associated with the MDEQ Laboratory Services Section at 3350 N. ML King Blvd., Lansing Michigan. Specific protocols for sample handling and storage, chain-of-custody, and laboratory analyses, data reduction, corrective action, and reporting are described. Further details on these policies and procedures are contained in SOPs and related documents. This Quality Manual, Laboratory SOPs, and related documentation describe the quality system for the MDEQ Laboratory.

The laboratory performs bacteriological analyses in drinking water, surface water and wastewater, as well as chemical analyses for inorganic and organic constituents in water, air, oil, and solids for various state and federal programs. The Laboratory's goal is to produce the highest quality data that is scientifically valid, defensible, and of known and documented quality in accordance with standards developed by the state and EPA regulations or requirements. The Drinking Water Laboratory Certification Program is also administered under the Laboratory Services Section, independent of the analytical laboratory services provided. This program certifies laboratories for chemical and microbiological analysis of drinking water from the state of Michigan. See Appendix E for program manual.

The technical and service requirements of all requests to provide analyses are thoroughly evaluated before commitments are made to accept the work. This includes a review of facilities and instrumentation, staffing, and any special QC or reporting requirements to ensure that analyses can be performed within the expected schedule. All measurements are made using published reference methods or methods developed by the MDEQ Laboratory Section.

1.2 Granted Authority

DRINKING WATER LABORATORY

AUTHORITY: The laboratory was created by 1907 P. A. 109, and is in operation based on 1978 P.A. 368, Section 9601, as amended, to maintain and operate laboratories for the protection of the public health. Michigan is required to have a principal state Drinking Water Laboratory certified by USEPA to maintain primacy for the Public Water Supply Supervision program under the Safe Drinking Water Act.

ENVIRONMENTAL LABORATORY

AUTHORITY: The Environmental Laboratory was first started under the direction of the Department of Public Health in 1929 under the Water Resources Commission Act (1929 P.A. 245). The two environmental lab units support environmental enforcement, regulatory, and monitoring programs in MDEQ, to include RCRA, SARA, UST, Clean Air Act, Clean Water Act, and Part 201 of the Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended.

DRINKING WATER LABORATORY CERTIFICATION PROGRAM

AUTHORITY: USEPA granted primacy to the State of Michigan in 1976 for the certification of Drinking Water Laboratories as specified by 40 CFR 142.10b(3) and Safe Drinking Water Act, 1976 P.A. 399, as amended. The state must retain oversight, issue the certificate, and maintain a state laboratory certified by USEPA capable of testing all contaminants listed in the drinking water standards.

1.2 PROGRAM DESCRIPTION

The ESSD Laboratory Services Section is the scientific testing arm of the Department of Environmental Quality. The analytical results produced by the laboratory drive science-based departmental decisions related to health investigations, environmental site cleanup and remediation. It is a not-for-profit, objective, scientific testing laboratory within the department, analyzing samples for the public, local, county, state and federal agencies. The test results from this laboratory are also used for the prevention/detection of public health outbreaks in drinking water, identifying chemical constituents of environmental pollution, and identifying sources of contamination. The laboratory is a key component in the testing of environmental samples from suspected Bioterrorism events.

The Laboratory Services Section has three areas of expertise and focus: the Environmental Laboratory; the Drinking Water Laboratory; and the Laboratory Certification Program. Each area provides a stable workforce of Laboratory Scientists whose knowledge and expertise insure sound scientific testing, court qualified data and expert witness testimony in department initiated criminal and civil litigation. It provides a wide range of scientific testing and review capabilities to the public, local, county, state, and federal agencies to detect/monitor public health outbreaks and environmental contamination. All three areas perform audits of private and public sector laboratories to insure data quality and compliance with state and federal rules. The section serves as a reference laboratory to resolve disputes on sample data submitted to DEQ for enforcement, compliance and monitoring purposes.

Environmental Laboratory:

- Testing for many compounds, including Mercury, DDT, PCB's, Ozone testing, particulates
- Incinerator testing
- Air, surface water, soil sample testing
- Brownfield testing for redevelopment
- Landfill testing for containments & monitor for leakage
- Identify contaminants in watersheds
- Provide scientific identification and quantification of contaminated sites
- Monitor clean-up activities to determine efficacy of remediation
- Mobile Laboratory – on-site testing

Drinking Water Laboratory:

- Provide scientific testing to drinking water supplies to prevent public health outbreaks.
- Provide available scientific testing to private and public water supplies for EPA/State/County required chemical and biological monitoring.
- Provide testing for beach monitoring programs that determine wheter to issue swimming advisories.
- Provide testing for the regulated community and public to monitor swimming pools and spas to insure water quality.
- Protection of drinking water sources from biological/chemical terrorism

Laboratory Certification:

- Insures laboratory integrity for quality testing
- Identify certified laboratories for public use
- Investigate complaints about certified laboratories
- Monitor certified laboratories to insure compliance to regulations through review of sample proficiency testing program evaluations.
-

NELAC: The Laboratory Director and Laboratory Certification Officer actively participate on the National Environmental Laboratory Accreditation Conference (NELAC). Both staff members work with other state and federal representatives to draft and vote on national standards for the certification of laboratories.

BIOLOGICAL/CHEMICAL TERRORISM: The section participates with the State Emergency Management System bioterrorism execises to prepare for biological/chemical attack response. The lab coordinates analytical testing with the other state laboratories, including DCH, MSP, MDA, and CIS. The laboratory has capability to test air, drinking water, surface water, and soil samples.

AUDITS: The laboratory staff perform comprehensive on-site audits for the department to insure data integrity and contract specifications. DEQ has several Overflow Contract Laboratories for testing of samples in the event the DEQ Laboratory does not have capacity during the heavy sampling season or for specialized testing that cannot be done at the state laboratory. This in-depth audit reviews test sample data, test methods, data documentation, data storage, chain-of-custody, and includes discussions with the analytical staff for method compliance.

ENFORCEMENT: The laboratory serves the Office of Criminal Investigation for testing samples under criminal or civil investigation. The staff also serve as a stable source of "expert witnesses" for the prosecutors and the Office of the Attorney General for prosecution and/or cost recovery.

DATA REVIEWS: In addition to sample testing, the laboratory also reviews private and public sector testing data. In many instances, test data from other laboratories may be subject to question due to split sample comparisons or inaccuracies of the final report. The state laboratory will review the test methods and raw data for any problems such as changes to the test method, time shifting, sink testing, poor quality control, or peak shaving. A report will be issued to accept the data, investigate further for criminal action, or reject the data.

ALTERNATE TEST PROCEDURE (ATP) REVIEWS: Many laboratories request the use of alternate test methods that are not promulgated/listed by EPA or the state. These methods, technology, instruments, and quality control must be reviewed to insure data quality. The laboratory will issue a report either recommending that EPA accept the ATP request or reject the request.

STATE AND FEDERAL ASSISTANCE: The laboratory staff provides assistance to the other state and federal agencies. Examples include auditing the MN state Drinking Water Laboratories for EPA when they did not have a certified Microbiology Auditor available; auditing the Mt. Pleasant Tribe Drinking Water Laboratory for EPA; assisting DOT and MSP on a Joint Evaluation Committee to select a Laboratory Information Management System (LIMS), EPA criminal investigations, drinking water testing for MDA, and testing of environmental samples from suspected methamphetamine laboratories.

TRAINING: The laboratory staff provide scientific training to the department staff. Topics include Laboratory Analytical Testing, Detecting Problems with Analytical Data, Laboratory Enforcement Training, Limits of Detection, and Proper Sample Collection for Analytical Testing.

FACILITIES: Three facilities are staffed by this section: the State Laboratory Building at 3350 N. ML King, the Program Support Facility at 815 Filly Street, and the State Laboratory Annex at 815 Terminal Street.

- The **State Laboratory Building** houses the majority of the testing equipment and staffing. The building is not a public facility and provides 24/7 security. The Department of Community Health Laboratory and the DEQ Laboratory share this building to provide clinical and environmental testing capability to the state.

  The **Program Support Facility** provides specialized air quality testing (ozone, paint, coal/oil fuels), equipment configuration and monitoring. The laboratory staff assigned to this facility provide equipment/instrument repair, custom fabrication of monitoring equipment/trailers, and equipment maintenance for the Air Quality Division programs. The Mobile Laboratory is stationed here between on-site scheduling. The building also houses the SWQD Toxicity Testing Laboratory and the Waste and Hazardous Materials Division Soil Testing Laboratory. Laboratory chemical solvents are stored in a specially built solvent storage shed attached to the building. Boats and other surface water collection equipment from SWQD are stored in the garage areas. This facility serves as the main storage facility for DEQ for items that cannot be stored at Constitution Hall.

- The **State Laboratory Annex** provides specialized testing and also serves as the storage area for the laboratory's chemicals and supplies as well as the staging area for sample kit preparation for sample collection.

2.0 ORGANIZATION AND RESPONSIBILITIES

2.1 Organization Chart

An organization chart for the MDEQ – ESSD Laboratory is shown in Figure 2-1.

The Section Chief is the Laboratory Director for the Laboratory Services Section (LSS), and manages the Environmental Laboratory, the Drinking Water Laboratory, and the Laboratory Certification Program. There are four units in the LSS, each managed by a Unit Chief (also known as a Technical Manager). Each Unit may have Senior Level Lead Worker(s) to coordinate the activities of the analysts and technicians. Designated Lead Workers may serve as temporary Acting Unit Chief (Technical Director) in the event a Unit Chief is not available.

2.2 Laboratory Director (Laboratory Services Section Chief)

The Laboratory Director is responsible for:

- Overall management of the laboratory operations including data quality, providing appropriate resources and facilities to perform requested work, and supervision of office and analytical staff;
- Defining the minimal level of experience and skills necessary for all positions in the laboratory and identifying the proper Civil Service classification position and level;
- Providing all appropriate safety items and analytical tools necessary for the proper completion of tests;
- Ensuring that all department, division, and laboratory polices and procedures are properly followed;
- Achieving the federal, state, department, division and laboratory goals and objectives;
- Ensuring timely compliance with audits and corrective actions;
- Maintaining a positive working environment that encourages open, constructive problem solving, continuous improvement and customer service;
- Developing a proactive program for prevention and detection of improper, unethical or illegal actions

2.3 Quality Assurance (QA) Officer

As shown in Figure 2-1, the QA Officer is independent of analytical duties, and has direct access to the Compliance Officer and Laboratory Director, to resolve any dispute involving data quality. The QA Officer serves as the focal point for QA/QC and is responsible in the review of quality control data with the Unit Managers. The officer is responsible for auditing the implementation of the Quality System. The QA Officer has sufficient authority to stop work as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Conducting internal audits on the entire technical operation annually; and
- Notifying laboratory management of deficiencies in the quality system and monitoring corrective action.

- Review of the MDLs, SO's & IDOCs.
- Monitor the Federal Register to keep current with newly promulgated regulations.
- Reviewing PT data to ensure the laboratory is meeting prescribed objectives and to determine systematic trends.
- Develop and maintain safety protocols in the laboratory to insure compliance with applicable regulations.
- Review QC data to determine if methods are in control or if trends are developing.

2.4 Unit Technical Directors (Unit Managers)

The **Unit** Technical Directors (Unit Managers) for each Unit reports to the Laboratory Director and is responsible for:

- Certifying personnel through an Initial Demonstration of Capability (IDOC) and overseeing all tests performed in the unit;
- Monitoring daily standards of performance in quality control and quality assurance;
- Monitoring the validity of the analyses performed and data generated in the laboratory to assure reliable data;
- Ensuring that sufficient numbers of qualified personnel are employed to perform and review the work of the unit; and
- Providing educational direction to laboratory staff;
- Ensuring the data quality and integrity of the analytical testing;
- Providing for the health and safety of staff while working in the facility by developing and maintaining safety protocols to insure compliance with applicable regulations.
- Provide training and serve as a resource for agency and division clients.
- May be designated and serve as temporary Acting Section Chief (Laboratory Director) in the event the Laboratory Director is not available.

2.5 Technical Staff (Laboratory Scientists and Laboratory Technicians)

Technical staff are responsible for preparation and sample analysis, data review, general equipment maintenance, LIMS entry, and identification of corrective actions. The staff report directly to the Unit Technical Directors. All personnel are responsible for complying with all quality assurance/quality control (QA/QC) requirements that pertain to their organizational/technical function. As documented in the employee records, each technical staff member has the experience and education to adequately demonstrate knowledge of their particular function and a general knowledge of laboratory operations, analytical test methods, quality assurance/quality control procedures and records management. The technical staff have the authority to halt analysis at any time the testing appears out of control. Communication with the Unit Manager is a daily requirement.

2.6. Training

Each employee has read, understood, and is using the latest version of the laboratory's SOPs, which relates to his/her job responsibilities. Each employee demonstrates continued proficiency by acceptable performance on Laboratory Control Samples (LCS) or Laboratory Fortified Blanks

(LFB). Training records (e.g., continuing education, participation in technical conferences, internal training activities) are kept with personnel files. Training is an integral part of the Performance Appraisal System and is documented with each employee's annual performance factors and evaluations.

2.7 Laboratory Capabilities

The Laboratory analyzes ground water, surface water, source water, wastewater, air, oil, and solid samples. Table 1 and APPENDIX E list the parameters/analytes measured, test references, and Reporting Limits (RL).

3.0 QUALITY ASSURANCE OBJECTIVES

The overall QA objectives for the MDEQ Laboratory are to develop and implement procedures for laboratory analysis, chain-of-custody, and reporting that will provide results which are of known and documented quality. Data Quality Indicators (DQIs) are used as qualitative and quantitative descriptors in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, bias (accuracy), and MDL's/RL's. DQIs are used as quantitative goals for the quality of data generated in the analytical measurement process. This section summarizes how specific QA objectives are achieved. The specific application of these various activities are contained in the method SOPs.

3.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement.

Precision is assessed through the calculation of relative percent difference (RPD) and relative standard deviations (RSD) for replicate samples. For inorganic analyses, laboratory precision is usually assessed through the analysis of a sample/sample duplicate pair and field duplicate pairs. For organic analyses, precision is usually assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD), or laboratory control sample/laboratory control sample duplicate (LCS/LCSD).

3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

Accuracy is assessed by the analysis of QC samples and through the adherence to all sample handling, preservation and holding times. Laboratory accuracy is further assessed through the analysis of MS/MSD, quality control samples, and surrogate compound spikes, as specified in the SOPs.

3.3 Method Detection Limits (MDL) and Reporting Limits (RL)

Method Detection Limits (MDLs) are determined for all target analytes as specified in 40 CFR Part 136, Appendix B. The MDL Study is completed annually or at the time a major change has occurred that would impact the analytical sensitivity. Laboratory grade water or sand will be used for the MDL determination. A specific matrix may be used if: 1) it is uniform in consistency; 2) routinely available to all laboratories in the state of Michigan; and 3) is representative of a matrix routinely submitted to the laboratory.

The MDEQ Laboratory recognizes that it is impractical to routinely report to the MDL for actual samples. Based on the calculated MDL, a Reporting Limit (RL) is determined, using the specific reference method, the MDL spiking concentration, or a concentration based on these factors and

Best Professional Judgement. For this reason, the RL is used as the routine quantitation limit. Typically, it may be at or near the spike concentration used to determine the MDL. In addition, for ease and convenience of reporting, the RL may be: (1) rounded up to the nearest one, two, five, or ten; or (2) rounded to a uniform number for a group of compounds in a gas chromatograph scan. In any case, the RL must be at or above the MDL and have a calibration standard at or below the RL. The reference SOP may take precedence in the selection of the low standard. See Admin SOP 103, "Method Detection Limit (MDL) and Reporting Limit (RL)". Sample results between the RL and the MDL may be reported to the client with a qualification flag indicating a lower confidence in the quantification process.

4.0 SAMPLING PROCEDURES

4.1. Environmental Laboratory sampling is conducted by MDEQ Field staff or staff under contract by state departments. The laboratory will advise sampling staff of the proper collection bottles, preservatives and storage and sample submission as needed. See Appendix C, Sample Bottle and Preservation Form, for details. Refer also to SOP 121, Sampling Techniques and Sample Submittal, and SOP 124, Sample Receiving/Environmental Laboratory.

4.2 Drinking Water Laboratory sampling is conducted by MDEQ Field staff, staff under contract by state departments, municipal water supplies and the general public. See Appendix F, Drinking Water Sampling Procedures Manual.

5.0 SAMPLE HANDLING

This section summarizes policies and practices for sample handling. Further details are contained in SOPs 109, 117, 119, 121, 122, & 124.

5.1 Sample Tracking

The MDEQ Laboratory assigns a unique Laboratory Information Management System (LIMS) generated Work Order Number and Bottle Number to each sample received to ensure that there can be no confusion regarding identity. This unique identification (ID) number is placed on each sample container, subsample and subsequent extracts and/or digestates.

5.2 Sample Acceptance Policy

The Laboratory has written sample acceptance SOPs that outline the circumstances under which samples will be accepted. Data from any samples that do not meet the policy are noted in the laboratory report defining the nature and substance of the variation. The SOP's require or establish:

- All samples must be from the department, other state agencies or government agencies or staff under the direct supervision and contract of government agencies (no environmental samples will be accepted or tested from the general public);
- The Drinking Water Laboratory accepts samples from the general public for fee testing.
- Proper, full, and complete documentation, including the sample identification, the location, date and time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample;
- Unique identification of samples using durable labels completed in indelible ink;
- Use of appropriate sample containers and preservation;
- Receipt within holding times unless qualifying data is acceptable under certain circumstances;
- Adequate sample volume;
- Procedures that are used when samples show signs of damage or contamination; and
- Storage of samples and proper disposal.

5.3 Sample Receipt Protocols

Upon receipt, the condition of the sample is recorded in the comment area of the LIMS if there are any abnormalities or departures from standard condition. All samples which require thermal preservation are considered acceptable if they arrive with ice, cold blue icepacks, or arrival temperature is either within +/-2 degrees C of the required temperature or the method specified range. For samples with a specified temperature of 4°C, samples with a temperature ranging from just above freezing temperature of water to 6°C are considered acceptable. Samples that are hand delivered to the laboratory immediately after collection may not meet this criteria. In these cases, the samples will be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

Where applicable, the MDEQ Field staff document preservation use on the sample bottle label.

Where there is any doubt as to the sample's suitability for testing, the Laboratory may consult its clients for further instruction before proceeding, or may proceed, but will qualify or provide comment on the data when reported. If the sample does not meet the sample receipt acceptance criteria, the Laboratory notes the condition of the samples on the chain of custody form and in the final report and/or in the LIMS.

5.4 Storage Conditions

Samples that require thermal preservation are stored under refrigeration which is +/-2°C of the specified preservation temperature. For samples with a specified storage temperature of 4°C, storage at a temperature above the freezing point of water to 6°C is considered acceptable. The main sample storage area is continuously monitored with an emergency notification of key personnel if the temperature exceeds the warning limits. Samples are stored in a manner that prevents cross contamination. For example, standards are stored separately from samples, and volatile samples are stored separately from all other samples.

5.5 Chain of Custody

The Sample Analysis Request Sheet and the Request for Water Analysis are the forms that document the sample chain-of-custody from the field to the laboratory, or from the laboratory to another location as required. A MDEQ Sample Transmittal form will be used for all Enforcement samples submitted to or through the laboratory. The main lab building is a secure and controlled access facility restricted to authorized personnel only. Access is allowed only through coded ID cards issued to authorized staff. In addition, cameras and monitors located throughout the building provide additional security monitoring capabilities.

Once samples are received in the secure environment of the laboratory, the LIMS will provide the necessary documentation of laboratory staff coming in contact with the sample. This LIMS documentation will identify staff, the date of extraction/digestion, and the date of analysis sufficient to reconstruct the sample COC as necessary. Refer to SOP 109, Chain of Custody Procedure for Criminal Court Cases, for further details.

5.6 Sample Disposal

All samples, digestates, leachates and extracts or other sample preparation products are disposed of in accordance with Federal and State laws and regulations. If the sample is part of litigation, disposal of the physical sample occurs only with the concurrence of the affected legal authority, sample data user and/or submitter of the sample. (See SOPs 109, 111, & 119).

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.1 Traceability of Calibration

Wherever applicable, calibration of analytical support equipment and instruments is traceable to national standards of measurement. Certificates of traceability
are maintained on file and all data can be traced back to these certificates via tracking numbers.

6.2 Reference Standards

Reference standards of measurement (such as Class S or equivalent weights or traceable thermometers) are used for calibration only. Reference standards are subjected to in-service checks between calibrations and verifications.

6.3 General Requirements

Each calibration is dated and labeled with or traceable to the method, instrument, analysis date, and each analyte name, concentration and response (or response factor). Sufficient information is recorded to permit reconstruction of the calibration. Acceptance criteria for calibrations comply with method requirements or are established and documented.

6.4 Analytical Support Equipment

Analytical support equipment includes: autoclaves, balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All such support equipment is:

- maintained in proper working order. The records of all activities including service calls are kept.
- calibrated or verified at least annually, using NIST traceable references when available, at the point of use or over the entire range of use. The results of such calibration must be within the specifications required of the application for which the equipment is used or the equipment is removed from service until repaired.

Balances, ovens, refrigerators, freezers, incubators and water baths are checked with NIST traceable references (where possible) in the expected use range. The acceptability for use or continued use is according to the needs of the analysis or application for which the equipment is being used. Mechanical volumetric dispensing devices used for quantitative purposes (except Class A glassware) are checked each day of use.

6.5 Instrument Calibration

Calibration procedures for a specific laboratory instrument will consist of an initial calibration, or a calibration verification when an initial calibration is not performed on the day of analysis unless otherwise specified in the Laboratory SOP and reference method. The SOP for each

analysis performed in the laboratory describes the calibration procedures, their frequency, acceptance criteria and the conditions that will require recalibration. In all cases, the initial calibration is verified using an independently prepared calibration verification solution. The laboratory maintains a document/instrument logbook for each instrument which contains the following information: instrument identification, serial number, maintenance and may contain the date of calibration, analyst, calibration solutions run and the samples associated with these calibrations.

All results are calculated based on the response curve from the initial calibration and are bracketed by calibration standards or reported as qualified data unless otherwise specified by the SOP (i.e. GC/MS).

If the initial calibration fails, the analysis procedure is stopped and evaluated. For example, a second standard may be analyzed and evaluated or a new initial calibration curve may be established and verified. In all cases, the initial calibration must be acceptable before analyzing any samples.

When an initial calibration is not performed on the day of analysis, a calibration verification check standard is analyzed at the beginning and end of each analytical batch or sequence as specified in the SOP. The concentration of this calibration check varies as described in each method SOP. If a calibration check standard fails, and routine corrective action procedures fail to produce a second consecutive calibration check within acceptance criteria, a new initial calibration curve is constructed. If the continuing calibration acceptance criteria are exceeded high (i.e., high bias), and there are non-detects for the corresponding analyte in all samples associated with the continuing calibration check, then those non-detects may be reported, otherwise the samples affected by the unacceptable check are reanalyzed after a new calibration curve has been established, evaluated and accepted. If the continuing calibration acceptance criteria are below the acceptance limit, results may be reported if sample results indicate a concentration above an action level and/or accurate values are not required by the client. Data will be flagged accordingly. Otherwise, additional sample analysis does not occur until a new calibration curve is established and verified. See analytical SOP's for specific details.

7.0 TEST METHODS AND STANDARD OPERATING PROCEDURES

The Laboratory maintains Standard Operating Procedures (SOPs) that accurately reflect all laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods. Copies of all SOPs are accessible to all staff from the immediate supervisor or via the Intranet. Each SOP indicates the effective date, the revision number, and the signature(s) of the Analyst, QA Officer, Technical Director, Compliance Officer, and Laboratory Director. The electronic copy on the server is considered to be the sole controlled document. All other copies or printouts are considered to be uncontrolled copies. All laboratory personnel are provided with computers to access the controlled document, but do not have the security rights to modify the existing controlled electronic document.

SOPs are used to ensure consistency and to save time and effort. Any deviation from an established procedure during an analysis is documented.

7.1 SOPs for Sample Management (SOP's 105, 109, 117, 119, 121, 122, 124)

The Sample Management SOPs describe the receipt, handling, scheduling, and storage of samples.

Sample Receipt and Handling -- These procedures describe the precautions to be used in opening sample shipment containers and how to verify that chain-of-custody has been maintained, examine samples for damage, check for proper preservatives and temperature, and log samples into the laboratory sample system.

Sample Scheduling -- These procedures describe the sample scheduling in the laboratory and include procedures used to ensure that holding time requirements are met.

Sample Storage -- These procedures describe the storage conditions for all samples, verification and documentation of daily storage conditions, and how to ensure that custody of the samples is maintained while in the laboratory.

7.2 Reagent/Standard Preparation

The method SOPs describe how to prepare specific standards, reagents, selection of specific grades of materials used in reagent and standard preparation, use of appropriate glassware and containers for preparation and storage, and proper labeling. Use of Stock Tracking Logbooks will maintain the documentation and recordkeeping for traceability. The following process will be used to complete the Stock Tracking Logbooks:

7.2.1 Stock Tracking Logbooks

1. All chemicals, solvents, acids, bases, reagents and standards received must be logged into the Stock Tracking Logbook.

2. Any of the above items that go directly to the Filley Street facility will have a receipt date

and a Filley number assigned with a prefix "FL-" and will be logged into a special Filley Street Logbook located at Filley Street.

3. Tracking logbooks will be bound into color-coded books.

4. The Environmental Lab will have a prefix of "EL-" and the Drinking Water Lab will have a prefix of "DW"assigned to all items in the Stocking Tracking Logbook and a receipt date will be documented for tracking purposes.

5. Any items arriving from Filley Street to building #44 must have a "FL" number on the container and must be logged into the Stock Tracking Logbook.

6. All certificates of analysis must have the "EL" or "DW" number written on the top right hand corner by the receiver. The original certificate is to be given to the Laboratory Compliance Officer or the QA Officer and a copy is to accompany the item into the lab.

7. Every container must have a tracking number written on it. (i.e. if a box of 4 bottles is received, these items must be written on each bottle.)

8. When a bottle is opened the opened date and initials of the person opening the bottle must be written on the bottle.

9. If multiple bottles of the same item are received at the same time with the same lot number, one line in the Stock Tracking Logbook may be filled out with a dash and then 1 through X (X represents the number of bottles.) (example: Received a box of methanol containing 4 bottles with all the same lot numbers. Let's assume the next entry in the Stock Tracking Logbook will be "EL-1020". The entry in the book for these bottles of methanol will be "EL-1020-1 through 4.". NOTE: Each bottle will have a unique number written on it. The numbers would be EL-1020-1; EL-1020-2; EL-1020-3; and EL-1020-4.

10. If the item was ordered by credit card put "Charge" in the PO # column.

11. If the item was received from Filley Street and the PO# and vendor are not easily found they can be found on the packing slip which Procurement should have.

7.3 General Laboratory Techniques

SOPs may be developed to describe all essentials of laboratory operations that are not addressed elsewhere. These techniques should include, but are not limited to, safety, sample submission, and chain-of-custody.

7.4 SOPs for Test Methods

Procedures for test methods describing how the analyses are actually performed in the laboratory are specified in method SOPs. These SOPs for sample preparation, cleanup and analysis are

based on reference methods published by EPA, ASTM, AWWA, and other organizations and on internally developed methods validated according to EPA's Performance-Based Measurement System. See SOP 108, Methodology Write Up Format . Each method SOP may include:

1) Applicable analytical methods;
2) applicable matrix or matrices;
3) method detection limits and Reporting Limits;
4) scope and application, including components to be analyzed;
5) method summary;
6) definitions;
7) interference's;
8) safety;
9) equipment and supplies;
10) reagents and standards;
11) sample collection, preservation, shipment and storage;
12) quality control;
13) calibration and standardization;
14) procedure;
15) calculations;
16) method performance;
17) pollution prevention;
18) data assessment;
19) corrective actions;
20) waste management;
21) references; and
22) any tables, diagrams, flowcharts and validation data
23) attachments

7.5 Equipment Calibration and Maintenance

SOPs may be developed to describe how to ensure that laboratory equipment and instrumentation are in working order if it is not addressed in the Method SOP. These procedures may include calibration procedures and schedules, maintenance procedures and schedules, maintenance logs, service arrangements for all equipment, and spare parts available in-house. Calibration and maintenance of laboratory equipment and instrumentation are in accordance with manufacturers' specifications or applicable test specifications.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Laboratory Quality Control Samples

The data acquired from QC procedures are used to determine the quality of analytical data, and the need for corrective action in response to identified deficiencies, and to interpret results after corrective action procedures are implemented. Each method SOP includes a QC section that addresses the minimum QC requirements for the procedure. The internal QC checks may differ slightly for each individual procedure but in general are described below. The acceptance limits and corrective actions for these QC checks are described in Section 12 and 13 of this Manual.

a) Method Blanks/Laboratory Reagent Blanks are performed at a minimum frequency of one per batch of samples per matrix type per sample extraction or preparation test method. The results of these samples are used to determine possible contamination of the test system.

b) LCS/LFB (QC Check Sample) are analyzed at a minimum of 1 per batch of 20 or fewer samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as (but not limited to) total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples are used to determine batch acceptance (see also MS/MSD for organic testing).

c) Matrix Spikes (MS) are performed at a minimum frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as (but not limited to), total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The sample(s) selected for spiking are rotated among received samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike generally indicates a problem with the sample composition, and not the laboratory analysis, and is reported to assist in data assessment.

d) Surrogates - Surrogate compounds are added to all samples, standards, and blanks for all organic chromatography test methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery generally indicates a problem with the sample composition and is reported to assist in data assessment.

e) Spike Components - In general, the spike compounds are those specified in the method as the spiking components or as the recommended spiking components (such methods 8270 or 625). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs), the test method has an extremely long list of components (such as Methods 8270 or 6010) or components are incompatible, a representative number (10%) of the listed components may be used. The components of each spiking mix represent all chemistries, elution patterns and masses and include permit-specified analytes and other client requested components. All reported components are used in the spike mixture within a two-year time period, and no one component or components dominates the spike mixture.

f) Matrix Spike Duplicates (MSDs) or Laboratory Duplicates are analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation test method. The selected sample(s) are rotated among received samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates generally indicates a problem with the sample composition and is reported to assist in data assessment.

8.2 Method Detection Limits (MDL) and Reporting Limits (RL)

For analytes for which spiking is a viable option, Method Detection Limits are determined as described in 40 CFR Part 136, Appendix B. The method detection limit is initially determined for the compounds of interest in each method in laboratory pure reagent water or sand.

An MDL study is not performed for any component for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature dissolved oxygen or turbidity. For these types of analytes, the reporting limit is based on the signal to noise ratio, from the analysis of a QC check sample, or calibration standard.

The MDEQ Laboratory recognizes that it is impractical to routinely report to the MDL for actual samples. Based on the calculated MDL, a Reporting Limit (RL) is determined, using the specific reference method, the MDL spiking concentration, or a concentration based on these factors and Best Professional Judgement. For this reason, the RL is used as the routine quantitation limit. Typically, it may be at or near the spike concentration used to determine the MDL. In addition, for ease and convenience of reporting, the RL may be: (1) rounded up to the nearest one, two, five, or ten; or (2) rounded to a uniform number for a group of compounds in a gas chromatograph scan. In any case, the RL must be at or above the MDL and have a calibration standard at or below the RL. The reference SOP may take precedence in the selection of the low standard. See Admin SOP 103, "Method Detection Limit (MDL) and Reporting Limit (RL)". Sample results between the RL and the MDL may be reported to the client with a qualification flag indicating a lower confidence in the quantification process.

8.3 Selectivity

a) Absolute and relative retention times aid in the identification of components in chromatographic analyses and help evaluate the effectiveness of a column to separate constituents. Acceptance criteria for retention time windows are documented in each method SOP.

b) A confirmation may be performed to verify a compound identification when positive results are detected on a sample from a location that has not been previously tested. Such confirmations are performed on organic tests except when the analysis involves the use of a mass spectrometer. Confirmation will be performed on a separate column, retesting, or by a different method.

c) Acceptance criteria for mass spectral tuning are contained in SOPs.

8.4 Initial Demonstration of Capability (IDOC)

Prior to acceptance and use of any method, satisfactory initial demonstration of method performance is required. This initial demonstration of method performance is performed each time there is a significant change in instrument type, personnel or test method. An IDOC is completed for each analyst documenting that this activity has been performed. The Unit Manager submits the IDOC to the QA Officer. The IDOC procedure is outlined in Appendix A.

9.0 DATA REDUCTION, REVIEW, REPORTING AND RECORDS

9.1 Data Reduction and Review

Analytical data is reduced according to protocols described in the laboratory SOPs. Computer programs used for data reduction are validated before use by manual calculations. All information used in the calculations (e.g., raw data, calibration files, tuning records, results of standard additions, interference check results, sample response, and blank or background-correction protocols) are recorded in order to enable reconstruction of the final result at a later date. Information on the preparation of the sample (e.g., weight or volume of sample used, percent dry weight for solids, extract volume, dilution factor used) is maintained in order to enable reconstruction of the final result at a later date.

Data may be entered into the LIMS after peer review or at the completion of the originating analyst review and approval. A draft of data entered into the LIMS is reviewed by a second analyst or supervisor according to laboratory procedures to ensure that the QC is acceptable, calculations are correct, qualifications are noted as required, and to detect transcription errors. Spot checks are performed on computer calculations to verify program validity. Errors detected in the review process are referred to the analyst(s) for corrective action. Once the data is validated, the report is finalized and printed for distribution.

As described in Section 12.0, the results of all quality control sample analyses are reviewed and evaluated before data are reported.

9.2 Report Format and Contents

The results of each test, or series of tests are normally reported in a report and include all the information necessary for the interpretation of the results. Each report typically includes:

1) name and address of laboratory, and phone number with name of contact person;
2) a unique identification number and the total number of pages, with all pages sequentially numbered;
3) name and address of client;
4) description and unambiguous identification of the sample(s) including the client identification code;
5) identification of results for any sample that did not meet sample acceptance requirements;
6) date of sample collection and date of sample receipt;
7) identification of the test method used;
8) if the laboratory collected the sample, reference to sampling procedure;
9) any deviations from, additions to or exclusions from SOPs, and any conditions that may have affected the quality of results, and including the use and definitions of data qualifiers;
10) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified; identification of whether data are calculated on a dry weight or wet weight basis; identification of the reporting units such as ug/L or mg/Kg;

11) clear identification of all test data provided by outside sources, such as subcontracted laboratories, clients, etc.; and
12) clear identification of numerical results.

Exceptions to this standard approach for reporting are allowed with approval of the Technical Director and are documented.

Material amendments to a test report after issue are made only in the form of a further document, or data transfer including the statement "Supplement to Test Report, identification number." If the test report is regenerated with corrections, the new report will be clearly marked as "CORRECTED COPY" and both copies, original and corrected, will be filed and maintained as part of the official laboratory documents. For the Drinking Water LABLIMS program, the new report will be clearly marked as "CORRECTED REPORT". Subsequent reports can be generated from LABLIMS at any time using the saved data files

Clients are notified promptly, in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a report.

9.3 Records

Records provide the direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning laboratory results. These records, particularly those that are anticipated to be used as evidentiary data, provide the historical evidence needed for later reviews and analyses. Records should be legible, identifiable, and retrievable, and protected against damage, deterioration, or loss. All records referenced in this section are retained for a minimum of seven years in accordance with the departments Record Retention Schedule.

Laboratory records generally consist of bound notebooks with pre-numbered pages, personnel qualification and training forms, equipment maintenance and calibration forms, chain-of-custody forms, sample analysis request forms, and analytical change request forms. All records are recorded in indelible ink and retained for seven years. Records that are stored or generated by computers or personal computers (PCs) have hard copy or write-protected backup copies.

Any documentation errors are corrected by drawing a single line through the error so that it remains legible and is initialed by the responsible individual, along with the date of change. The correction is written adjacent to the error. The person who performed the instrumental analysis signs strip-chart recorder printouts. If corrections need to be made in computerized data, a system parallel to the corrections for handwritten data is used.

Laboratory records include the following:

Standard Operating Procedures -- Any revisions to laboratory procedures are written, dated, and distributed to all affected individuals to ensure implementation of changes. These are readily available to all staff on the laboratory Intranet. An archive of obsolete SOPs are maintained to

determine how historical data was derived. Each revision is given an effective date and an obsolete date in order to define the time frame that the SOP was used.

Equipment Maintenance Documentation -- Documents detailing the receipt and specification of analytical equipment is retained. A history of the maintenance record of each system serves as an indication of the adequacy of maintenance schedules and parts inventory. As appropriate, the maintenance guidelines of the equipment manufacturer are followed. When maintenance is necessary, it is documented in either standard forms or in logbooks.

Calibration Records & Traceability of Standards/Reagents -- The frequency, conditions, standards, and records reflecting the calibration history of a measurement system are recorded.

Sample Management -- A record of all procedures to which a sample is subjected while in the possession of the laboratory is maintained. These include records pertaining to:
a) Sample preservation including appropriateness of sample container and compliance with holding time requirement;
b) Sample identification, receipt, acceptance or rejection and log-in;
c) Sample storage, transmittal forms, and internal routing and assignment records;
d) Disposal of hazardous samples including the date of sample or subsample disposal and name of the responsible person;
e) Automated sample-handling systems.

Original Data -- The raw data and calculated results for all samples is maintained in laboratory notebooks, logs, benchsheets, files or other sample tracking or data entry forms. Instrumental output is stored in a computer file or a hard copy report. These records include:
a) Laboratory sample ID code;
b) Date of analysis;
c) Instrumentation identification and instrument operating conditions/parameters;
d) Analysis type and sample preparation information, including sample aliquots processed, cleanup, and separation protocols.;
e) All manual, automated, or statistical calculations;
f) Confirmatory analysis data, when required to be performed; and
g) Analyst's or operator's initials/signature.

QC Data -- The raw data and calculated results for all QC samples and standards are maintained in the manner described in the preceding paragraph. Documentation allows correlation of sample results with associated QC data. Documentation also includes the source and lot numbers of standards for traceability. QC samples include, but are not limited to, control samples, method blanks, matrix spikes, and matrix spike duplicates.

Deviations -- All deviations from SOPs are reviewed and approved by the QA Officer or Technical Director.

Final Report -- A copy of any report issued and any supporting documentation.

Administrative Records -- The following are maintained:
a) Personnel qualifications, experience and training records;
b) Initial demonstration of proficiency for each analyst; and
c) A log of names, initials and signatures for all individuals who are responsible for signing or initialing any laboratory record.

9.4 Document Control System

A document control system is used to ensure that all staff have access to current policies and procedures at all times. Documents which are managed by this system include this Quality Manual and all SOPs. The system consists of a document review, revision and approval system, and, document control and distribution.

All quality documents (this Manual, SOPs, policies, etc.) are reviewed and approved by the QA Officer, Compliance Officer, Technical Director and the Laboratory Director. Such documents are revised whenever the activity described changes significantly. All documents are reviewed at least every 3 years.

The Compliance Officer controls all quality documents. Controlled copies are available \ in read-only .pdf format only on the DEQ Intranet at P:\ESSD\LSS\SOP Directory\Drinking Water SOP's. Uncontrolled copies may be printed as needed by staff, however, the controlled document remains on the website.

9.5 Confidentiality

All laboratory results and associated raw data are kept in confidence to the client who requested the analyses. Freedom of Information Act (FOIA) requests shall follow all rules and regulations as specified by the department and division. Access to laboratory records and LIMs data is limited to laboratory personnel except with the permission of the Unit Managers, Compliance Officer or Laboratory Director. Laboratory & personnel records may be made available to authorized accrediting authority personnel.

Where clients require transmission of test results by telephone, telex, facsimile or other electronic or electromagnetic means, staff will ensure confidentiality is preserved.

10.0 PERFORMANCE AND SYSTEM AUDITS AND FREQUENCY

10.1 Internal Laboratory Audits

Annual internal audits are performed to verify that laboratory operations continue to comply with the requirements of the quality system. The quality assurance officer does such audits. Upon completion of the audit, the QA Officer generates an inspection report citing any deficiencies discovered during the audit. The report is given to the Laboratory Director with a copy to the appropriate Unit Manager and Compliance Officer. It is the ultimate responsibility of the Laboratory Director to ensure that proper corrective action has been implemented on a permanent basis. Where the audit findings cast doubt on the correctness or validity of the laboratory's results, an immediate corrective action is initiated and any client whose work may have been affected is notified.

The internal system audits include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc.

10.2 Managerial Review

At least once per year, laboratory management conducts a review of the quality system to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations. The review takes account of reports from managerial and supervisory personnel, the outcome of recent internal audits, assessments by external bodies, the results of proficiency tests, any changes in the volume and type of work undertaken, feedback from clients, corrective actions and other relevant factors.

11.0 FACILITIES, EQUIPMENT, REAGENTS, AND PREVENTATIVE MAINTENANCE

11.1 Equipment

Records are maintained for each major equipment and all reference materials significant to the tests performed. These records include documentation on all routine and non-routine maintenance activities and reference material verifications.
The records include:
1) the name of the equipment;
2) the manufacturer's name, type identification, and serial number or other unique identification;
3) date received and date placed in service (if available);
4) current location, where appropriate;
5) if available, condition when received (e.g. new, used, reconditioned);
6) copy of the manufacturer's instructions, where available;
7) dates and results of calibrations;
8) details of maintenance carried out to date and planned for the future; and
9) history of any damage, malfunctions, modification or repair.

Glassware Cleaning - Glassware is cleaned to meet the requirements of the method. Any cleaning and storage procedures that are not specified by the method are documented in laboratory records and SOPs.

11.2 Documentation and Labeling of Standards and Reagents

Records are kept for all standards, including the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage conditions, and an expiration date after which the material is not used unless it is verified. See also Section 7.2.

Original containers provided by the vendor are labeled with an expiration date.

Detailed records are maintained on reagent and standard preparation. These records indicate traceability to purchased stocks or neat compounds, details of preparation, date of preparation, expiration date and preparer's initials.

All containers of prepared reagents and standards bear a unique identifier and expiration date and are linked to the documentation requirements above.

1) Reagents - In methods where the purity of reagents is not specified, analytical reagent grade shall be used. Reagents of lesser purity than those specified by the method are not to be used. The labels on the container are checked to verify that the purity of the reagents meets the requirements of the particular method. Such information is documented.

2) Water - The quality of reagent water sources is monitored and documented to meet method specified requirements.

11.3 Computers and Electronic Data Related Requirements

Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of test data:

- Computer software is documented to be adequate for use (provided by vendor);
- Procedures are established and implemented for protecting the integrity of data;
- Computer and automated equipment are maintained to ensure proper functioning;
- Appropriate procedures are used for the maintenance of security of data including the prevention of unauthorized access to, and the unauthorized amendment of, computer records through password protection and read only attributes.

11.4 Preventative Maintenance

A routine preventative maintenance program is used to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of all instruments. All maintenance that is performed is documented in the instrument maintenance logbook. All laboratory instruments are maintained in accordance with manufacturer's specifications. Maintenance will be specified by the manufacturer, reference method and in the SOPs.

11.5 Inspection/Acceptance Requirements for Supplies and Consumables

Labels indicating the following information on receipt and testing are to be used for critical supplies and consumables.

- Unique identification number (if not clearly shown).
- Date received and initials.
- Date opened and initials.
- Expiration date.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO EVALUATE DATA QUALITY

Quality control acceptance criteria are used to determine the validity of the data based on the analysis of internal quality control check (QC) samples (see Section 8.0). The specific QC samples and acceptance criteria are found in the laboratory SOPs. Typically, laboratory established acceptance criteria are taken from published EPA methods. Where no EPA criteria exist, laboratory generated acceptance criteria are established. Acceptance criteria for bias are based on the historical mean recovery plus or minus three standard deviations from the mean, and acceptance criteria for precision range from zero (no difference between duplicate control samples) to the historical mean relative percent difference plus three standard deviation units.

Analytical data generated with QC samples that fall within prescribed acceptance criteria indicate the laboratory was in control. Data generated with QC samples that fall outside the established acceptance criteria indicate the laboratory was "out-of-control" for the failing tests. These data are considered suspect and the corresponding samples are reanalyzed or reported with qualifiers.

Many published EPA methods do not contain recommended acceptance criteria for QC sample results. In these situations, the MDEQ Environmental Laboratory uses 70 - 130% as interim acceptance criteria for recoveries of spiked analytes, until in-house limits are developed. In-house limits are based on a 95% confidence interval and must include a minimum of 20 data points.

12.1 Laboratory Control Samples or Fortified Blanks

A laboratory control sample (LCS) or fortified blank (LFB) is analyzed with each batch of samples to verify that the accuracy of the analytical process is within the expected performance of the method. The results of the laboratory control sample are compared to acceptance criteria to determine usability of the data. Data generated with LCS/LFB samples that fall outside the established acceptance criteria are judged to be out-of-control. These data are considered suspect and the corresponding samples are reanalyzed or reported with qualifiers. See specific Organic SOP's for use of MS/MSD vs LCS/LCSD.

12.2 Matrix Spikes/Matrix Spike Duplicates

Results from MS/MSD analyses are primarily designed to assess data quality in a given matrix, and not laboratory performance. In general, if the LCS results are within acceptance criteria, performance problems with MS/MSD results may either be related to the specific sample matrix or to an inappropriate choice of extraction, cleanup, or determinative methods. If any individual percent recovery in the matrix spike (or matrix spike duplicate) falls outside the designated acceptance criteria, the laboratory will determine if the poor recovery is related to a matrix effect or a laboratory performance problem. A matrix effect is indicated if the LCS data are within acceptance criteria but the matrix spike data exceed the acceptance criteria.

12.3 Surrogate Recoveries

Surrogates are used in organic analyses. Surrogate recovery data from individual samples are compared to laboratory generated limits (and reference surrogate recovery acceptance criteria if available). As for MS/MSD results, surrogate recoveries are used primarily to evaluate data quality and not laboratory performance.

12.4 Method Blanks

Method blank analyses are used to assess acceptance of sample results and to demonstrate the presence of any interferences or contamination throughout the entire analytical process, including sample preparation. The source of contamination is investigated and measures taken to correct, minimize or eliminate the problem if:

- the blank contamination exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated sample batch or
- the blank contamination exceeds the concentration present in the samples and is greater than 1/10 of the specified regulatory limit.
- any blank value above the RL is reported with the appropriate qualifying remark code

Each sample in the affected batch is assessed against the above criteria to determine if the sample results are acceptable. Any sample associated with the contaminated blank is reprocessed for analysis or the result is reported with appropriate data qualifying codes.

13.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out of control QC performance that can affect data quality. To the extent possible, samples are reported only if all quality control measures are acceptable. If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure are reported with the appropriate data qualifier(s). Sample results may also be qualified when holding times are not met, improper sample containers and/or preservatives are used or when other deviations from laboratory standard practices and procedures occur.

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples may be identified during sample log-in or just prior to analysis. The SOPs specify conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, and automatic reinjection/reanalysis when certain QC criteria are not met.

Any QC sample result outside of acceptance limits requires corrective action. Once the problem has been identified and addressed, corrective action may include the reanalysis of samples, or appropriately qualifying the results.

The analyst will identify the need for corrective action. The Unit Technical Director will approve the required corrective action to be implemented by the laboratory staff. The QA Officer will ensure implementation and documentation of the corrective action.

Corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both a corrective action log (signed by analyst, Unit Technical Director, and QA Officer), and the narrative in data report. Reported results that have been qualified do not require entry into the corrective action log.

Where a complaint, or any other circumstance, raises doubt concerning the laboratory's compliance with the laboratory's policies or procedures, or with the quality of the laboratory's tests, the laboratory shall ensure that those areas of activity and responsibility involved are promptly audited. Records of the complaint and subsequent actions are maintained.

14 SUBCONTRACTING AND SUPPORT SERVICES AND SUPPLIES

14.1 Contracting Laboratory Services

- The MDEQ Environmental Laboratory has eight State Contract Laboratories available as overflow labs. Field staff submitting samples to the DEQ Laboratory will designate the appropriate contract laboratory for referral if such funding is available. Clients are advised if any analyses will be referred to a contract laboratory. At this time, all reporting and invoicing transactions for samples referred to a contract laboratory will be handled between the client and the contracting laboratory.
- The State Contract Laboratories must have an MDEQ approved QAPP, are subject to on-site audits, and may have their data audited to ensure acceptable quality.

14.2 Outside Support Services and Supplies

The Laboratory only uses those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's tests. Records of all suppliers for support services or supplies required for tests are maintained.

15.0 REFERENCES

NELAC Standards, July 1999

Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, Washington, DC 20460.

RCRA QAPP Instructions, U. S. EPA Region 5, Revision: April 1998

ASTM D-5283-92.Generation of Environmental Data Related to Waste Management Activities: Quality assurance and Quality Control Planning and Implementation

"American National Standards Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4)", 1994

EPA 2185 - Good Automated Laboratory Practices, 1995

ISO/IEC Guide 25: 1990. General requirements for the competence of calibration and testing laboratories

QA/R-2: EPA Requirements for Quality Management Plans, August, 1994

QA/G-4: Guidance for the Data Quality Objectives Process EPA/600/R-96/055, September, 1994

QA/R-5: EPA Requirements for Quality Assurance Project Plans Draft - November 1997

QA/G-5: Guidance on Quality Assurance Project Plans EPA/600/R-98/018, February, 1998

QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November, 1995

QA/G-9: Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA/600/R-96/084 , January, 1998

Manual for the Certification of Laboratories Analyzing Drinking Water EPA/570/9-90/008

MICHIGAN DEPARTMENT
OF
ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX A

Initial Demonstration of Capability

QAPP-Ver2.0, Revison 0
May 5, 2003

APPENDIX A
INITIAL DEMONSTRATION OF CAPABILITY (IDOC)

A demonstration of capability (DOC) is made prior to using any test method, and at any time there is a significant change in instrument type, personnel or test method.

All demonstrations are documented through the use of the form in this appendix.

The following steps are performed.

a) A quality control sample is obtained from an outside source. If not available, the QC sample is prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

b) The analyte(s) are diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified, or if unspecified, to a concentration approximately 10 times the laboratory-calculated detection limit.

c) Four aliquots are prepared and analyzed according to the test method either concurrently or over a period of days.

d) Using all of the results, the mean recovery and the standard deviation is calculated for each parameter of interest.

e) The calculated mean and standard deviation are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

f) When one or more of the tested parameters fail at least one of the acceptance criteria, the laboratory repeats the test for all parameters that failed to meet criteria. If repeated failure occurs, the laboratory will locate and correct the source of the problem and repeat the test for all compounds of interest beginning with c).

g) For those analysts that have past recognized historical laboratory analytical training, experience, responsibilities and duties, the use of recent control data may be used for the purposes of documenting an IDOC.

Documentation

The IDOC data is used to document the completion of each demonstration of capability. The Unit Manager will review the data, accept/reject, and forward to the QA Officer. A copy will be maintained by the QA Officer, analyst, and staff record file.

Michigan Department of Environmental Quality
Laboratory Section
Drinking Water and Radiological Protection Division
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE:
ANALYST:
METHOD:
MATRIX:

SUPERVISOR APPROVAL:

INITIAL DEMONSTRATION OF CAPABILITY

Analyte	Spike Value (units)	REP #1	REP #2	REP #3	REP #4	STANDARD DEVIATION	MEAN	%RSD	Acceptance Criteria	RESULTS ACCEPTABLE?	COMMENTS
Example		7.00	4.00	5.00	4.00	1.41	5.00	28.28	20.00	Fail	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	
Example		5.00	4.00	5.00	4.00	0.58	4.50	12.83	20.00	Pass	

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION ENVIRONMENTAL LABORATORY QUALITY ASSURANCE PROGRAM PLAN

APPENDIX B

List of Standard Operating Procedures (SOP's)

QAPP-Ver2.0, Revison 0
May 5, 2003

APPENDIX B

TABLE OF CONTENTS - STANDARD OPERATION PROCEDURE (SOP)
DWRPD LABORATORY SERVICES SECTION

UNIT	SOP #	TYPE	TITLE
Administrative	SOP 100	N/A	Safety
Administrative	SOP 101	N/A	Minimal Requirements for an Analytical Program
Administrative	SOP 102	N/A	Requisition of Supplies
Administrative	SOP 103	N/A	Method Detection Limit (MDL) and Reporting Limit (RL)
Administrative	SOP 104	N/A	Laboratory Safety Inspections
Administrative	SOP 105	N/A	Lab Opening and Closing
Administrative	SOP 106	N/A	Lab Result Remark Codes
Administrative	SOP 107	N/A	Methodology Approval
Administrative	SOP 108	N/A	Methodology Write-Up Format
Administrative	SOP 109	N/A	Chain of Custody for Criminal Court Cases
Administrative	SOP 110	N/A	Field Blanks and Field Replicates
Administrative	SOP 111	N/A	Handling of Laboratory Wastes and Materials
Administrative	SOP 112	N/A	Handling of "A" Designated Carcinogens
Administrative	SOP 113	N/A	Emergency Evacuation
Administrative	SOP 114	N/A	Equipment Procurement
Administrative	SOP 115	N/A	Method Development Request
Administrative	SOP 116	N/A	Cost Accounting

UNIT	SOP #	TYPE	TITLE
Administrative	SOP 117	N/A	Identifying Samples Known or Suspected to be Hazardous
Administrative	SOP 118	N/A	Annual Precision and Accuracy Summaries
Administrative	SOP 119	N/A	Storage of Samples and Lab Data
Administrative	SOP 120	N/A	Recycling
Administrative	SOP 121	N/A	Sampling Techniques and Sample Submittal
Administrative	SOP 122	N/A	Sample Receiving/Drinking Water Laboratory
Administrative	SOP 123	N/A	Notification of Positive Bacteriological Samples (E. coli and Repeat Total Coliform)
Administrative	SOP 124	N/A	Sample Receiving/Environmental Laboratory
Environmental Inorganic	SOP 200	Sample Prep.	ASTM Leachate Procedure
Environmental Inorganic	SOP 201	Sample Prep.	Acid Digestion for Arsenic, Selenium, and Antimony
Environmental Inorganic	SOP 202	Sample Prep.	Extraction Procedure Toxicity (EP Tox.)
Environmental Inorganic	SOP 203	Sample Prep.	Acid Digestion for Metals (Hot Plate)
Environmental Inorganic	SOP 204	Sample Prep.	Solid Digestion for Arsenic and Selenium
Environmental Inorganic	SOP 205	Sample Prep.	Sediment Drying Procedure for Metals
Environmental Inorganic	SOP 206	Sample Prep.	Synthetic Precipitation Leaching Procedure (SPLP)
Environmental Inorganic	SOP 207	Sample Prep.	Microwave Digestion for Metals in Water
Environmental Inorganic	SOP 208	Sample Prep.	Microwave Digestion for Metals in Organic Matrices
Environmental Inorganic	SOP 209	Sample Prep.	Sediment Digestion for Metals
Environmental Inorganic	SOP 210	Sample Prep.	Sediment Digestion for Arsenic
Environmental Inorganic	SOP 211	Sample Prep.	Extraction of Filter Material

UNIT	SOP #	TYPE	TITLE
Environmental Inorganic	SOP 300	Analytical	Chloride (Colorimetric, Automated Ferricyanide, Traacs 800)
Environmental Inorganic	SOP 301	Analytical	Alkalinity (Colorimetric, Automated Methyl Orange, Traacs 800)
Environmental Inorganic	SOP 302	Analytical	Sulfate (Colorimetric, Automated Methylthymol Blue, Traacs)
Environmental Inorganic	SOP 303	Analytical	Determination of Total Kjeldahl Nitrogen in Water
Environmental Inorganic	SOP 304	Analytical	Determination of Total Phosphorus in Water
Environmental Inorganic	SOP 305	Analytical	Biological Oxygen Demand (BOD)
Environmental Inorganic	SOP 306	Analytical	Ultimate Biochemical Oxygen Demand (UBOD)
Environmental Inorganic	SOP 307	Analytical	Chemical Oxygen Demand (COD) - Low Level in Water
Environmental Inorganic	SOP 308	Analytical	Chemical Oxygen Demand (COD) - High Level in Water
Environmental Inorganic	SOP 309	Analytical	Chemical Oxygen Demand (COD) - Total in Sediments
Environmental Inorganic	SOP 310	Analytical	Chlorophyll A
Environmental Inorganic	SOP 311	Analytical	Conductivity
Environmental Inorganic	SOP 312	Analytical	Cyanide, Total
Environmental Inorganic	SOP 313	Analytical	Cyanide, Amenable to Chlorination
Environmental Inorganic	SOP 314	Analytical	Flash Point
Environmental Inorganic	SOP 315	Analytical	Dissolved Oxygen (DO)
Environmental Inorganic	SOP 316	Analytical	Ammonia
Environmental Inorganic	SOP 317	Analytical	Kjeldahl Nitrogen (Total in Solids)
Environmental Inorganic	SOP 318	Analytical	Nitrate Plus Nitrite
Environmental Inorganic	SOP 319	Analytical	Nitrite in Water

UNIT	SOP #	TYPE	TITLE
Environmental Inorganic	SOP 320	Analytical	Orthophosphate in Water
Environmental Inorganic	SOP 321	Analytical	Dissolved Orthophosphate
Environmental Inorganic	SOP 322	Analytical	Percent Total Solids
Environmental Inorganic	SOP 323	Analytical	Percent Volatile Solids
Environmental Inorganic	SOP 324	Analytical	Phenolics
Environmental Inorganic	SOP 325	Analytical	Pheophytin A
Environmental Inorganic	SOP 326	Analytical	Residue – Total Settleable
Environmental Inorganic	SOP 327	Analytical	Residue – Total Dissolved
Environmental Inorganic	SOP 328	Analytical	Residue – Total Solids
Environmental Inorganic	SOP 329	Analytical	Residue – Total Suspended Solids
Environmental Inorganic	SOP 330	Analytical	Residue – Suspended Volatile Solids
Environmental Inorganic	SOP 331	Analytical	Reactive Silicates
Environmental Inorganic	SOP 332	Analytical	Sulfide (Titrimetric in Water)
Environmental Inorganic	SOP 333	Analytical	Sulfide (Total in Water)
Environmental Inorganic	SOP 334	Analytical	Total Organic Compound (TOC)
Environmental Inorganic	SOP 335	Analytical	Total Suspended Particulate (TSP) Hi-Vol Filter
Environmental Inorganic	SOP 336	Analytical	Turbidity
Environmental Inorganic	SOP 337	Analytical	Alkalinity – Phenolphthalein
Environmental Inorganic	SOP 338 (M-6)	Analytical	Arsenic, Selenium, and Antimony by AA-Hydride TO BE UPDATED INTO NELAC FORMAT
Environmental Inorganic	SOP 339	Analytical	Arsenic – Total in Sediments

UNIT	SOP #	TYPE	TITLE
Environmental Inorganic	SOP 340	Analytical	Calcium, Magnesium, Sodium, and Potassium
Environmental Inorganic	SOP 341	Analytical	Fuel Analysis
Environmental Inorganic	SOP 342	Analytical	Hardness (Calculated)
Environmental Inorganic	SOP 343	Analytical	Hexavalent Chromium
Environmental Inorganic	SOP 344 (M-7)	Analytical	Mercury – AA/Cold Vapor (M-7 TO BE UPDATED INTO NELAC FORMAT)
Environmental Inorganic	SOP 345	Analytical	Metals in Hi-Vol Filters
Environmental Inorganic	SOP 346	Analytical	Metals – Total and Dissolved
Environmental Inorganic	SOP 347	Analytical	Metals – AA/Graphite Furnace
Environmental Inorganic	SOP 348 (M-4)	Analytical	Metals – ICP (M-4 TO BE UPDATED INTO NELAC FORMAT)
Environmental Inorganic	SOP 349	Analytical	Metals – ICP/MS
Environmental Inorganic	SOP 350	Analytical	pH
Environmental Inorganic	SOP 351	Analytical	pH – Soil
Environmental Inorganic	SOP 352	Analytical	Selenium – AA/Hydride
Environmental Inorganic	SOP 353	Analytical	Chlorine – Total in Fuels
Environmental Inorganic	SOP 354	Analytical	Gravimetric Determination of Oil and Grease in Water Matrix Samples Via Solid Phase Extraction
Environmental Inorganic	SOP 355	Analytical	Mercury – CVAFS (Gold Trap)
Environmental Inorganic	SOP 356	Analytical	Mercury – CVAFS (Without Gold Trap)
Environmental Organic	SOP 400	Sample Prep.	Gel-Permeation Cleanup (GPC)
Environmental Organic	SOP 401	Sample Prep.	Pressurized Fluid Extraction (Accelerated Solvent Extraction)
Environmental Organic	SOP 402	Sample Prep.	Silica Gel Cleanup

UNIT	SOP #	TYPE	TITLE
Environmental Organic	SOP 403	Sample Prep.	Florisil Cleanup
Environmental Organic	SOP 404	Sample Prep.	Waste Dilution for Semi-Volatile Organic Compounds
Environmental Organic	SOP 405	Sample Prep.	Separatory Funnel Liquid-Liquid Extraction
Environmental Organic	SOP 406	Sample Prep.	Zero Headspace Extraction of Volatile Organic Compounds
Environmental Organic	SOP 500	Analytical	Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)
Environmental Organic	SOP 501	Analytical	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)
Environmental Organic	SOP 502 (TO-8)	Analytical	Organochlorine Pesticides, Polychlorinated Biphenyls (PCB's) and Chlorinated Hydrocarbon Organic Compounds by Gas Chromatography with Electron Capture Detection (GC/ECD) (TO-8 TO BE UPDATED INTO NELAC FORMAT)
Environmental Organic	SOP 503	Analytical	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) in Air Canisters
Drinking Water	SOP 600	Microbiology	Heterotrophic Plate Count
Drinking Water	SOP 601	Microbiology	Chromogenic Substrate Coliform Test Using ONPG-MUG (Colilert, Colisure)
Drinking Water	SOP 602	Microbiology	Determination of Fecal Coliforms
Drinking Water	SOP 603	Microbiology	Escherichia Coli and Enterococci in Water by the Membrane Filter Procedure
Drinking Water	SOP 602	Microbiology	Determination of Fecal Coliform by Membrane Filter Procedure
Drinking Water	SOP 603	Microbiology	Escherichia Coli (E. coli) in Water by the Membrane Filter Procedure
Drinking Water	SOP 700 (ARCHIVED)	Inorganics	Determination of Turbidity by Nephelometry
Drinking Water	SOP 700 (REVISION 1)	Inorganics	Determination of Turbidity by Nephelometry
Drinking Water	SOP 701	Inorganics	Automated Testing – Nitrate, Nitrite, Chloride, Fluoride, Sodium, Iron, Hardness, and Sulfate
Drinking Water	SOP 702	Inorganics	Cyanide Analysis by Colorimetric Determination

UNIT	SOP #	TYPE	TITLE
Drinking Water	SOP 703	Inorganics	Determination of Ammonia by Selective Electrode Method
Drinking Water	SOP 704	Inorganics	Conductivity/Resistance of Water by Platinum Electrode
Drinking Water	SOP 705	Inorganics	Alkalinity (Titrimetric, pH 4.5)
Drinking Water	SOP 706	Inorganics	Hydrogen Ion pH Using Glass Electrodes
Drinking Water	SOP 707	Inorganics	Quantitative Hydrogen Sulfide by Titrimetric Determination
Drinking Water	SOP 708	Inorganics	Qualitative Detection of Hydrogen Sulfide
Drinking Water	SOP 709	Inorganics	Qualitative Detection of Tannin-Lignin
Drinking Water	SOP 710	Inorganics	Ortho-Phosphate by Colorimetry
Drinking Water	SOP 711	Inorganics	Fluorescent Dye Testing of Charcoal Packets
Drinking Water	SOP 712	Inorganics	Determination of Silica as SiO_2 by Molybdosilicate Method
Drinking Water	SOP 713	Inorganics	Toluidine Blue Active Substance (TBAS) Screening
Drinking Water	SOP 714	Inorganics	Determination of Perchlorate in Drinking Water Using Ion Chromatography
Drinking Water	SOP 715	Inorganics	Determination of Inorganic Disinfection By-Products in Drinking Water by Ion Chromatography
Drinking Water	SOP 716	Inorganics	Maximum Potential Formation of Total Trihalomethanes
Drinking Water	SOP 717	Inorganics	Analysis of Phenols (Acidic Extract) by GC/FID
Drinking Water	SOP 718	Inorganics	Determination of Ammonia by Selective Electrode
Drinking Water	SOP 719	Inorganics	Conductivity/Resistance of Water by Platinum Electrode
Drinking Water	SOP 720	Inorganics	Alakalinity
Drinking Water	SOP 721	Inorganics	Hydrogen Ion pH Using Glass Electrodes
Drinking Water	SOP 722	Inorganics	Quantitative Hydrogen Sulfide by Titrimetric Determination

UNIT	SOP #	TYPE	TITLE
Drinking Water	SOP 723	Inorganics	Qualitative Detection of Tannin-Lignin
Drinking Water	SOP 800	Metals	Trace Metals Analysis Using ICP/MS
Drinking Water	SOP 801	Metals	Lead Analysis by Zeeman Graphite Furnace Atomic Absorption Spectrometry
Drinking Water	SOP 802	Metals	Metals Analysis by Atomic Absorption Spectrometry
Drinking Water	SOP 803	Metals	Metals Analysis by Flame Photometric Method
Drinking Water	SOP 804	Metals	Metals by Atomic Absorption Spectrometry
Drinking Water	SOP 805	Metals	Potassium
Drinking Water	SOP 806	Metals	Sodium
Drinking Water	SOP 900	Organics	Determination of Endothall in Drinking Water by Ion Exchange Extraction, Acidic Methanol Methylation, and GC/MS
Drinking Water	SOP 901	Organics	Measurement of N-Methyl Carbamoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post-Column Derivatization
Drinking Water	SOP 901 (REVISION 1)	Organics	Measurement of N-Methyl Carbamoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post-Column Derivatization
Drinking Water	SOP 902	Organics	Analysis of Purgeable Organic Compounds in Drinking Water by Gas Chromatography and ITD Mass Spectrometry
Drinking Water	SOP 903	Organics	Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry
Drinking Water	SOP 904	Organics	Determination of Polynuclear Aromatics and Phthalates in Drinking Water by Solid Phase Extraction and Gas Chromatography and Mass Spectrometry
Drinking Water	SOP 905	Organics	Determination of Diquat and Paraquat in Drinking Water by Solid Phase Extraction and High Performance Liquid Chromatography with Ultra-violet Detection
Drinking Water	SOP 906	Organics	Determination of Chlorinated Acids in Water Using Solid Phase Extraction and GC with an Electron Capture Detector
Drinking Water	SOP 907	Organics	Determination of Haloacetic Acids and Dalapon in Drinking Water by Ion-Exchange Liquid-Solid Extraction and Gas Chromatography with

UNIT	SOP #	TYPE	TITLE
			Electron Capture Detection
Drinking Water	SOP 908	Organics	Determination of Glyphosate in Drinking Water by Direct Aqueous Injection HPLC Post-column Derivatization and Fluorescence Detection
Drinking Water	SOP 909	Organics	Analysis of Purgeable Organic Compounds of Drinking Water by Gas Chromatography and ITD-Mass Spectrometry
Drinking Water	SOP 910	Organics	1,2-Dribromoethane (EDB) and 1,2-Dibromo-3-Chloro Propane (DBCP) in Water by Microextraction and Gas Chromatography
Drinking Water	SOP 911	Organics	Determination of Total Organic Carbon in Drinking Water by UV-Persulfate Oxidation with Nondispersive Infrared Detector (NDIR)
Drinking Water	SOP 912	Organics	Maximum Potential Formation of Total Trihalomethanes
Drinking Water	SOP 913	Organics	Analysis of Phenols
Drinking Water	SOP 914	Organics	Determination of Organophosphate Pesticides in Drinking Water by Solid Phase Extraction and Gas Chromatography/Mass Spectrometry
Drinking Water	SOP 915	Organics	Determination of Pesticides in Drinking Water and Ground Water by High Performance Liquid Chromatography with a Photodiode Array Detector
Drinking Water	SOP 916	Organics	Determination of Pesticides

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX C

Sample Bottle and Preservation Form

QAPP-Ver2.0, Revison 0
May 5, 2003

MDEQ ENVIRONMENTAL LABORATORY
Sample Bottle and Preservative Request Form
Contact : Barry Baker
Phone (517)335-9686
Fax (517)335-9551

Requested by:	*Phone Number:*	*Date(s) Scheduled at MDEQ Laboratory*	TODAY'S DATE / /
Division/District	*Site or Project*	**PLEASE ALLOW AT LEAST 2 WEEKS FOR PREPARATION**	PICK-UP DATE / / AM PM

	Bottle Code	Parameter Group	Plastic Containers: 500 mL White	250 mL White	250 mL Brown	Glass Containers: 40 mL Septum Vial	MeOH Kit*	1000 mL Amber	250 mL (8oz) Wide	250 mL Narrow	250 mL SC CAP	Preservatives	Need	Prepared
WATER	DO	Dissolved Oxygen										DO KIT ***		
	GN	Gen Chem/Neutral Ortho-phos Nitrite, BOD, Silica, Residues												
	GA	Gen Chem/Acidic COD, TOC Ammonia, Kjel N, Tot Phos, Nitrate + Nitrite										H2SO4		
	GG	Gen Chem/ Phenolics-Glass										H2SO4		
	GB	Gen Chem/Basic Cyanide										10 N NaOH		
	S	Sulfide										1 M ZnAC 10 N NaOH		
	CA	Chlorophyll a										1% MgCO3		
	MA	Metals/Total Acidic Cd Cr Cu,Ni,Pb Zn,Fe,Co, Li,Mn,Al,Ti,V,Ba,Be,Tl,Sr, Ag Hg,As Se Sb,Ca,Mg, Na,K										1:1 HNO3		
	MAD	Metals/Acidic Dissolved Parameter List Same as MA, Field Filtered										1:1 HNO3		
	MD	Metals/Dissolved Parameter List Same as MA, Lab Filtered												
	MN	Minerals/Neutral pH Conduct, Cr+6, Chloride, Sulfate Alk, Carbonate, Bicarbonate												
	OG	Oil and Grease	OG samples require 2 x 250mL jars per sample									H2SO4		
	VOA	Volatiles 8260/624	VOA requires 2 vials									1:1 HCL		
	ON	PCB/Pesticides 608/8081/8082	ON samples require 2 ambers**											
	BNA	BNA/PNA/BN/Acids 8270/625	BNA samples require 2 ambers**											
SOIL	MS	Metals Parameter List Same as MA												
	GS	Gen Chem/ TP, Kjel-N,Phenolics, COD, Cyanide												
	VOA	Volatiles MeOH/8260*										MeOH		
	OS/BNA	PCB/Pesticides/BNA/PNA/BN 8270/8081/8082												
OIL	MO	Metals/Oil Liq & Solid Waste Parameter List Same as MA												
	OL	Volatiles/PCB/Pesticides/BNA/BN 8260/8270/8081/8082												
	HW	Flash Point/ Solubility												
	MX	Metals/TCLP/SPLP/ASTM for MI-10												
	OX	TCLP/SPLP Volatiles 8260												
Please include field QC in the bottle count														
	TOTAL REQUESTED													
	NUMBER PREPARED													

Other Requested Supplies:

MESSAGE RECEIVED BY: _____ PREPARED BY: _____

Refer to back of form for collection and preservation information.

* MeOH Kit includes 1-tared vial, 1-10mL MeOH tube, 1-capped syringe, & 1-syringe label.

** See note #14 on reverse side.

*** DO Kit: DO-1 & DO-2 reagent, must request H2SO4 (unless you already have it)

COLLECTION AND PRESERVATION OF WATER, SEDIMENT, AND OIL SAMPLES

	BOTTLE CODE	PARAMETER GROUP	NOTES	BOTTLE TYPE	SIZE/COMMENTS	COOL TO 4 C° X = YES	PRESERVATIVE	AMOUNT	MAXIMUM HOLDING TIME
	DO	DISSOLVED OXYGEN	1	GLASS	250 mL GLASS STOPPER	X	FIX ON SITE (WINKLER)		8 HR
	GN	GEN CHM/NEUTRAL	2,3	PLASTIC	500 mL	X			2, 7, or 28 DAYS
	GA	GEN CHM/ACIDIC	3,4	PLASTIC	500 mL	X	H2SO4 TO pH < 2	10 DROPS/ 500 mL	28 DAYS
	GG	GEN CHM/PHENOLICS	5	GLASS	250 mL SCREW CAP	X	H2SO4 TO pH<2	5 DROPS/ 250 mL	28 DAYS
	GB	GEN CHM/BASIC	3,6,7,8	PLASTIC	250 mL OR 500 mL	X	10N NaOH TO pH=12	10 DROPS/ 250 mL	14 DAYS (24 HR)
W	S	SULFIDE	1	PLASTIC	250 mL	X	2N ZnAC, 10N NaOH TO pH>9	10 DROPS 2 DROPS/ 250 mL	7 DAYS
A	CA	CHLOROPHYLL A	9	PLASTIC	250 mL	X	1% MgCO3	5 DROPS/ 250 mL	2 DAYS
T	MA	METALS/TOTAL ACIDIC	10	PLASTIC	500 mL		1 1 HNO3 TO pH<2	5 mL/ 500 mL	28 DAYS, 6 MO
E	MAD	METALS/ACIDIC FIELD FILTERED	10,11	PLASTIC	500 mL		FILTER ON SITE THEN ADD 1 1 HNO3 TO pH<2	5 mL/ 500mL	28 DAYS, 6 MO
R	MD	METALS/LAB FILTERED	11	PLASTIC	500 mL	X	LAB FILT & PRES.		W/IN 24 HRS
	MN	MINERAL/NEUTRAL	12	PLASTIC	500 mL	X			W/IN 24 HRS, 2 DAYS, 14 & 28 DAYS
	OG	OIL & GREASE		GLASS	2x250mL W.M.	X	H2SO4 to pH<2	10 DROPS/250mL	28 DAYS
	VOA	VOLATILES 8260/624	13	GLASS	2-40mL SEPTUM VIALS	X	1 1 HCl TO pH<2	5 DROPS/VIAL	14 DAYS
	ON	PCB/PESTICIDES 608/8081/8082	14,17,18	GLASS	2-1000mL AMBER	X			7 DAYS
	BNA	BNA/PNA/BN/ACIDS 625/8270	14,18	GLASS	2-1000mL AMBER	X			7 DAYS
S	MS	METALS		GLASS	250 mL W.M	X			
O	GS	GEN CHEM		GLASS	250mL W M	X			
I	VOA	VOLATILES MeOH/8260	16	GLASS	MeOH Kit	X	METHANOL	10g/10mL MeOH	14 DAYS
L	OS/BNA	PCB/PESTICIDES/BNA/PNA/BN 8270/8081/8082		GLASS	250mL W M	X			14 DAYS
O	MO	METALS		GLASS	250 mL W.M.	X			
I	OL	VOLATILES/PCB/PESTICIDES/BNA/BN	15	GLASS	250 mL W.M.	X			
L	HW	FLASH POINT		GLASS	250mL W M	X			
	MX	METALS/TCLP/SPLP/ASTM for MI10		GLASS	250mL W M.	X			
	OX	TCLP/SPLP VOLATILES 8260		GLASS	250 mL SEPTUM JARS	X			14 DAYS

NOTES:

1 EXTRA CARE SHOULD BE TAKEN DURING COLLECTION SO THAT THE SAMPLE IS NOT AERATED BEFORE PRESERVATION

2 GN, GEN CHM/NEUTRAL, INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES. SETTLEABLE RESIDUE, NITRITE, ORTHOPHOSPHATE, BOD, AND TURBIDITY (2 DAYS), TOTAL, FILTERABLE, NONFILTERABLE AND VOLATILE RESIDUES (7 DAYS), SILICATES (28 DAYS).

3 ADD SUFFIX "D" TO BOTTLE CODE WHEN SAMPLE IS FIELD FILTERED.

4 EXCESS ACID PRESERVATIVE WILL CAUSE INTERFERENCE.. COUNT DROPS CAREFULLY, CHECK pH, ADD MORE ACID IF NECESSARY (pH=2). GA INCLUDES CHEMICAL OXYGEN DEMAND (COD), TOTAL ORGANIC CARBON (TOC), NITRATE PLUS NITRITE, AMMONIA, KJELDAHL NITROGEN, AND TOTAL PHOSPHORUS.

5 CHLORINATED SAMPLES FOR PHENOLS SHOULD BE COLLECTED IN A SEPARATE BOTTLE AND DECHLORINATED WITH .141N FAS (FERROUS AMMONIUM SULFATE, USUALLY ONE DROP) BEFORE PRESERVATION (USE BOTTLE CODE GP).

6 GB INCLUDES TOTAL CYANIDE, AND CYANIDE AMMENABLE TO CHLORINATION (FREE) HOLDING TIME IS 24 HOURS IF SULFIDES ARE PRESENT.

7 CHLORINATED SAMPLES FOR CYANIDES MUST BE DECHLORINATED WITH ASCORBIC ACID (0.6 G/L) IMMEDIATELY AFTER COLLECTION AND THEN PRESERVED WITH NaOH.

8 THE PROPER CONTAINER DEPENDS ON PARAMETERS REQUESTED 250 ML FOR TOTAL ONLY, 500 ML FOR AMENABLE

9 IF SAMPLE IS FILTERED ON SITE AND THE MEMBRANE FILTER ADDED TO 90% ACETONE (SUPPLIED BY THE LAB) AND REFRIGERATED, HOLDING TIME IS ONE MONTH. STORE FILTERED SAMPLE IN THE DARK AND ON ICE.

10 RECOMMENDED MAXIMUM HOLDING TIME FOR MERCURY, SODIUM, POTASSIUM, MAGNESIUM, CALCIUM (28 DAYS); OTHER METALS (6 MONTHS).

11 IF FIELD FILTRATION IS NOT AVAILABLE, SEND UNFILTERED SAMPLE TO THE LAB AS SOON AS POSSIBLE (WITHIN 24 HOURS). DO NOT ADD ACID TO DISSOLVED METAL IF UNFILTERED.

12 MN, MINERALS/NEUTRAL INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES: pH (ANALYSES SHOULD BE PERFORMED IMMEDIATELY ON SITE); HEXAVALENT CHROMIUM (24 HOURS); ALKALINITIES (CO3, HCO3, TOTAL ALK) (14 DAYS); SPECIFIC CONDUCTANCE, CHLORIDE, SULFATE (28 DAYS)

13 FILL BOTTLE COMPLETELY (NO AIR BUBBLES) AND MAKE SURE TEFLON SIDE OF SEPTUM FACES SAMPLES DUPLICATE VIALS REQUIRED

14 IF BOTH ON AND BNA ARE COLLECTED,COLLECT A MAXIMUM OF 3 AMBERS PER SAMPLE IDENTIFICATION

15 INCLUDES PETROLEUM HYDROCARBONS, SPILL IDENTIFICATION

16 WEIGH OUT 10 GRAMS OF SOIL AND ADD TO A 40mL TARED VIAL. OPEN THE 10 mL METHANOL TUBE AND ADD TO THE VIAL FILL, CAP, AND LABEL THE SYRINGE WITH SOIL SAMPLE

17 LOW LEVEL PCB BY SPECIAL REQUEST ONLY COLLECT 3 AMBERS PER SAMPLE.

18 COLLECT 3 AMBERS PER SAMPLE PER PARAMETER GROUP FOR QA/QC FOR ONE SAMPLE IN TWENTY

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX D

Annual Accuracy and Precision Statements

QAPP-Ver2.0, Revison 0
May 5, 2003

MICHIGAN DEPARTMENT (,MENTAL QUALITY
QA Summa.. .or Year 2001
Method 8260
FULL LCS-Water

			ACCURACY				Control Windows			
			Standard	*Average*	*Recovery*		% *Recovery*			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
Dichlorodifluoromethane	50	22	7.859	52.07	104.14	15.09	56.98	151.29	72.70	135.57
Chloromethane	50	22	5.809	51.84	103.68	11.21	68.83	138.54	80.44	126.92
Vinyl Chloride	50	22	6.962	54.68	109.36	12.73	67.59	151.13	81.52	137.21
Bromomethane	50	22	8.089	55.43	110.86	14.59	62.33	159.40	78.51	143.22
Chloroethane	50	22	6.201	54.25	108.50	11.43	71.30	145.70	83.70	133.30
Trichlorofluoromethane	50	22	5.718	56.00	112.00	10.21	77.69	146.31	89.13	134.87
2-Propanone (acetone)	50	22	14.693	48.41	96.82	30.35	8.66	184.98	38.04	155.59
Diethylether	50	22	5.032	55.70	111.41	9.03	81.21	141.60	91.28	131.54
1,1-Dichloroethylene	50	22	5.473	56.55	113.09	9.68	80.25	145.93	91.20	134.98
Methyl Iodide	50	22	14.774	62.52	125.05	23.63	36.40	213.69	65.95	184.14
Acrylonitrile	50	22	6.130	56.43	112.86	10.86	76.08	149.64	88.34	137.38
Methylene Chloride	50	22	5.292	54.84	109.68	9.65	77.93	141.44	88.51	130.85
Carbon Disulfide	50	22	4.968	55.02	110.05	9.03	80.24	139.85	90.17	129.92
trans-1,2-Dichloroethylene	50	22	5.060	55.43	110.86	9.13	80.50	141.22	90.62	131.10
Methyl Tertiary Butyl Ether	50	22	4.763	55.11	110.23	8.64	81.65	138.81	91.17	129.28
1,1-Dichloroethane	50	22	5.228	54.89	109.77	9.53	78.40	141.14	88.86	130.68
2-Butanone (MEK)	50	22	10.093	48.14	96.27	20.97	35.72	156.83	55.90	136.64
cis-1,2-Dichloroethylene	50	22	5.131	55.20	110.41	9.29	79.62	141.19	89.89	130.93
Chloroform	50	22	5.155	55.11	110.23	9.35	79.30	141.15	89.61	130.85
Tetrahydrofuran	50	22	5.583	54.50	109.00	10.24	75.50	142.50	86.67	131.33
Bromochloromethane	50	22	5.817	54.61	109.23	10.65	74.33	144.13	85.96	132.49
1,1,1-Trichloroethane	50	22	4.907	55.84	111.68	8.79	82.24	141.13	92.05	131.31
1,2-Dichloroethane	50	22	4.922	55.80	111.59	8.82	82.06	141.13	91.90	131.28
Benzene	50	22	4.748	54.95	109.91	8.64	81.42	138.40	90.92	128.90
Carbon Tetrachloride	50	22	5.500	56.48	112.95	9.74	79.95	145.95	90.95	134.95
1,2-Dichloropropane	50	22	4.825	55.70	111.41	8.66	82.46	140.36	92.11	130.71
Trichloroethylene	50	22	4.535	55.20	110.41	8.21	83.20	137.62	92.27	128.55
Dibromomethane	50	22	4.522	56.20	112.41	8.04	85.28	139.54	94.32	130.50
Bromodichloromethane	50	22	4.993	56.05	112.09	8.91	82.14	142.05	92.12	132.06
4-Methyl-2-Pentanone (MIBK)	50	22	5.528	54.57	109.14	10.13	75.97	142.30	87.03	131.25
cis-1,3-Dichloropropene	50	22	4.461	54.73	109.45	8.15	82.69	136.22	91.61	127.30
trans-1,3-Dichloropropene	50	22	4.816	54.93	109.86	8.77	80.97	138.76	90.60	129.13
Toluene	50	22	4.428	54.34	108.68	8.15	82.12	135.25	90.97	126.39
1,1,2-Trichloroethane	50	22	4.486	56.07	112.14	8.00	85.22	139.05	94.19	130.08
2-Hexanone	50	22	9.076	49.70	99.41	18.26	44.95	153.86	63.11	135.71
Dibromochloromethane	50	22	4.946	55.59	111.18	8.90	81.50	140.86	91.40	130.97
1,2-Dibromoethane	50	22	4.428	56.20	112.41	7.88	85.84	138.98	94.70	130.12
Tetrachloroethylene	50	22	4.457	54.48	108.95	8.18	82.21	135.70	91.12	126.78
Chlorobenzene	50	22	4.029	54.61	109.23	7.38	85.05	133.40	93.11	125.35

QA Summary for Year 2001
Method 8260
FULL LCS-Water

1,1,1,2-Tetrachloroethane	50	22	4.988	56.50	113.00	8.83	83.07	142.93	93.05	132.95

			ACCURACY				Control Windows % Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average Recovery ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
Ethylbenzene	50	22	4.464	55.00	110.00	8.12	83.22	136.78	92.14	127.86
m & P-Xylene	50	22	4.072	52.93	105.86	7.69	81.43	130.29	89.58	122.15
Bromoform	50	22	5.454	55.02	110.05	9.91	77.32	142.77	88.23	131.86
Styrene	50	22	4.731	56.61	113.23	8.36	84.84	141.61	94.30	132.15
o-Xylene	50	22	4.422	55.07	110.14	8.03	83.60	136.67	92.45	127.82
1,1,2,2-Tetrachloroethane	50	22	5.651	53.86	107.73	10.49	73.82	141.63	85.12	130.33
1,2,3-Trichloropropane	50	22	6.411	55.57	111.14	11.54	72.67	149.60	85.49	136.78
1,4-Dichloro-2-butene	50	22	8.735	46.93	93.86	18.61	41.46	146.27	58.93	128.80
Isopropylbenzene	50	22	5.674	54.57	109.14	10.40	75.09	143.18	86.44	131.83
Bromobenzene	50	22	5.309	53.39	106.77	9.95	74.92	138.63	85.54	128.01
n-Propyl Benzene	50	22	5.946	54.89	109.77	10.83	74.10	145.45	85.99	133.56
1,3,5-Trimethylbenzene	50	22	5.359	54.43	108.86	9.85	76.71	141.02	87.43	130.30
tert-Butylbenzene	50	22	5.714	54.86	109.73	10.41	75.44	144.01	86.87	132.58
1,2,4-Trimethylbenzene	50	22	4.921	53.61	107.23	9.18	77.70	136.75	87.54	126.91
sec-Butylbenzene	50	22	5.813	54.86	109.73	10.60	74.85	144.60	86.48	132.98
1,3-Dichlorobenzene	50	22	5.269	53.64	107.27	9.82	75.66	138.89	86.20	128.35
1,4-Dichlorobenzene	50	22	4.879	52.70	105.41	9.26	76.14	134.68	85.89	124.92
p-isopropyl Toluene	50	22	5.445	54.57	109.14	9.98	76.47	141.81	87.36	130.92
1,2-Dichlorobenzene	50	22	5.178	53.61	107.23	9.66	76.16	138.29	86.52	127.94
n-Butylbenzene	50	22	5.824	55.02	110.05	10.58	75.10	144.99	86.75	133.34
Hexachloroethane	50	22	6.649	53.55	107.09	12.42	67.20	146.99	80.49	133.69
1,2-Dibromo-3-chloropropane	50	22	5.816	54.02	108.05	10.77	73.15	142.94	84.78	131.31
1,2,4-Trimethylbenzene	50	22	5.507	53.39	106.77	10.32	73.73	139.82	84.74	128.80
Naphthalene	50	22	7.566	53.43	106.86	14.16	61.47	152.26	76.60	137.13
1,2,3-Trichlorobenzene	50	22	6.237	53.41	106.82	11.68	69.40	144.24	81.87	131.76
2-Methyl Naphthalene	50	22	11.241	54.73	109.45	20.54	42.01	176.90	64.49	154.42

LCS= Lab Control Sample

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
MS/MSD - Water

ACCURACY

Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	Control Windows % Recovery LCL	UCL	LWL	UWL
1,1-Dichloroethylene	50	765	8.099	50.08	100.16	16.17	51.57	148.75	67.76	132.55
Benzene	50	761	6.757	50.73	101.46	13.32	60.92	142.00	74.44	128.49
Trichloroethylene	50	765	6.684	48.96	97.92	13.65	57.82	138.03	71.19	124.66
Toluene	50	759	6.439	50.96	101.93	12.63	63.29	140.56	76.17	127.68
Chlorobenzene	50	765	6.102	50.16	100.32	12.17	63.71	136.94	75.91	124.73

PRECISION*

Compound		PAIRS	SD of RPDs	Average RPD		RPD UCL		UWL
1,1-Dichloroethylene		379	9.582	7.82		28.75		19.16
Benzene		377	10.215	7.58		30.65		20.43
Trichloroethylene		379	9.930	7.79		29.79		19.86
Toluene		376	9.490	7.32		28.47		18.98
Chlorobenzene		379	9.536	7.28		28.61		19.07

***Precision is from in batch MS/MSD spike duplicates**

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
Dichlorodifluoromethane	50	8	5.309	53.79	107.58	9.87	75.73	139.43	86.34	128.81
Chloromethane	50	8	7.608	49.52	99.03	15.36	53.38	144.68	68.60	129.46
Vinyl Chloride	50	8	6.436	51.57	103.13	12.48	64.51	141.75	77.39	128.87
Bromomethane	50	8	11.744	45.30	90.60	25.92	20.14	161.06	43.63	137.58
Chloroethane	50	8	5.447	49.93	99.85	10.91	67.17	132.53	78.06	121.64
Trichlorofluoromethane	50	8	5.239	50.46	100.91	10.38	69.48	132.35	79.96	121.87
2-Propanone (acetone)	50	8	5.853	28.35	56.69	20.65	21.57	91.81	33.28	80.10
Diethylether	50	8	6.344	50.16	100.32	12.65	62.25	138.38	74.94	125.69
1,1-Dichloroethylene	50	8	5.788	50.70	101.41	11.42	66.68	136.14	78.26	124.56
Methyl Iodide	50	8	9.032	61.50	123.01	14.68	68.82	177.20	86.88	159.14
Acrylonitrile	50	8	7.254	51.05	102.09	14.21	58.57	145.62	73.08	131.11
Methylene Chloride	50	8	7.106	48.93	97.87	14.52	55.23	140.50	69.45	126.29
Carbon Disulfide	50	8	5.607	49.84	99.68	11.25	66.03	133.32	77.25	122.11
trans-1,2-Dichloroethylene	50	8	5.327	48.55	97.10	10.97	65.14	129.06	75.79	118.41
Methyl Tertiary Butyl Ether	50	8	5.935	49.48	98.95	12.00	63.34	134.56	75.21	122.69
1,1-Dichloroethane	50	8	5.437	47.55	95.10	11.43	62.48	127.72	73.35	116.85
2-Butanone (MEK)	50	8	4.415	37.40	74.80	11.81	48.31	101.29	57.14	92.46
cis-1,2-Dichloroethylene	50	8	5.223	47.08	94.16	11.09	62.83	125.50	73.27	115.06
Chloroform	50	8	4.822	47.69	95.37	10.11	66.44	124.31	76.08	114.66
Tetrahydrofuran	50	8	7.714	48.01	96.01	16.07	49.72	142.30	65.15	126.87
Bromochloromethane	50	8	4.951	48.47	96.94	10.21	67.24	126.65	77.14	116.75
1,1,1-Trichloroethane	50	8	4.486	48.15	96.29	9.32	69.37	123.21	78.34	114.24
1,2-Dichloroethane	50	8	4.671	49.00	97.99	9.53	69.97	126.02	79.31	116.68
Benzene	50	8	4.689	48.36	96.71	9.70	68.58	124.85	77.96	115.47
Carbon Tetrachloride	50	8	5.192	47.95	95.91	10.83	64.75	127.06	75.14	116.67
1,2-Dichloropropane	50	8	4.697	48.57	97.15	9.67	68.97	125.32	78.36	115.93
Trichloroethylene	50	8	4.753	46.22	92.43	10.28	63.91	120.95	73.42	111.44
Dibromomethane	50	8	4.898	49.23	98.45	9.95	69.06	127.84	78.86	118.04
Bromodichloromethane	50	8	4.702	48.88	97.75	9.62	69.54	125.97	78.95	116.56
4-Methyl-2-Pentanone (MIBK)	50	8	6.536	49.67	99.33	13.16	60.12	138.54	73.19	125.47

MICHIGAN DEPARTMENT Or ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average Recovery ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
cis-1,3-Dichloropropene	50	8	4.928	48.05	96.10	10.26	66.53	125.67	76.39	115.81
trans-1,3-Dichloropropene	50	8	4.884	48.47	96.94	10.08	67.64	126.24	77.40	116.47
Toluene	50	8	4.815	47.16	94.31	10.21	65.43	123.20	75.05	113.57
1,1,2-Trichloroethane	50	8	5.105	48.65	97.30	10.49	66.67	127.93	76.88	117.72
2-Hexanone	50	8	4.489	39.50	78.99	11.36	52.06	105.92	61.04	96.95
Dibromochloromethane	50	8	5.130	49.29	98.59	10.41	67.81	129.37	78.07	119.11
1,2-Dibromoethane	50	8	5.436	49.10	98.20	11.07	65.58	130.81	76.45	119.94
Tetrachloroethylene	50	8	5.359	45.12	90.24	11.88	58.08	122.39	68.80	111.67
Chlorobenzene	50	8	5.664	46.08	92.16	12.29	58.18	126.15	69.50	114.82
1,1,1,2-Tetrachloroethane	50	8	4.769	49.17	98.34	9.70	69.72	126.95	79.26	117.41
Ethylbenzene	50	8	5.645	46.74	93.49	12.08	59.62	127.36	70.91	116.07
m & P-Xylene	50	8	4.834	44.65	89.30	10.83	60.30	118.31	69.97	108.64
Bromoform	50	8	7.080	47.21	94.42	15.00	51.94	136.91	66.10	122.75
Styrene	50	8	10.036	44.63	89.26	22.49	29.04	149.47	49.11	129.40
o-Xylene	50	8	5.589	46.86	93.72	11.93	60.18	127.25	71.36	116.07
1,1,2,2-Tetrachloroethane	50	8	5.833	48.98	97.96	11.91	62.96	132.96	74.62	121.29
1,2,3-Trichloropropane	50	8	6.771	50.33	100.66	13.45	60.03	141.29	73.58	127.74
1,4-Dichloro-2-butene	50	8	7.626	45.18	90.36	16.88	44.60	136.11	59.85	120.86
Isopropylbenzene	50	8	7.406	46.40	92.80	15.96	48.37	137.24	63.18	122.43
Bromobenzene	50	8	7.067	43.91	87.83	16.09	45.43	130.23	59.56	116.10
n-Propyl Benzene	50	8	8.381	45.35	90.69	18.48	40.41	140.98	57.17	124.22
1,3,5-Trimethylbenzene	50	8	7.842	44.88	89.76	17.47	42.71	136.81	58.40	121.13
tert-Butylbenzene	50	8	8.795	45.14	90.28	19.48	37.51	143.05	55.10	125.46
1,2,4-Trimethylbenzene	50	8	7.320	44.17	88.35	16.57	44.43	132.27	59.07	117.63
sec-Butylbenzene	50	8	10.069	43.36	86.72	23.22	26.31	147.13	46.45	127.00
1,3-Dichlorobenzene	50	8	9.290	43.38	86.75	21.42	31.01	142.49	49.59	123.91
1,4-Dichlorobenzene	50	8	8.829	42.61	85.21	20.72	32.24	138.18	49.90	120.53
p-isopropyl Toluene	50	8	10.072	43.11	86.22	23.36	25.78	146.65	45.93	126.50
1,2-Dichlorobenzene	50	8	9.561	43.00	86.00	22.24	28.63	143.36	47.75	124.24
n-Butylbenzene	50	8	11.442	41.81	83.63	27.37	14.97	152.28	37.86	129.40
Hexachloroethane	50	8	12.504	40.04	80.07	31.23	5.04	155.10	30.05	130.09
1,2-Dibromo-3-chloropropane	50	8	7.793	48.99	97.97	15.91	51.22	144.73	66.80	129.14
1,2,4-Trimethylbenzene	50	8	12.946	40.09	80.18	32.29	2.51	157.86	28.40	131.97
Naphthalene	50	8	12.330	44.20	88.40	27.90	14.42	162.38	39.08	137.72
1,2,3-Trichlorobenzene	50	8	12.793	39.72	79.44	32.21	2.68	156.20	28.26	130.61
2-Methyl Naphthalene	50	8	19.401	46.01	92.03	42.16	-24.38	208.43	14.42	169.63

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

		PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
Dichlorodifluoromethane		4	7.787	8.04		23.36		15.57
Chloromethane		4	9.526	9.26		28.58		19.05
Vinyl Chloride		4	7.893	8.73		23.68		15.79
Bromomethane		4	14.895	17.68		44.68		29.79
Chloroethane		4	8.836	10.06		26.51		17.67
Trichlorofluoromethane		4	9.962	8.55		29.89		19 92
2-Propanone (acetone)		4	15.884	21.81		47.65		31.77
Diethylether		4	10.485	9.14		31.46		20.97
1,1-Dichloroethylene		4	10.219	9.02		30.66		20 44
Methyl Iodide		4	12.622	21.56		37.86		25.24
Acrylonitrile		4	11.757	10.19		35.27		23.51
Methylene Chloride		4	9.566	8.81		28.70		19.13
Carbon Disulfide		4	9.750	8.38		29.25		19.50
trans-1,2-Dichloroethylene		4	10.163	9.10		30.49		20.33
Methyl Tertiary Butyl Ether		4	10.019	10.80		30.06		20.04
1,1-Dichloroethane		4	9.622	9.04		28.87		19.24
2-Butanone (MEK)		4	11.506	11.36		34 52		23.01
cis-1,2-Dichloroethylene		4	10.187	9.30		30.56		20.37
Chloroform		4	9.669	9.04		29.01		19 34
Tetrahydrofuran		4	10.373	11.35		31.12		20.75
Bromochloromethane		4	10.302	9.61		30.91		20.60
1,1,1-Trichloroethane		4	10.484	9.42		31.45		20.97
1,2-Dichloroethane		4	10.401	8.98		31.20		20.80
Benzene		4	10.373	9.01		31.12		20.75
Carbon Tetrachloride		4	11.411	10.36		34.23		22.82
1,2-Dichloropropane		4	10.044	8.82		30.13		20.09
Trichloroethylene		4	11.073	9.41		33.22		22.15
Dibromomethane		4	9.912	9.71		29.74		19 82
Bromodichloromethane		4	10.386	9.34		31.16		20.77
4-Methyl-2-Pentanone (MIBK)		4	12.294	11.04		36.88		24.59
cis-1,3-Dichloropropene		4	10.759	9.78		32.28		21.52
trans-1,3-Dichloropropene		4	10.461	10.23		31.38		20.92
Toluene		4	11.380	10.03		34.14		22.76
1,1,2-Trichloroethane		4	10.080	9.34		30.24		20.16
2-Hexanone		4	12.465	11.10		37.40		24.93
Dibromochloromethane		4	9.298	10.98		27.89		18 60
1,2-Dibromoethane		4	10.271	10.43		30.81		20.54
Tetrachloroethylene		4	9.753	8.82		29.26		19.51
Chlorobenzene		4	9.285	9.52		27.86		18 57
1,1,1,2-Tetrachloroethane		4	9.617	9.82		28.85		19.23
Ethylbenzene		4	10.128	9.53		30.38		20.26
m & P-Xylene		4	10.118	9.39		30 35		20.24
Bromoform		4	9.097	12.64		27.29		18.19

MICHIGAN DEPARTMENT Of ENVIRONMENTAL QUALITY

QA Summary for Year 2001

Method 8260

FULL LIST MS/MSD - Water

	PRECISION*			RPD			
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
Styrene		4	8.762	11.40		26.29		17.52
o-Xylene		4	9.829	9.73		29.49		19.66
1,1,2,2-Tetrachloroethane		4	9.628	10.29		28.88		19.26
1,2,3-Trichloropropane		4	10.558	9.75		31.67		21.12
1,4-Dichloro-2-butene		4	12.220	11.96		36.66		24.44
Isopropylbenzene		4	10.335	9.73		31.01		20.67
Bromobenzene		4	9.588	10.77		28.76		19.18
n-Propyl Benzene		4	9.424	10.56		28.27		18.85
1,3,5-Trimethylbenzene		4	9.339	10.68		28.02		18.68
tert-Butylbenzene		4	10.023	10.85		30.07		20.05
1,2,4-Trimethylbenzene		4	10.267	11.03		30.80		20.53
sec-Butylbenzene		4	9.394	11.74		28.18		18.79
1,3-Dichlorobenzene		4	10.414	11.45		31.24		20.83
1,4-Dichlorobenzene		4	9.489	10.96		28.47		18.98
p-isopropyl Toluene		4	9.843	11.27		29.53		19.69
1,2-Dichlorobenzene		4	9.678	12.14		29.03		19.36
n-Butylbenzene		4	10.053	11.95		30.16		20.11
Hexachloroethane		4	10.547	14.11		31.64		21.09
1,2-Dibromo-3-chloropropane		4	12.279	12.88		36.84		24.56
1,2,4-Trimethylbenzene		4	9.808	14.66		29.42		19.62
Naphthalene		4	10.301	16.13		30.90		20.60
1,2,3-Trichlorobenzene		4	10.006	15.80		30.02		20.01
2-Methyl Naphthalene		4	10.296	23.36		30.89		20.59

*Precision is from in batch MS/MSD spike duplicates

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
LCS-Water

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
1,1-Dichloroethylene	50	287	6.437	50.10	100.20	12.85	61.57	138.82	74.45	125.95
Benzene	50	287	5.221	50.47	100.93	10.35	69.60	132.26	80.05	121.82
Trichloroethylene	50	287	5.422	49.96	99.92	10.85	67.38	132.45	78.23	121.61
Toluene	50	287	5.126	50.70	101.39	10.11	70.64	132.14	80.89	121.89
Chlorobenzene	50	287	5.061	50.33	100.66	10.06	70.29	131.03	80.42	120.91

LCS= Lab Control Sample

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260/624
Surrogate - Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
Dibromofluoromethane	50	10850	2.523	49.75	99.50	5.07	84.36	114.65	89.41	109.60
Toluene-d8	50	10850	1.235	50.37	100.73	2.45	93.33	108.14	95.80	105.67
4-Bromofluorobenzene	50	10850	3.603	51.98	103.95	6.93	82.33	125.57	89.54	118.37

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRO. . . QUALITY

QA Summary
Method 625
LCS - Water 2001

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
N-Nitrosodimethylamine	50	18	4.140	21.61	43.21	19.16	18.37	68.05	26.65	59.77
Phenol	100	17	5.002	27.00	27.00	18.53	11.99	42.00	16.99	37.00
Bis (2-chloroethyl) ether	50	18	6.140	29.56	59.12	20.77	22.28	95.97	34.56	83.68
2-Chlorophenol	100	17	11.925	58.94	58.94	20.23	23.17	94.72	35.09	82.79
1,3-Dichlorobenzene	50	18	4.456	18.31	36.61	24.34	9.88	63.35	18.79	54.44
1,4-Dichlorobenzene	50	18	4.413	18.92	37.84	23.33	11.36	64.32	20.18	55.49
1,2-Dichlorobenzene	50	18	4.863	20.38	40.76	23.86	11.58	69.94	21.31	60.21
Bis (2-chloroisopropyl) ether	50	18	6.365	30.58	61.16	20.81	22.97	99.35	35.70	86.62
Hexachloroethane	50	18	11.077	24.60	49.19	45.03	-17.27	115.65	4.89	93.50
N-nitrosodi-n-propyl amine	50	18	9.666	27.88	55.76	34.67	-2.23	113.75	17.10	94.42
Nitrobenzene	50	18	6.432	31.62	63.25	20.34	24.66	101.84	37.52	88.97
Isophorone	50	18	5.569	31.00	61.99	17.97	28.57	95.41	39.71	84.27
2 - Nitrophenol	100	17	12.878	63.69	63.69	20.22	25.06	102.33	37.93	89.45
2,4 - Dimethylphenol	100	17	11.559	65.50	65.50	17.65	30.82	100.17	42.38	88.62
Bis (2-chloroethoxy) methane	50	18	6.385	33.75	67.49	18.92	29.18	105.80	41.95	93.03
2,4 - Dichlorophenol	100	17	12.611	68.31	68.31	18.46	30.48	106.14	43.09	93.53
1,2,4 - Trichlorobenzene	50	18	4.899	21.61	43.22	22.67	13.83	72.62	23.63	62.82
Naphthalene	50	18	5.305	25.29	50.58	20.98	18.74	82.41	29.35	71.80
Hexachlorobutadiene	50	18	5.061	19.95	39.90	25.37	9.54	70.27	19.66	60.15
Phenol, 4-chloro-3-methyl-	50	18	19.883	68.42	136.85	29.06	17.55	256.15	57.31	216.38
Hexachlorocyclopentadiene	50	18	3.565	12.41	24.82	28.73	3.43	46.22	10.56	39.08
2,4,6 - Trichlorophenol	100	17	12.323	71.40	71.40	17.26	34.43	108.37	46.76	96.05
2- Chloronaphthalene	50	18	5.720	27.18	54.36	21.05	20.04	88.68	31.48	77.24
Dimethylphthalate	50	18	7.793	33.96	67.92	22.95	21.16	114.67	36.75	99.09
Acenaphthylene	50	18	7.587	33.03	66.06	22.97	20.54	111.58	35.71	96.41
2,6 - Dinitrotoluene	50	18	5.632	37.17	74.34	15.15	40.55	108.13	51.81	96.86
Acenaphthene	50	18	5.674	29.79	59.57	19.05	25.53	93.61	36.88	82.27
2,4 - Dinitrophenol	100	17	10.056	63.37	63.37	15.87	33.20	93.53	43.25	83.48
2,4 - Dinitrotoluene	50	18	5.478	34.51	69.02	15.87	36.15	101.89	47.11	90.93
4-Nitrophenol	100	18	10.487	32.04	32.04	32.73	0.58	63.50	11.07	53.01
Fluorene	50	18	6.036	31.85	63.70	18.95	27.48	99.92	39.55	87.85
Diethylphthalate	50	18	6.072	37.61	75.23	16.14	38.79	111.66	50.94	99.52
4-Chlorophenyl phenyl ether	50	18	5.828	30.45	60.89	19.14	25.93	95.86	37.58	84.21
4,6 - Dinitro-2-methylphenol	100	17	9.199	75.70	75.70	12.15	48.10	103.30	57.30	94.10
N-Nitrosodiphenylamine	50	18	6.141	38.31	76.62	16.03	39.78	113.47	52.06	101.19
4-Bromophenyl phenyl ether	50	18	5.358	35.57	71.13	15.07	38.98	103.28	49.70	92.57
Hexachlorobenzene	50	18	5.437	38.25	76.50	14.21	43.88	109.12	54.75	98.25
Pentachlorophenol	100	17	9.372	71.79	71.79	13.05	43.68	99.91	53.05	90.54
Phenanthrene	50	18	5.288	37.06	74.12	14.27	42.40	105.85	52.97	95.27
Anthracene	50	18	4.607	35.48	70.95	12.99	43.31	98.60	52.53	89.38
Di-n-butyl phthalate	50	18	6.186	40.79	81.58	15.16	44.47	118.70	56.84	106.32
Fluoranthene	50	18	5.607	40.15	80.29	13.97	46.65	113.94	57.86	102.72
Pyrene	50	18	5.583	38.87	77.73	14.37	44.23	111.23	55.40	100.07
Butylbenzyl phthalate	50	18	7.608	40.53	81.07	18.77	35.42	126.72	50.64	111.50
Benzo [a] anthracene	50	18	4.935	40.40	80.79	12.22	51.18	110.40	61.05	100.53
Chrysene	50	18	5.052	41.03	82.07	12.31	51.76	112.38	61.86	102.28
Bis (2-ethylhexyl) phthalate	50	18	58.332	56.13	112.27	103.92	-237.73	462.26	-121.06	345.59
Di-n-Octyl phthalate	50	18	4.517	40.62	81.23	11.12	54.13	108.34	63.16	99.30
Benzo [b] fluoranthene	50	18	6.396	42.74	85.48	14.97	47.10	123.86	59.89	111.06
Benzo [k] fluoranthene	50	18	5.864	41.24	82.48	14.22	47.30	117.66	59.03	105.93
Benzo [a] pyrene	50	18	4.613	36.89	73.78	12.50	46.10	101.46	55.33	92.23
Indeno (1,2,3-cd) pyrene	50	18	7.897	37.76	75.52	20.92	28.13	122.90	43.93	107.11
Dibenzo [a,h] anthracene	50	18	7.266	38.07	76.14	19.09	32.55	119.74	47.08	105.21
Benzo [g,h,i] perylene	50	18	7.056	38.64	77.28	18.26	34.95	119.62	49.06	105.51

LCS = Lab Control Sample
TV= True Value
N= Number of data points
RSD= Relative Standard Deviation

LCL= Lower Control Limit
UCL= Upper Control Limit
LWL= Lower Warning Limit
UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary
Method 8270
MS/MSD - Water
2001

ACCURACY

Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average Recovery ug/L	Average Recovery %	% RSD	Control Windows % Recovery LCL	UCL	LWL	UWL
1,4-Dichlorobenzene	50	152	7.073	22.32	44.64	31.69	2.20	87.08	16.35	72.93
N-Nitroso-Di-N-Propylamine	50	152	10.037	34.71	69.42	28.91	9.20	129.65	29.28	109.57
1,2,4-Trichlorobenzene	50	152	7.860	25.98	51.97	30.25	4.81	99.13	20.53	83.41
Acenaphthene	50	152	8.962	33.74	67.49	26.56	13.71	121.26	31.64	103.34
2,4-Dinitrotoluene	50	152	6.428	38.45	76.90	16.72	38.33	115.47	51.19	102.61
Pyrene	50	152	7.878	37.74	75.47	20.88	28.20	122.74	43.96	106.98
Phenol	100	148	13.392	38.61	38.61	34.68	-1.56	78.79	11.83	65.39
2-Chlorophenol	100	148	17.834	60.12	60.12	29.66	6.62	113.62	24.45	95.79
4-Chloro-m-cresol	100	148	16.338	74.30	74.30	21.99	25.28	123.31	41.62	106.97
4-Nitrophenol	100	148	14.199	50.71	50.71	28.00	8.12	93.31	22.32	79.11
Pentachlorophenol	100	148	14.228	80.95	80.95	17.58	38.26	123.63	52.49	109.41

PRECISION*

Compound		PAIRS	SD of RPDs	Average RPD		RPD UCL		UWL
1,4-Dichlorobenzene		76	8.938	9.79		26.81		17.88
N-Nitroso-Di-N-Propylamine		76	8.613	9.13		25.84		17.23
1,2,4-Trichlorobenzene		76	8.477	8.72		25.43		16.95
Acenaphthene		76	6.751	7.22		20.25		13.50
2,4-Dinitrotoluene		76	5.953	6.21		17.86		11.91
Pyrene		76	8.410	6.83		25.23		16.82
Phenol		74	7.761	8.76		23.28		15.52
2-Chlorophenol		74	8.262	8.23		24.79		16.52
4-Chloro-m-cresol		74	5.077	6.26		15.23		10.15
4-Nitrophenol		74	16.604	11.79		49.81		33.21
Pentachlorophenol		74	22.572	10.22		67.72		45.14

***Precision is from in batch MS/MSD spike duplicates**

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD = Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary
Method 8270
LCS/LCSD - Water
2001

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
1,4-Dichlorobenzene	50	109	4.778	18.16	36.33	26.30	7.66	64.99	17.21	55.44
N-Nitroso-Di-N-Propylamine	50	109	9.277	32.58	65.15	28.48	9.49	120.81	28.04	102.26
1,2,4-Trichlorobenzene	50	109	5.206	21.55	43.10	24.16	11.86	74.34	22.27	63.92
Acenaphthene	50	109	8.284	29.46	58.92	28.12	9.22	108.62	25.79	92.06
2,4-Dinitrotoluene	50	109	10.435	33.38	66.76	31.26	4.15	129.37	25.02	108.50
Pyrene	50	109	10.109	34.16	68.33	29.59	7.67	128.99	27.89	108.77
Phenol	100	101	5.521	26.75	26.75	20.64	10.19	43.31	15.71	37.79
2-Chlorophenol	100	101	11.216	59.48	59.48	18.86	25.83	93.13	37.05	81.91
4-Chloro-m-cresol	100	101	13.028	70.91	70.91	18.37	31.82	109.99	44.85	96.96
4-Nitrophenol	100	101	7.019	31.74	31.74	22.12	10.68	52.79	17.70	45.78
Pentachlorophenol	100	101	14.179	75.60	75.60	18.75	33.07	118.14	47.25	103.96

			PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
1,4-Dichlorobenzene		15	9.863	11.53		29.59		19.73
N-Nitroso-Di-N-Propylamine		15	10.689	11.35		32.07		21.38
1,2,4-Trichlorobenzene		15	8.132	10.36		24.40		16.26
Acenaphthene		15	8.831	7.52		26.49		17.66
2,4-Dinitrotoluene		15	12.766	9.65		38.30		25.53
Pyrene		15	13.019	7.73		39.06		26.04
Phenol		12	7.322	7.93		21.96		14.64
2-Chlorophenol		12	5.446	7.60		16.34		10.89
4-Chloro-m-cresol		12	7.609	9.76		22.83		15.22
4-Nitrophenol		12	12.843	10.98		38.53		25.69
Pentachlorophenol		12	16.940	13.45		50.82		33.88

***Precision is from in batch LCS/LCSD spike duplicates.**

LCS = Lab Control Sample

LCSD = Lab Control Sample Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT ENVIRONMENTAL QUALITY
QA Summary
Method 625
MS/MSD - Water
2001

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
N-Nitrosodimethylamine	50	32	9.070	24.37	48.74	37.21	-5.68	103.16	12.46	85.02
Phenol	50	30	15.675	34.52	69.04	45.41	-25.01	163.09	6.34	131.74
Bis (2-chloroethyl) ether	50	32	9.642	27.25	54.50	35.39	-3.36	112.35	15.93	93.06
2-Chlorophenol	100	30	19.141	54.24	54.24	35.29	-3.19	111.66	15.95	92.52
1,3-Dichlorobenzene	50	32	7.786	19.46	38.93	40.00	-7.79	85.64	7.78	70.07
1,4-Dichlorobenzene	50	32	7.994	20.31	40.62	39.36	-7.34	88.59	8.65	72.60
1,2-Dichlorobenzene	100	32	8.297	21.55	21.55	38.51	-3.34	46.44	4.95	38.14
Bis (2-chloroisopropyl) ether	50	32	9.954	29.09	58.17	34.22	-1.55	117.90	18.36	97.99
Hexachloroethane	50	32	11.430	23.52	47.03	48.60	-21.55	115.61	1.31	92.75
N-nitrosodi-n-propyl amine	50	32	10.272	27.01	54.03	38.03	-7.60	115.65	12.94	95.11
Nitrobenzene	50	32	9.698	29.43	58.86	32.95	0.68	117.05	20.07	97.65
Isophorone	50	32	8.914	27.70	55.39	32.18	1.91	108.88	19.74	91.05
2 - Nitrophenol	100	30	18.373	57.97	57.97	31.70	2.85	113.09	21.22	94.71
2,4 - Dimethylphenol	100	30	17.611	62.57	62.57	28.15	9.74	115.40	27.35	97.79
Bis (2-chloroethoxy) methane	50	32	9.775	30.36	60.72	32.20	2.07	119.37	21.62	99.82
2,4 - Dichlorophenol	100	30	18.029	63.54	63.54	28.38	9.45	117.63	27.48	99.60
1,2,4 - Trichlorobenzene	50	32	8.377	23.68	47.36	35.37	-2.90	97.62	13.86	80.87
Naphthalene	50	32	8.459	26.12	52.24	32.39	1.48	103.00	18.40	86.08
Hexachlorobutadiene	50	32	7.788	22.01	44.01	35.39	-2.72	90.74	12.86	75.17
Phenol, 4-chloro-3-methyl-	100	30	16.047	69.33	69.33	23.14	21.19	117.47	37.24	101.43
Hexachlorocyclopentadiene	50	32	5.560	13.64	27.29	40.75	-6.07	60.65	5.05	49.53
2,4,6 - Trichlorophenol	100	30	16.327	67.28	67.28	24.27	18.30	116.25	34.62	99.93
2- Chloronaphthalene	50	32	8.534	28.52	57.05	29.92	5.84	108.25	22.91	91.18
Dimethylphthalate	50	32	8.247	32.86	65.71	25.10	16.23	115.19	32.73	98.70
Acenaphthylene	50	32	8.746	31.88	63.77	27.43	11.29	116.24	28.78	98.75
2,6 - Dinitrotoluene	50	32	6.996	35.56	71.12	19.68	29.14	113.09	43.13	99.10
Acenaphthene	50	32	7.809	30.65	61.30	25.48	14.44	108.15	30.06	92.53
2,4 - Dinitrophenol	100	30	14.875	57.46	57.46	25.89	12.84	102.09	27.71	87.21
2,4 - Dinitrotoluene	50	32	9.863	39.43	78.87	25.01	19.69	138.05	39.42	118.32
4-Nitrophenol	100	30	13.235	40.68	40.68	32.54	0.97	80.38	14.21	67.14
Fluorene	50	32	7.164	32.45	64.91	22.07	21.92	107.89	36.25	93.56
Diethylphthalate	50	32	6.020	36.14	72.28	16.66	36.16	108.40	48.20	96.36
4-Chlorophenyl phenyl ether	50	32	7.282	32.01	64.01	22.75	20.32	107.71	34.89	93.14
4,6 - Dinitro-2-methylphenol	100	30	16.133	70.66	70.66	22.83	22.26	119.06	38.39	102.92
N-Nitrosodiphenylamine	50	32	6.686	38.04	76.07	17.58	35.96	116.19	49.33	102.82
4-Bromophenyl phenyl ether	50	32	6.513	36.86	73.71	17.67	34.63	112.79	47.66	99.76
Hexachlorobenzene	50	32	9.349	39.23	78.46	23.83	22.37	134.55	41.07	115.85
Pentachlorophenol	100	30	14.067	72.41	72.41	19.43	30.21	114.61	44.27	100.54
Phenanthrene	50	32	5.506	37.25	74.50	14.78	41.46	107.53	52.47	96.52
Anthracene	50	32	5.723	35.07	70.14	16.32	35.80	104.48	47.25	93.03
Di-n-butyl phthalate	50	32	7.019	39.16	78.33	17.92	36.22	120.44	50.25	106.40
Fluoranthene	50	32	6.268	38.72	77.44	16.19	39.83	115.05	52.37	102.51
Pyrene	50	32	5.511	38.15	76.29	14.45	43.23	109.36	54.25	98.33
Butylbenzyl phthalate	50	32	7.315	40.13	80.25	18.23	36.36	124.14	50.99	109.51
Benzo [a] anthracene	50	32	6.413	38.67	77.35	16.58	38.87	115.82	51.70	103.00
Chrysene	50	32	6.988	39.87	79.75	17.52	37.82	121.67	51.80	107.70
Bis (2-ethylhexyl) phthalate	50	32	30.480	44.61	89.22	68.33	-93.66	272.10	-32.70	211.14
Di-n-Octyl phthalate	50	32	8.453	37.75	75.50	22.39	24.78	126.22	41.69	109.31
Benzo [b] fluoranthene	50	32	8.415	40.13	80.26	20.97	29.77	130.75	46.60	113.92
Benzo [k] fluoranthene	50	32	7.820	38.32	76.65	20.41	29.73	123.56	45.37	107.92
Benzo [a] pyrene	50	32	6.679	34.49	68.99	19.36	28.92	109.06	42.28	95.70
Indeno (1,2,3-cd) pyrene	50	32	11.330	33.88	67.77	33.44	-0.21	135.75	22.45	113.09
Dibenzo [a,h] anthracene	50	32	10.353	33.79	67.59	30.63	5.47	129.70	26.18	109.00
Benzo [g,h,i] perylene	50	31	11.949	33.93	67.85	35.22	-3.84	139.54	20.06	115.65

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary
Method 625
MS/MSD - Water
2001

		PRECISION*			RPD		
Compound	PAIRS	SD of RPDs	Average RPD		UCL		UWL
N-Nitrosodimethylamine	16	11.223	11.91		33.67		22.45
Phenol	15	8.524	10.56		25.57		17.05
Bis (2-chloroethyl) ether	16	11.455	11.61		34.36		22.91
2-Chlorophenol	15	11.335	10.42		34.01		22.67
1,3-Dichlorobenzene	16	9.477	10.05		28.43		18.95
1,4-Dichlorobenzene	16	10.869	12.10		32.61		21.74
1,2-Dichlorobenzene	16	6.867	8.73		20.60		13.73
Bis (2-chloroisopropyl) ether	16	11.553	12.04		34.66		23.11
Hexachloroethane	16	11.045	11.53		33.14		22.09
N-nitrosodi-n-propyl amine	16	9.919	9.32		29.76		19.84
Nitrobenzene	16	11.145	9.32		33.44		22.29
Isophorone	16	10.088	9.69		30.26		20.18
2 - Nitrophenol	15	10.528	8.76		31.59		21.06
2,4 - Dimethylphenol	15	8.729	7.83		26.19		17.46
Bis (2-chloroethoxy) methane	16	10.117	8.49		30.35		20.23
2,4 - Dichlorophenol	15	8.835	7.76		26.51		17.67
1,2,4 - Trichlorobenzene	16	9.560	10.04		28.68		19.12
Naphthalene	16	8.920	9.21		26.76		17.84
Hexachlorobutadiene	16	11.012	10.30		33.04		22.02
Phenol, 4-chloro-3-methyl-	15	5.748	6.38		17.24		11.50
Hexachlorocyclopentadiene	16	11.519	16.57		34.56		23.04
2,4,6 - Trichlorophenol	15	5.297	7.85		15.89		10.59
2- Chloronaphthalene	16	8.771	8.82		26.31		17.54
Dimethylphthalate	16	7.273	8.83		21.82		14.55
Acenaphthylene	16	7.117	7.98		21.35		14.23
2,6 - Dinitrotoluene	16	5.114	7.54		15.34		10.23
Acenaphthene	16	6.433	7.69		19.30		12.87
2,4 - Dinitrophenol	15	10.857	11.48		32.57		21.71
2,4 - Dinitrotoluene	16	7.709	8.74		23.13		15.42
4-Nitrophenol	15	13.298	13.93		39.89		26.60
Fluorene	16	6.881	7.67		20.64		13.76
Diethylphthalate	16	6.959	8.49		20.88		13.92
4-Chlorophenyl phenyl ether	16	7.392	7.62		22.18		14.78
4,6 - Dinitro-2-methylphenol	15	7.148	7.86		21.45		14.30
N-Nitrosodiphenylamine	16	7.275	7.74		21.83		14.55
4-Bromophenyl phenyl ether	16	5.913	6.63		17.74		11.83
Hexachlorobenzene	16	17.317	10.49		51.95		34.63
Pentachlorophenol	15	17.271	13.02		51.81		34.54
Phenanthrene	16	7.053	6.88		21.16		14.11
Anthracene	16	10.934	10.37		32.80		21.87
Di-n-butyl phthalate	16	10.387	10.31		31.16		20.77
Fluoranthene	16	8.141	8.11		24.42		16.28
Pyrene	16	8.867	9.83		26.60		17.73
Butylbenzyl phthalate	16	7.363	8.59		22.09		14.73
Benzo [a] anthracene	16	7.146	8.56		21.44		14.29
Chrysene	16	7.562	9.43		22.69		15.12
Bis (2-ethylhexyl) phthalate	16	32.495	18.59		97.49		64.99
Di-n-Octyl phthalate	16	5.942	9.19		17.83		11.88
Benzo [b] fluoranthene	16	6.350	8.10		19.05		12.70
Benzo [k] fluoranthene	16	5.754	6.83		17.26		11.51
Benzo [a] pyrene	16	6.626	9.41		19.88		13.25
Indeno (1,2,3-cd) pyrene	16	8.756	10.41		26.27		17.51
Dibenzo [a,h] anthracene	16	8.172	8.36		24.52		16.34
Benzo [g,h,i] perylene	16	48.263	22.22		144.79		96.53

***Precision is from in batch MS/MSD spike duplicates**
TV= True Value
N= Number of data points
RSD= Relative Standard Deviation
SD= Standard Deviation

RPD = Relative Percent Difference
LCL= Lower Control Limit
UCL= Upper Control Limit
LWL= Lower Warning Limit
UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8270
Surrogate - Water

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
2-Fluorophenol	50	873	5.862	16.63	33.25	35.25	-1.92	68.42	9.81	56.70
Phenol -d5	50	873	5.100	13.40	26.80	38.05	-3.80	57.41	6.40	47.20
Nitrobenzene -d5	25	1111	4.510	16.66	66.66	27.07	12.53	120.78	30.58	102.74
2-Fluorobiphenyl	25	1113	3.883	16.63	66.52	23.35	19.92	113.11	35.45	97.58
2,4,6-Tribromophenol	50	877	11.101	40.84	81.68	27.18	15.07	148.29	37.28	126.09
p-Terphenyl-d14	25	1113	4.320	21.63	86.52	19.97	34.68	138.37	51.96	121.09

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082/608
Surrogate - Water

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
Tetrachloro-m-Xylene	0.20	1047	0.026	0.097	48.38	26.87	9.39	87.37	22.38	74.37
Decachlorobiphenyl	0.20	1047	0.037	0.113	56.72	32.65	1.16	112.28	19.68	93.76

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082/608
MS/MSD - Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
a-BHC	0 20	86	0 025	0.133	66.74	18.636	29.428	104.061	41 867	91.622
b-BHC	0 20	88	0 024	0.156	78 13	15 346	42.162	114 103	54.152	102 113
g-BHC	0 20	88	0 027	0 141	70 50	19.265	29.756	111 251	43 339	97 668
d-BHC	0 20	88	0 022	0 149	74 29	14 653	41 633	106 950	52 519	96 064
Heptachlor	0 20	88	0 027	0.124	62.12	21.404	22.233	102 011	35 529	88.715
Aldrin	0 20	88	0 025	0 111	55 68	22.392	18.277	93 086	30 746	80.618
Hept-Epox	0 20	88	0 025	0.155	77.36	15 950	40.346	114 380	52 685	102 041
g-Chlordane	0 20	88	0 024	0.152	75 88	16.107	39 212	112 539	51.433	100 318
Endosulfan I	0 20	88	0 033	0 120	59 97	27.457	10 574	109 375	27 041	92 908
a-Chlordane	0 20	88	0 026	0 145	72.71	17 973	33 506	111.916	46 574	98 848
Dieldrin	0 20	86	0 029	0 159	79 38	18.071	36 346	122.412	50 691	108 068
4,4'-DDE	0.20	88	0 022	0.152	75 86	14.719	42 361	109 354	53 526	98 188
Endrin	0 20	88	0 038	0 175	87 55	21 683	30.600	144 504	49 584	125 520
Endosulfan II	0 20	84	0 033	0 130	64.86	25.083	16 054	113 672	32 324	97.403
4,4'-DDD	0.20	86	0 026	0 164	82.15	15.690	43.480	120 812	56.368	107 924
Endrin Aldehyde	0 20	84	0.027	0 124	62.16	21.318	22.409	101 921	35 661	88 669
Endosulfan Sulfate	0 20	84	0 030	0.124	62.04	24.386	16 652	107.422	31.780	92.294
4,4'-DDT	0 20	88	0 028	0.148	73 83	18 647	32.527	115 125	46.293	101 359
Endrin Ketone	0 20	84	0 029	0.150	74.89	19.681	30.671	119 100	45 409	104 362
HBB	0 20	88	0 035	0.134	66 76	26.081	14 525	118 997	31 937	101.585
Methoxychlor	0.20	86	0 029	0.150	75.02	19 450	31.244	118 789	45 835	104.198
Mirex	0 20	88	0 031	0.163	81 30	19.134	34.634	127.971	50 190	112.415
BP-6	0 20	88	0 033	0.145	72 57	22 988	22.521	122 615	39 204	105 933
Aroclor 1016	1.00	10	0.111	0.734	73 36	15 135	40 050	106 670	51.153	95.567
Aroclor 1260	1 00	12	0.124	0 860	86 01	14.469	48 674	123 343	61 119	110 898

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082/608
LCS-Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
a-BHC	0.20	64	0.023	0.144	72.12	16.066	37.359	106.877	48.945	95.291
b-BHC	0.20	64	0.024	0.164	82.24	14.505	46.455	118.033	58.385	106.103
g-BHC	0.20	64	0.025	0.150	75.06	16.580	37.723	112.389	50.167	99.945
d-BHC	0.20	64	0.023	0.156	77.96	14.509	44.025	111 894	55.337	100.582
Heptachlor	0.20	64	0.021	0.115	57.41	18.563	25.442	89.388	36.099	78.730
Aldrin	0.20	64	0.021	0.097	48.59	21.395	17.404	79.781	27.800	69.385
Hept-Epox.	0.20	64	0.028	0.159	79.57	17.844	36.973	122.158	51.171	107.961
g-Chlordane	0.20	64	0.022	0.144	72.11	15.380	38.836	105 375	49.926	94.285
Endosulfan I	0.20	64	0.038	0.128	63.97	29.819	6.744	121.203	25.821	102.126
a-Chlordane	0.20	63	0.025	0.144	71.82	17.292	34.562	109.078	46.981	96.658
Dieldrin	0.20	64	0.031	0.165	82.69	18.936	35.714	129.658	51.371	114.000
4,4'-DDE	0.20	64	0.019	0.141	70.38	13.800	41.240	99.513	50.952	89.801
Endrin	0.20	64	0.032	0.182	90.81	17.454	43.262	138.368	59.113	122.517
Endosulfan II	0.20	62	0.036	0.139	69.42	26.013	15.244	123.590	33.302	105.532
4,4'-DDD	0.20	64	0.025	0.170	84.85	14.464	48.030	121.667	60.303	109.394
Endrin Aldehyde	0.20	62	0.027	0.126	63.10	21.454	22.486	103.708	36.023	90.171
Endosulfan Sulfate	0.20	62	0.031	0.134	66.96	23.197	20.362	113.559	35.895	98.026
4,4'-DDT	0.20	64	0.024	0.152	75.99	15.833	39.896	112.085	51.927	100.054
Endrin Ketone	0.20	62	0.027	0.155	77.74	17.366	37.239	118.236	50.738	104.736
HBB	0.20	64	0.032	0.138	68.97	22.867	21.655	116.284	37.427	100.513
Methoxychlor	0.20	64	0.030	0.159	79.74	18.683	35.047	124.439	49.946	109.540
Mirex	0.20	64	0.026	0.159	79.52	16.339	40.545	118.504	53.538	105.510
BP-6	0.20	64	0.028	0.150	75.03	18.771	32.780	117.283	46.863	103.199
Aroclor 1016	1.00	22	0.102	0.635	63.45	16.096	32.812	94.088	43.024	83.876
Aroclor 1260	1.00	22	0.133	0.758	75.75	17.589	35.780	115.720	49.103	102.397

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082/608
MS/MSD - Water

			PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
a-BHC		43	7.622	9.343		22.866		15.244
b-BHC		44	4.770	6.420		14.309		9.539
g-BHC		44	7.982	9.056		23.945		15.963
d-BHC		44	5.747	7.124		17.242		11.495
Heptachlor		44	8.537	10.427		25.612		17.074
Aldrin		44	9.415	11.306		28.246		18.831
Hept-Epox.		44	5.282	6.703		15.845		10.563
g-Chlordane		44	7.377	7.856		22.130		14.753
Endosulfan I		44	7.054	7.753		21.162		14.108
a-Chlordane		44	11.398	8.664		34.194		22.796
Dieldrin		43	5.742	6.541		17.225		11.483
4,4'-DDE		44	7.788	7.762		23.365		15.577
Endrin		44	26.403	11.750		79.209		52.806
Endosulfan II		42	5.234	6.271		15.703		10.469
4,4'-DDD		43	5.262	6.173		15.787		10.525
Endrin Aldehyde		42	7.617	8.367		22.851		15.234
Endosulfan Sulfate		42	7.016	7.026		21.048		14.032
4,4'-DDT		44	4.983	6.690		14.950		9.967
Endrin Ketone		42	5.976	6.143		17.927		11.951
HBB		44	7.498	8.104		22.495		14.997
Methoxychlor		43	9.900	8.978		29.699		19.799
Mirex		44	10.059	8.545		30.177		20.118
BP-6		44	10.043	9.141		30.128		20.085
Aroclor 1016		5	3.382	7.816		10.145		6.763
Aroclor 1260		6	4.579	7.474		13.738		9.158

***Precision is from in batch MS/MSD spike duplicates**

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082
Surrogate - Soil

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/Kg)	N	Deviation (ug/Kg)	ug/Kg	%	% RSD	LCL	UCL	LWL	UWL
Tetrachloro-m-Xylene	100	1398	15.636	76.78	76.78	20.36	29.87	123.69	45.51	108.06
Decachlorobiphenyl	100	1426	19.189	78.57	78.57	24.42	21.00	136.14	40.19	116.95

TV= True Value
N= Number of data points
RSD= Relative Standard Deviation

LCL= Lower Control Limit
UCL= Upper Control Limit
LWL= Lower Warning Limit
UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082
LCS-Soil

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/Kg)	N	Deviation (ug/Kg)	ug/Kg	%	% RSD	LCL	UCL	LWL	UWL
a-BHC	100	46	12.383	78.96	78.96	15.68	41.81	116.10	54.19	103.72
b-BHC	100	46	13.873	94.11	94.11	14.74	52.49	135.73	66.36	121.85
g-BHC	100	46	14.344	83.63	83.63	17.15	40.60	126.66	54.94	112.32
d-BHC	100	45	27.333	61.33	61.33	44.56	-20.67	143.33	6.67	116.00
Heptachlor	100	46	16.386	92.41	92.41	17.73	43.25	141.57	59.64	125.19
Aldrin	100	46	12.122	85.63	85.63	14.16	49.26	122.00	61.39	109.87
Hept-Epox.	100	46	13.310	96.67	96.67	13.77	56.74	136.60	70.05	123.29
g-Chlordane	100	46	12.379	91.52	91.52	13.53	54.39	128.66	66.76	116.28
Endosulfan I	100	45	21.656	31.90	31.90	67.89	-33.07	96.87	-11.41	75.21
a-Chlordane	100	46	12.276	90.57	90.57	13.55	53.74	127.39	66.01	115.12
Dieldrin	100	46	13.423	93.50	93.50	14.36	53.23	133.77	66.65	120.35
4,4'-DDE	100	46	12.855	94.78	94.78	13.56	56.22	133.35	69.07	120.49
Endrin	100	45	14.820	106.91	106.91	13.86	62.45	151.37	77.27	136.55
Endosulfan II	100	45	22.750	37.91	37.91	60.01	-30.34	106.16	-7.59	83.41
4,4'-DDD	100	35	14.980	99.66	99.66	15.03	54.72	144.60	69.70	129.62
Endrin Aldehyde	100	35	19.002	56.57	56.57	33.59	-0.43	113.58	18.57	94.58
Endosulfan Sulfate	100	46	13.545	94.48	94.48	14.34	53.84	135.11	67.39	121.57
4,4'-DDT	100	45	23.913	102.18	102.18	23.40	30.44	173.92	54.35	150.00
Endrin Ketone	100	46	17.505	94.11	94.11	18.60	41.59	146.62	59.10	129.12
HBB	100	46	22.444	78.39	78.39	28.63	11.06	145.72	33.50	123.28
Methoxychlor	100	42	20.244	101.62	101.62	19.92	40.89	162.35	61.13	142.11
Mirex	100	46	12.547	93.76	93.76	13.38	56.12	131.40	68.67	118.86
BP-6	100	46	19.642	100.37	100.37	19.57	41.44	159.29	61.09	139.65
Aroclor 1016	500	29	71.479	465.14	93.03	15.37	50.14	135.92	64.44	121.62
Aroclor 1260	500	29	70.227	516.10	103.22	13.61	61.08	145.36	75.13	131.31

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082
MS/MSD - Soil

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/Kg)	N	Standard Deviation (ug/Kg)	Average Recovery ug/Kg	Recovery %	% RSD	LCL	UCL	LWL	UWL
a-BHC	100	90	19.375	80.87	80.87	23.96	22.74	138.99	42.12	119.62
b-BHC	100	90	14.974	90.37	90.37	16.57	45.44	135.29	60.42	120.32
g-BHC	100	90	17.390	82.07	82.07	21.19	29.90	134.24	47.29	116.85
d-BHC	100	88	26.399	71.30	71.30	37.03	-7.90	150.49	18.50	124.09
Heptachlor	100	87	15.454	89.34	89.34	17.30	42.98	135.71	58.44	120.25
Aldrin	100	90	14.081	83.06	83.06	16.95	40.81	125.30	54.89	111.22
Hept-Epox.	100	90	13.088	89.99	89.99	14.54	50.73	129.25	63.81	116.16
g-Chlordane	100	90	13.956	83.69	83.69	16.68	41.82	125.56	55.78	111.60
Endosulfan I	100	88	25.056	47.99	47.99	52.21	-27.18	123.16	-2.12	98.10
a-Chlordane	100	90	17.359	84.19	84.19	20.62	32.11	136.26	49.47	118.91
Dieldrin	100	88	14.129	86.75	86.75	16.29	44.36	129.14	58.49	115.01
4,4'-DDE	100	86	14.552	88.84	88.84	16.38	45.18	132.49	59.73	117.94
Endrin	100	90	16.003	103.93	103.93	15.40	55.93	151.94	71.93	135.94
Endosulfan II	100	90	26.333	55.56	55.56	47.40	-23.44	134.55	2.89	108.22
4,4'-DDD	100	70	16.822	92.19	92.19	18.25	41.72	142.65	58.54	125.83
Endrin Aldehyde	100	66	15.895	58.06	58.06	27.38	10.38	105.74	26.27	89.85
Endosulfan Sulfate	100	86	15.875	89.62	89.62	17.71	41.99	137.24	57.87	121.37
4,4'-DDT	100	86	26.110	98.49	98.49	26.51	20.16	176.82	46.27	150.71
Endrin Ketone	100	90	17.122	88.09	88.09	19.44	36.72	139.45	53.85	122.33
HBB	100	90	18.782	79.33	79.33	23.67	22.99	135.68	41.77	116.90
Methoxychlor	100	78	15.921	95.42	95.42	16.68	47.66	143.19	63.58	127.26
Mirex	100	90	13.867	83.69	83.69	16.57	42.09	125.29	55.96	111.42
BP-6	100	90	17.980	91.82	91.82	19.58	37.88	145.76	55.86	127.78
Aroclor 1016	500	56	74.193	439.36	87.87	16.89	43.36	132.39	58.19	117.55
Aroclor 1260	500	56	80.276	458.71	91.74	17.50	43.58	139.91	59.63	123.85

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8081/8082
MS/MSD - Soil

		PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
a-BHC		45	13.819	13.783		41.46		27.64
b-BHC		45	9.845	9.998		29.54		19.69
g-BHC		45	13.896	12.560		41.69		27.79
d-BHC		44	28.112	25.210		84.34		56.22
Heptachlor		43	10.610	11.065		31.83		21.22
Aldrin		45	9.891	11.088		29.67		19.78
Hept-Epox.		45	9.470	9.773		28.41		18.94
g-Chlordane		45	9.406	9.668		28.22		18.81
Endosulfan I		44	36.962	28.489		110.89		73.92
a-Chlordane		45	25.342	13.555		76.02		50.68
Dieldrin		44	9.528	10.177		28.59		19.06
4,4'-DDE		43	10.348	10.026		31.05		20.70
Endrin		45	10.224	9.745		30.67		20.45
Endosulfan II		45	34.778	25.919		104.33		69.56
4,4'-DDD		35	15.039	11.143		45.12		30.08
Endrin Aldehyde		33	13.758	12.954		41.27		27.52
Endosulfan Sulfate		43	12.731	11.979		38.19		25.46
4,4'-DDT		43	11.645	10.944		34.94		23.29
Endrin Ketone		45	11.063	9.792		33.19		22.13
HBB		45	11.683	12.970		35.05		23.37
Methoxychlor		39	10.955	11.600		32.87		21.91
Mirex		45	10.434	9.791		31.30		20.87
BP-6		45	11.067	10.451		33.20		22.13
Aroclor 1016		28	12.119	12.422		36.36		24.24
Aroclor 1260		28	10.446	12.843		31.34		20.89

***Precision is from in batch MS/MSD spike duplicates**

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method TO-15 AIR

		PRECISION*			RPD		
Compound	PAIRS	SD of RPDs	Average RPD		UCL		UWL
Dichlorodifluoromethane	16	3.328	3.622		9.98		6.66
Chloromethane	16	2.972	3.959		8.92		5.94
1,2-Dichloro-1,1,2,2-Tetrafluoroethane	#	#	#		#		#
1,3-Butadiene	12	3.364	5.101		10.09		6.73
Vinyl Chloride	#	#	#		#		#
Bromomethane	#	#	#		#		#
Chloroethane	#	#	#		#		#
Acetonitrile	#	#	#		#		#
Trichlorofluoromethane	16	1.658	2.160		4.97		3.32
Acrylonitrile	#	#	#		#		#
1,1-Dichloroethylene	#	#	#		#		#
Methylene Chloride	10	2.737	3.516		8.21		5.47
1,1,2-Trichloro-1,2,2-Trifluoroethane	#	#	#		#		#
trans-1,2-Dichloroethylene	#	#	#		#		#
1,1-Dichloroethane	#	#	#		#		#
Methyl Tertiary Butyl Ether	#	#	#		#		#
Methyl Ethyl Ketone	#	#	#		#		#
2-Chloro-1,3-Butadiene	#	#	#		#		#
cis-1,2-Dichloroethylene	#	#	#		#		#
Hexane	#	#	#		#		#
Chloroform	#	#	#		#		#
1,2-Dichloroethane	#	#	#		#		#
1,1,1-Trichloroethane	#	#	#		#		#
Benzene	14	2.196	3.051		6.59		4.39
Carbon Tetrachloride	#	#	#		#		#
1,2-Dichloropropane	#	#	#		#		#
Bromodichloromethane	#	#	#		#		#
Trichloroethylene	#	#	#		#		#
2,2,4-Trimethylpentane	4	2.822	3.742		8.47		5.64
cis-1,3-Dichloropropylene	#	#	#		#		#
Methyl Isobutyl Ketone	#	#	#		#		#
trans-1,3-Dichloropropylene	#	#	#		#		#
1,1,2-Trichloroethane	#	#	#		#		#
Toluene	15	3.648	5.474		10.95		7.30
Dibromochloromethane	#	#	#		#		#
1,2-Dibromoethane	#	#	#		#		#
Tetrachloroethylene	#	#	#		#		#
Chlorobenzene	#	#	#		#		#
Ethylbenzene	3	4.308	5.975		12.93		8.62
m&p-Xylene	14	5.100	6.135		15.30		10.20
Bromoform	#	#	#		#		#
Styrene	#	#	#		#		#
1,1,2,2-Tetrachloroethane	#	#	#		#		#
o-Xylene	7	3.619	5.560		10.86		7.24
1,3,5-Trimethylbenzene	#	#	#		#		#
1,2,4-Trimethylbenzene	8	5.840	6.686		17.52		11.68
Benzyl Chloride	#	#	#		#		#
1,3-Dichlorobenzene	#	#	#		#		#
1,4-Dichlorobenzene	#	#	#		#		#
1,2-Dichlorobenzene	#	#	#		#		#
1,2,4-Trichlorobenzene	#	#	#		#		#
Hexachloro-1,3-Butadiene	#	#	#		#		#

SD= Standard Deviation
RPD= Relative Percent Difference
*** Precisision is from duplicate injections of the same canister.**
Units are in ppbv.
 # Not enough data points
UCL= Upper Control Limit
UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method TO-11
AIR

			ACCURACY*				Control Windows			
							% Recovery			
Compound	TV (mg/L)	N	Standard Deviation (mg/L)	Average mg/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
Formaldehyde	6.99	15	0.397	6.63	94.86	5.99	77.81	111.91	83.49	106.23
Acetaldehyde	5.10	15	0.272	4.34	85.07	6.27	69.08	101.07	74.41	95.73
Acetone	4.10	14	0.452	3.65	88.94	12.38	55.90	121.99	66.91	110.97
Propionaldehyde	4.10	15	0.304	3.63	88.56	8.38	66.31	110.81	73.73	103.40
Crotonaldehyde	3.57	15	0.347	2.77	77.70	12.51	48.54	106.85	58.26	97.13
n-Butyraldehyde	3.50	15	0.318	3.22	92.04	9.86	64.82	119.25	73.89	110.18
Benzaldehyde	2.70	15	0.248	2.58	95.45	9.63	67.86	123.04	77.06	113.85
Isovaleraldehyde	3.10	15	0.181	2.86	92.32	6.31	74.83	109.80	80.66	103.97
Valeraldehyde	3.10	15	0.168	3.12	100.55	5.40	84.25	116.85	89.68	111.42
o-Tolualdehyde	2.50	15	0.208	2.17	86.90	9.57	61.95	111.86	70.27	103.54
m,p-Tolualdehyde	5.00	15	0.449	4.61	92.19	9.73	65.27	119.10	74.24	110.13
Hexanaldehyde	2.80	15	0.180	2.32	82.99	7.76	63.68	102.30	70.12	95.86
2,5-Dimethylbenzaldehyde	2.34	15	0.184	1.98	84.41	9.32	60.81	108.00	68.68	100.14

*Accuracy is determined from spiking underivitized standard onto a blank cartridge.

			PRECISION**				RPD			
Compound		PAIRS	SD of RPDs	Average RPD				UCL		UWL
Formaldehyde		17	1.873	1.523				5.62		3.75
Acetaldehyde		17	2.003	1.783				6.01		4.01
Acetone		17	0.882	1.309				2.64		1.76
Propionaldehyde		12	4.904	4.974				14.71		9.81
Crotonaldehyde		1	#	#				#		#
n-Butyraldehyde		8	3.220	2.786				9.66		6.44
Benzaldehyde		3	#	#				#		#
Isovaleraldehyde		4	#	#				#		#
Valeraldehyde		4	#	#				#		#
o-Tolualdehyde		1	#	#				#		#
m,p-Tolualdehyde		1	#	#				#		#
Hexanaldehyde		5	#	#				#		#
2,5-Dimethylbenzaldehyde		0	#	#				#		#

**Precision is from duplicate injections of the same sample extract.

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

Units are mg/L which are direct readings from the HPLC of the ester compound.

Insufficient data points

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	LCL	UCL	LWL	UWL
Dichlorodifluoromethane	50	8	5.309	53.79	107.58	9.87	75.73	139.43	86.34	128.81
Chloromethane	50	8	7.608	49.52	99.03	15.36	53.38	144.68	68.60	129.46
Vinyl Chloride	50	8	6.436	51.57	103.13	12.48	64.51	141.75	77.39	128.87
Bromomethane	50	8	11.744	45.30	90.60	25.92	20.14	161.06	43.63	137.58
Chloroethane	50	8	5.447	49.93	99.85	10.91	67.17	132.53	78.06	121.64
Trichlorofluoromethane	50	8	5.239	50.46	100.91	10.38	69.48	132.35	79.96	121.87
2-Propanone (acetone)	50	8	5.853	28.35	56.69	20.65	21.57	91.81	33.28	80.10
Diethylether	50	8	6.344	50.16	100.32	12.65	62.25	138.38	74.94	125.69
1,1-Dichloroethylene	50	8	5.788	50.70	101.41	11.42	66.68	136.14	78.26	124.56
Methyl Iodide	50	8	9.032	61.50	123.01	14.68	68.82	177.20	86 88	159.14
Acrylonitrile	50	8	7.254	51.05	102.09	14.21	58.57	145.62	73.08	131.11
Methylene Chloride	50	8	7.106	48.93	97.87	14.52	55.23	140.50	69.45	126.29
Carbon Disulfide	50	8	5.607	49 84	99.68	11.25	66.03	133.32	77.25	122.11
trans-1,2-Dichloroethylene	50	8	5.327	48.55	97.10	10.97	65.14	129 06	75.79	118.41
Methyl Tertiary Butyl Ether	50	8	5.935	49.48	98.95	12.00	63.34	134.56	75.21	122.69
1,1-Dichloroethane	50	8	5.437	47.55	95.10	11.43	62.48	127.72	73.35	116.85
2-Butanone (MEK)	50	8	4.415	37.40	74.80	11.81	48.31	101.29	57.14	92.46
cis-1,2-Dichloroethylene	50	8	5.223	47.08	94.16	11.09	62.83	125.50	73.27	115.06
Chloroform	50	8	4.822	47.69	95.37	10.11	66.44	124.31	76.08	114 66
Tetrahydrofuran	50	8	7.714	48.01	96.01	16.07	49.72	142.30	65.15	126.87
Bromochloromethane	50	8	4.951	48 47	96.94	10.21	67.24	126.65	77.14	116.75
1,1,1-Trichloroethane	50	8	4.486	48.15	96.29	9.32	69.37	123.21	78.34	114.24
1,2-Dichloroethane	50	8	4.671	49.00	97.99	9.53	69.97	126.02	79.31	116.68
Benzene	50	8	4.689	48.36	96.71	9.70	68.58	124.85	77.96	115.47
Carbon Tetrachloride	50	8	5.192	47.95	95.91	10.83	64.75	127.06	75.14	116.67
1,2-Dichloropropane	50	8	4.697	48.57	97.15	9.67	68.97	125.32	78.36	115.93
Trichloroethylene	50	8	4.753	46.22	92.43	10.28	63.91	120.95	73.42	111.44
Dibromomethane	50	8	4.898	49.23	98.45	9.95	69.06	127.84	78.86	118 04
Bromodichloromethane	50	8	4.702	48.88	97.75	9 62	69.54	125.97	78.95	116.56
4-Methyl-2-Pentanone (MIBK)	50	8	6.536	49.67	99.33	13.16	60.12	138.54	73.19	125.47

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
cis-1,3-Dichloropropene	50	8	4.928	48.05	96.10	10.26	66.53	125.67	76.39	115.81
trans-1,3-Dichloropropene	50	8	4.884	48.47	96.94	10.08	67.64	126.24	77.40	116.47
Toluene	50	8	4.815	47.16	94.31	10.21	65.43	123.20	75.05	113.57
1,1,2-Trichloroethane	50	8	5.105	48.65	97.30	10.49	66.67	127.93	76.88	117.72
2-Hexanone	50	8	4.489	39.50	78.99	11.36	52.06	105.92	61.04	96 95
Dibromochloromethane	50	8	5.130	49.29	98.59	10.41	67.81	129.37	78.07	119.11
1,2-Dibromoethane	50	8	5.436	49.10	98.20	11.07	65.58	130.81	76.45	119.94
Tetrachloroethylene	50	8	5.359	45.12	90.24	11.88	58.08	122.39	68.80	111.67
Chlorobenzene	50	8	5.664	46.08	92.16	12.29	58.18	126.15	69.50	114.82
1,1,1,2-Tetrachloroethane	50	8	4.769	49 17	98.34	9.70	69.72	126.95	79 26	117.41
Ethylbenzene	50	8	5.645	46.74	93.49	12 08	59.62	127.36	70 91	116.07
m & P-Xylene	50	8	4.834	44.65	89.30	10.83	60.30	118.31	69.97	108.64
Bromoform	50	8	7.080	47.21	94.42	15.00	51.94	136.91	66.10	122.75
Styrene	50	8	10.036	44.63	89.26	22.49	29.04	149.47	49.11	129.40
o-Xylene	50	8	5.589	46.86	93.72	11.93	60.18	127.25	71 36	116.07
1,1,2,2-Tetrachloroethane	50	8	5.833	48.98	97.96	11.91	62.96	132.96	74.62	121.29
1,2,3-Trichloropropane	50	8	6.771	50.33	100.66	13.45	60.03	141.29	73.58	127.74
1,4-Dichloro-2-butene	50	8	7.626	45.18	90.36	16.88	44.60	136.11	59.85	120.86
Isopropylbenzene	50	8	7.406	46.40	92.80	15.96	48.37	137.24	63.18	122 43
Bromobenzene	50	8	7.067	43.91	87.83	16.09	45.43	130.23	59.56	116.10
n-Propyl Benzene	50	8	8.381	45.35	90.69	18.48	40.41	140.98	57.17	124.22
1,3,5-Trimethylbenzene	50	8	7.842	44.88	89.76	17.47	42.71	136.81	58.40	121.13
tert-Butylbenzene	50	8	8.795	45.14	90.28	19.48	37.51	143.05	55.10	125.46
1,2,4-Trimethylbenzene	50	8	7.320	44.17	88.35	16.57	44.43	132.27	59.07	117.63
sec-Butylbenzene	50	8	10.069	43.36	86.72	23.22	26.31	147.13	46.45	127.00
1,3-Dichlorobenzene	50	8	9.290	43.38	86.75	21.42	31.01	142.49	49.59	123.91
1,4-Dichlorobenzene	50	8	8.829	42.61	85.21	20.72	32.24	138.18	49.90	120.53
p-isopropyl Toluene	50	8	10.072	43.11	86.22	23.36	25.78	146.65	45.93	126 50
1,2-Dichlorobenzene	50	8	9.561	43.00	86.00	22.24	28.63	143.36	47.75	124.24
n-Butylbenzene	50	8	11.442	41.81	83.63	27.37	14.97	152.28	37.86	129.40
Hexachloroethane	50	8	12.504	40.04	80.07	31.23	5.04	155.10	30.05	130.09
1,2-Dibromo-3-chloropropane	50	8	7.793	48.99	97.97	15.91	51.22	144.73	66.80	129.14
1,2,4-Trimethylbenzene	50	8	12.946	40.09	80.18	32.29	2.51	157.86	28.40	131.97
Naphthalene	50	8	12.330	44.20	88.40	27.90	14.42	162.38	39.08	137.72
1,2,3-Trichlorobenzene	50	8	12 793	39.72	79.44	32.21	2.68	156.20	28.26	130.61
2-Methyl Naphthalene	50	8	19.401	46 01	92.03	42.16	-24.38	208.43	14.42	169.63

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

		PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
Dichlorodifluoromethane		4	7.787	8.04		23.36		15.57
Chloromethane		4	9.526	9.26		28.58		19.05
Vinyl Chloride		4	7.893	8.73		23.68		15.79
Bromomethane		4	14.895	17.68		44.68		29.79
Chloroethane		4	8.836	10.06		26.51		17.67
Trichlorofluoromethane		4	9.962	8.55		29 89		19.92
2-Propanone (acetone)		4	15.884	21.81		47.65		31.77
Diethylether		4	10.485	9.14		31.46		20.97
1,1-Dichloroethylene		4	10.219	9.02		30.66		20.44
Methyl Iodide		4	12.622	21.56		37.86		25.24
Acrylonitrile		4	11.757	10.19		35.27		23.51
Methylene Chloride		4	9.566	8.81		28.70		19.13
Carbon Disulfide		4	9.750	8.38		29.25		19.50
trans-1,2-Dichloroethylene		4	10.163	9.10		30.49		20.33
Methyl Tertiary Butyl Ether		4	10.019	10.80		30.06		20.04
1,1-Dichloroethane		4	9.622	9.04		28.87		19.24
2-Butanone (MEK)		4	11.506	11.36		34.52		23.01
cis-1,2-Dichloroethylene		4	10.187	9.30		30.56		20.37
Chloroform		4	9.669	9.04		29.01		19.34
Tetrahydrofuran		4	10.373	11.35		31.12		20.75
Bromochloromethane		4	10.302	9.61		30.91		20.60
1,1,1-Trichloroethane		4	10.484	9.42		31.45		20.97
1,2-Dichloroethane		4	10.401	8.98		31.20		20.80
Benzene		4	10.373	9.01		31.12		20.75
Carbon Tetrachloride		4	11.411	10.36		34.23		22.82
1,2-Dichloropropane		4	10.044	8.82		30.13		20.09
Trichloroethylene		4	11.073	9.41		33.22		22.15
Dibromomethane		4	9.912	9.71		29.74		19.82
Bromodichloromethane		4	10.386	9.34		31.16		20.77
4-Methyl-2-Pentanone (MIBK)		4	12.294	11.04		36.88		24.59
cis-1,3-Dichloropropene		4	10.759	9.78		32.28		21.52
trans-1,3-Dichloropropene		4	10.461	10.23		31.38		20.92
Toluene		4	11.380	10.03		34.14		22.76
1,1,2-Trichloroethane		4	10.080	9.34		30.24		20.16
2-Hexanone		4	12.465	11.10		37.40		24.93
Dibromochloromethane		4	9.298	10.98		27.89		18.60
1,2-Dibromoethane		4	10.271	10.43		30.81		20 54
Tetrachloroethylene		4	9.753	8.82		29.26		19.51
Chlorobenzene		4	9.285	9.52		27.86		18.57
1,1,1,2-Tetrachloroethane		4	9.617	9.82		28.85		19.23
Ethylbenzene		4	10.128	9.53		30.38		20.26
m & P-Xylene		4	10.118	9.39		30.35		20.24
Bromoform		4	9.097	12.64		27.29		18.19

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
FULL LIST MS/MSD - Water

		PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL	UWL
Styrene		4	8.762	11.40		26.29	17.52
o-Xylene		4	9.829	9.73		29.49	19.66
1,1,2,2-Tetrachloroethane		4	9.628	10.29		28.88	19.26
1,2,3-Trichloropropane		4	10.558	9.75		31.67	21.12
1,4-Dichloro-2-butene		4	12.220	11.96		36.66	24.44
Isopropylbenzene		4	10.335	9.73		31.01	20.67
Bromobenzene		4	9.588	10.77		28.76	19.18
n-Propyl Benzene		4	9.424	10.56		28.27	18.85
1,3,5-Trimethylbenzene		4	9.339	10.68		28.02	18.68
tert-Butylbenzene		4	10.023	10.85		30.07	20.05
1,2,4-Trimethylbenzene		4	10.267	11.03		30.80	20.53
sec-Butylbenzene		4	9.394	11.74		28.18	18.79
1,3-Dichlorobenzene		4	10.414	11.45		31.24	20.83
1,4-Dichlorobenzene		4	9.489	10.96		28.47	18.98
p-isopropyl Toluene		4	9.843	11.27		29.53	19.69
1,2-Dichlorobenzene		4	9.678	12.14		29.03	19.36
n-Butylbenzene		4	10.053	11.95		30.16	20.11
Hexachloroethane		4	10.547	14.11		31.64	21.09
1,2-Dibromo-3-chloropropane		4	12.279	12.88		36.84	24.56
1,2,4-Trimethylbenzene		4	9.808	14.66		29.42	19.62
Naphthalene		4	10.301	16.13		30.90	20.60
1,2,3-Trichlorobenzene		4	10.006	15.80		30.02	20.01
2-Methyl Naphthalene		4	10.296	23.36		30.89	20.59

*Precision is from in batch MS/MSD spike duplicates

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260/624
Surrogate - Water
Mobile Lab

			ACCURACY				Control Windows			
			Standard	Average Recovery			% Recovery			
Compound	TV (ug/L)	N	Deviation (ug/L)	ug/L	%	% RSD	LCL	UCL	LWL	UWL
Dibromofluoromethane	50	1614	1.382	49.18	98.36	2.81	90.07	106.66	92.83	103.89
Toluene-d8	50	1666	0.825	50.35	100.69	1.64	95.74	105.64	97.39	103.99
4-Bromofluorobenzene	50	1666	0.854	50.22	100.45	1.70	95.32	105.57	97.03	103.87

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
MS/MSD - Water
Mobile Lab

ACCURACY

Compound	TV (ug/L)	N	Standard Deviation (ug/L)	Average ug/L	Recovery %	% RSD	Control Windows % Recovery LCL	UCL	LWL	UWL
1,1-Dichloroethylene	50	186	4.679	49.15	98.30	9.52	70.23	126.37	79.59	117.02
Benzene	50	186	2.169	51.92	103.85	4.18	90.83	116.86	95.17	112.52
Trichloroethylene	50	186	1.928	48.95	97.90	3.94	86.33	109.46	90.18	105.61
Toluene	50	186	2.037	51.27	102.54	3.97	90.32	114.76	94.39	110.69
Chlorobenzene	50	186	1.766	50.99	101.98	3.46	91.38	112.57	94.92	109.04

PRECISION*

Compound		PAIRS	SD of RPDs	Average RPD		RPD UCL		UWL
1,1-Dichloroethylene		93	2.015	2.23		6.05		4.03
Benzene		93	1.611	2.00		4.83		3.22
Trichloroethylene		93	1.644	2.04		4.93		3.29
Toluene		93	1.578	2.02		4.73		3.16
Chlorobenzene		93	1.668	1.93		5.01		3.34

***Precision is from in batch MS/MSD spike duplicates**

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
Surrogate - Soil
Mobile Lab

			ACCURACY				Control Windows			
			Standard	Average	Recovery		% Recovery			
Compound	TV (ug/Kg)	N	Deviation (ug/Kg)	ug/Kg	%	% RSD	LCL	UCL	LWL	UWL
Dibromofluoromethane	2500	622	585.884	2291.35	91.65	25.57	21.35	161.96	44.78	138.52
Toluene-d8	2500	622	413.177	2336.26	93.45	17.69	43.87	143.03	60.40	126.50
4-Bromofluorobenzene	2500	622	653.249	2521.89	100.88	25.90	22.49	179.27	48.62	153.14

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
QA Summary for Year 2001
Method 8260
MS/MSD - Soil
Mobile Lab

			ACCURACY				Control Windows			
							% Recovery			
Compound	TV (ug/Kg)	N	Standard Deviation (ug/Kg)	Average ug/Kg	Recovery %	% RSD	LCL	UCL	LWL	UWL
1,1-Dichloroethylene	2500	84	248.051	2488.75	99.55	9.97	69.78	129.32	79.71	119.39
Benzene	2500	84	149.346	2624.09	104.96	5.69	87.04	122.89	93.02	116.91
Trichloroethylene	2500	84	109.781	2528.98	101.16	4.34	87.99	114.33	92.38	109.94
Toluene	2500	84	196.609	2501.09	100.04	7.86	76.45	123.64	84.31	115.77
Chlorobenzene	2500	84	101.555	2572.67	102.91	3.95	90.72	115.09	94.78	111.03

			PRECISION*			RPD		
Compound		PAIRS	SD of RPDs	Average RPD		UCL		UWL
1,1-Dichloroethylene		42	1.763	2.30		5.29		3.53
Benzene		42	1.298	1.77		3.89		2.60
Trichloroethylene		42	1.631	2.06		4.89		3.26
Toluene		42	1.545	1.75		4.64		3.09
Chlorobenzene		42	1.370	1.83		4.11		2.74

***Precision is from in batch MS/MSD spike duplicates**

MS= Matrix Spike

MSD= Matrix Spike Duplicate

TV= True Value

N= Number of data points

RSD= Relative Standard Deviation

SD= Standard Deviation

RPD= Relative Percent Difference

LCL= Lower Control Limit

UCL= Upper Control Limit

LWL= Lower Warning Limit

UWL= Upper Warning Limit

MDEQ Environmental Laboratory

INORGANIC UNIT 2001 AC AND PC SUMMARY

			ACCURACY					PRECISION *		
	EPA		CONC	%RECOVERY			N	MC (ug/l)		N
ELEMENT	NO.	MATRIX	(ug/l)	MEAN	S.D.	RSD		MEAN	S.D.	
Aluminum	200.8/6020	water	50	95.5	13.4	14.0	300	48.5	5.6	371
Antimony	200.8/6020	water	50	114.4	6.9	6.0	374	52	6.3	371
Arsenic	200.8/6020	water	50	101.3	8	7.9	373	50	3.8	371
Barium	6010	TCLP	100	91.6	6.03	6.6	14	185.2	10.9	10
Barium	200.8/6020	water	50	96.8	7.3	7.5	372	49.7	5.2	371
Beryllium	200.8/6020	water	50	103.4	10.7	10.3	373	50.3	3.9	371
Boron	200.7/6010	water	100	101.8	4.95	4.9	159	102.6	4.51	225
Cadmium	6010	TCLP	100	88.7	2.12	2.4	9	163.1	5.52	7
Cadmium	200.8/6020	water	50	100.4	4.5	4.5	379	50.2	3.3	371
Chromium	6010	TCLP	500	94.3	5.4	5.7	11	234.3	8.88	8
Chromium	7190	water	50	100.3	6.17	6.2	206	40.4	1.22	18
Chromium	200.7/6010	water	50	99.5	6.7	6.7	13	50.1	3.38	13
Cobalt	200.8/6020	water	50	95.8	6.8	7.1	378	50	3.8	371
Copper	6010	TCLP	500	93.6	3.2	3.4	8	324.8	3.9	5
Copper (63)	200.8/6020	water	50	92.4	7	7.6	373	50.6	4.4	371
Copper (65)	200.8/6020	water	50	92.5	6.6	7.1	372	50.6	4.4	371
Hex Chrom.	7196	water	361	95.8	3.9	4.1	92	No Hexavalent Cr present		
Iron	200.7/6010	water	500	99.4	4.3	4.3	188	506.5	17.8	274
Lead	6010	TCLP	1000	95.3	6.3	6.6	11	460.6	18.8	7
Lead	200.8/6020	water	50	100.6	8.4	8.4	377	50.9	3.6	371
Lithium	200.7/6010	water	100	99.8	4.31	4.3	148	99.4	7.45	204
Manganese	200.7/6010	water	50	101.5	4.9	4.9	21	51.2	1.92	29
Manganese	200.8/6020	water	50	97.8	7.9	8.1	312	50	3.6	371
Mercury	7470	water	4	99.7	2.8	2.8	196	1.27	0.042	20
Low Level Mercury	1631	water	0.005	101.9	6.6	6.5	9	5.23	0.39	18
Low Level Mercury	1631	water	0.003	94.9	8.8	9.3	50	5.97	0.91	20
Molybdenum	200.8/6020	water	50	104.9	7.2	6.9	374	53	4.2	371
Nickel	6010	TCLP	500	88	11.5	13.1	6	316.8	1.3	4
Nickel	200.8/6020	water	50	93.4	7.6	8.1	374	49.9	3.9	371
Selenium	7740	water	50	98.7	5.3	5.4	206	22.9	0.92	23
Silver	200.8/6020	water	50	89	9.7	10.90	365	51.1	4.6	371
Strontium	200.8/6020	water	50	98	9.1	9.29	304	50.7	5.2	371
Thallium	200.8/6020	water	50	99.1	8.8	8.88	377	51	6.4	371
Titanium	200.8/6020	water	50	100	8.2	8.20	376	50.9	4.3	371
Vanadium	200.8/6020	water	50	101	7.2	7.13	378	50.2	3.5	371
Zinc	6010	TCLP	100	100.1	6.9	6.9	12	90.4	5	9
Zinc	200.8/6020	water	50	97.2	9.2	9.46	327	49.9	3.4	371

*Precision is based on samples of known concentration and indicates between run precision.

MDEQ Environmental Laboratory

INORGANIC UNIT 2001 AC AND PC SUMMARY

			ACCURACY					PRECISION *		
ELEMENT	EPA NO.	MATRIX	CONC (mg/l)	%RECOVERY MEAN	%RECOVERY S.D.	%RECOVERY RSD	N	MC (mg/l) MEAN	MC (mg/l) S.D.	N
Alkalinity #	310.2	water	100	93.2	4.05	4.3	179	251	5.15	47
Calcium	7140	water	30	101	6.11	6.1	202	26.6	0.69	107
Chloride #	375.2	water	100	99.3	2.11	2.1	236	50.4	0.51	64
Magnesium	7450	water	10	101.6	7.52	7.4	209	7.36	0.12	108
Oil & Grease	413.1	water	40	88	7.95	9.0	18	35.1	2.99	18
Potassium	7610	water	1.6	102.8	7.44	7.2	173	1.05	0.02	90
Sodium	7770	water	30	99.9	5.94	6.0	187	10.5	0.47	94
Sulfate #	325.2	water	100	99.6	2.93	2.9	224	49.4	1.27	67

*Precision is based on samples of known concentration and indicates between run precision.
#Precision is based on a blank spiked with a known conc./between run precision.

MDEQ Environmental Laboratory

INORGANIC UNIT 2001 AC AND PC SUMMARY

			ACCURACY					PRECISION *		
	EPA		CONC	%RECOVERY			N	NIST REF.(mg/kg)		N
ELEMENT	NO.	MATRIX	(ug/l)	MEAN	S.D.	RSD		MEAN	S.D.	
Aluminum	6010	sediment	2500	103.8	3.47	3.3	61	8912	477	21
Arsenic	7061	sediment	40	97.1	10.1	10.3	30	15.7	0.33	16
Arsenic	7060	sediment	5	92.3	7.7	8.3	87	6.73	0.42	41
Barium	6010	sediment	100	97.5	4.6	4.7	100	100.9	4.9	52
Beryllium	6010	sediment	50	97.6	3.4	3.5	41	0.64	0.037	22
Cadmium	7130	sediment	100	96.9	3.4	3.5	111	4.9	0.28	59
Chromium	6010	sediment	100	96.4	4.7	4.9	113	58.6	2.1	58
Cobalt	7200	sediment	500	94.2	4.3	4.6	45	8.4	0.4	24
Copper	7210	sediment	500	95.8	3.4	3.6	114	75.9	3.6	56
Iron	7380	sediment	2500	100.8	8.09	5.0	40	19300	1018	24
Lead	7420	sediment	500	95.6	3.3	3.5	113	121	8.6	52
Lithium	7430	sediment	100	97.3	2.9	3.0	38	16.3	0.5	22
Manganese	7460	sediment	100	98.6	5.4	5.5	44	355.3	10.4	26
Mercury	7471	sediment	4	99.8	5.3	5.3	101	1.42	0.063	36
Molybdenum	6010	sediment	100	92	5.5	6.0	49	2.1	0.6	25
Nickel	7520	sediment	500	94.8	4.4	4.6	111	34.9	1.4	58
Selenium	7741	sediment	40	91.1	9.4	10.3	32	1.36	0.08	17
Selenium	7740	sediment	5	90.8	6.42	7.1	70	1.13	0.16	34
Silver	7761	sediment	2	95.4	6.63	7.0	98	0.99	0.14	34
Strontium	6010	sediment	100	98	3.2	3.3	42	69.2	1.8	21
Thallium	7841	sediment	5	94.2	6.45	6.9	14	1.62	0.18	6
Titanium	6010	sediment	250	99.7	2.85	2.9	58	140.2	18.6	17
Vanadium	6010	sediment	100	95.4	3.3	3.5	37	21.7	0.95	18
Zinc	7950	sediment	500	95.5	3.77	4.0	112	258	8.9	56

*Precision is calculated from reference standards and indicates between run precision.

MDEQ Environmental Laboratory

INORGANIC UNIT 2001 AC AND PC SUMMARY

			ACCURACY					PRECISION *		
	EPA		CONC	% RECOVERY			N	OIL REF. (mg/kg)		N
ELEMENT	NO.	MATRIX	(ug/l)	MEAN	S.D.	RSD		MEAN	S.D.	
Arsenic	7061	organic	40	87.3	9.05	10.4	9	90.5	6.28	8
Barium	6010	organic	20	106	8.49	8.0	10	93.3	4.9	11
Cadmium	7130	organic	20	95	3.53	3.7	10	92.2	4.7	11
Copper	7210	organic	100	102.3	4.9	1.9	10	97.8	3.9	11
Chromium	6010	organic	20	100.5	6.47	6.4	10	100.3	3.5	11
Lead	7420	organic	100	95	4.9	5.2	10	95.5	3.5	11
Mercury	7471	organic	4	85.6	14.9	17.5	5	66.01	10.45	7
Nickel	7520	organic	20	101	4.46	4.4	10	97.7	3.8	11
Zinc	7950	organic	100	96.7	5.6	5.8	8	90.4	4	10

*Precision is calculated from reference standards and indicates between run precision.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX E

Drinking Water Laboratory Test List

QAPP-Ver2.0, Revison 0
May 5, 2003

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP
CAG	16.00	SILVER BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 5 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CAL	16.00	ALUMINUM BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 6 Rev. 07/18/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		ALUMINUM BY ICP/MS [# 001 Code: AL Rev: 07/18/96 R# 5]
		PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: NONE ESTABLISHED CAS: 7429-90-5
CAS	16.00	ARSENIC BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 7 Rev. 04/15/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		ARSENIC [# 002 Code: AS Rev: 04/15/97 R# 6]
		PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.01 mg/L REGULATORY MCL CAS: 7440-38-2
CB	16.00	BORON BY ICP/MS [Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 8 Rev. 07/21/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CBA	16.00	BARIUM BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 9 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		BARIUM [# 001 Code: BA Rev: 07/01/96 R# 7]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 2 mg/L REGULATORY MCL CAS: 7440-39-3
CBE	16.00	BERYLLIUM BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 10 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		BERYLLIUM [# 001 Code: BE Rev: 07/01/96 R# 8]
		PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.004 mg/L REGULATORY MCL CAS: 7440-41-7
CCA	18.00	CALCIUM BY FLAME AA [Ref.: SM3111A-B]
		Sample Kit: 32, 33 Holding Limit: 180 days Lab Group: METALS [Rec# 11 Rev. 04/15/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		CALCIUM [# 002 Code: CA Rev: 04/15/97 R# 9]
		PQL: 0.3 mg/L Min DL: 0.3 mg/L RMCL: NONE ESTABLISHED CAS: 7440-70-2

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP

CCD 16.00 CADMIUM BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 13 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CADMIUM [# 001 Code: CD Rev: 07/01/96 R# 10]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 7440-43-9

CCR 16.00 CHROMIUM BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 19 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CHROMIUM [# 001 Code: CR Rev: 07/01/96 R# 15]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 7440-47-3

CCU 6.00 COPPER BY ICP/MS [Ref.: EPA 200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 20 Rev. 11/01/01]

REPORTED ANALYTES FOR TEST PROCEDURE:

COPPER [# 001 Code: CU Rev: 11/01/01 R# 16]
PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: NONE ESTABLISHED CAS: 7440-50-8

CFE 5.00 IRON BY ICP/MS [Ref.: EPA 200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 25 Rev. 11/01/01]

REPORTED ANALYTES FOR TEST PROCEDURE:

IRON [# 001 Code: FE Rev: 11/01/01 R# 24]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6

CHG 16.00 MERCURY TESTING BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 28 days Lab Group: METALS [Rec# 27 Rev. 04/16/97]

REPORTED ANALYTES FOR TEST PROCEDURE:

MERCURY [# 002 Code: HG Rev: 04/16/97 R# 26]
PQL: 0.0001 mg/L Min DL: 0.0001 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7439-97-6

CK 13.00 POTASSIUM BY FLAME AA [Ref.: SM3500KD]
Sample Kit: 32, 33 Holding Limit: 180 days Lab Group: METALS [Rec# 29 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

POTASSIUM [# 001 Code: K Rev: 07/01/96 R# 28]
PQL: 0.03 mg/L Min DL: 0.03 mg/L RMCL: NONE ESTABLISHED CAS: 7440-09-7

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP
CMAS	12.00	ARSENIC BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 30 Rev. 05/05/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CMCU	5.00	COPPER BY ICP/MS [Ref.: EPA 200.8]
		Sample Kit: 36CC Holding Limit: 180 days Lab Group: METALS [Rec# 31 Rev. 01/04/00]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		COPPER [# 001 Code: CU Rev: 01/04/00 R# 29]
		PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: NONE ESTABLISHED CAS: 7440-50-8
CMG	5.00	MAGNESIUM BY FLAME AA [Ref.: SM3111A-B]
		Sample Kit: 32, 33 Holding Limit: 180 days Lab Group: METALS [Rec# 32 Rev. 04/16/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		MAGNESIUM [# 002 Code: MG Rev: 04/16/97 R# 30]
		PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7439-95-4
CMN	4.00	MANGANESE BY ICP/MS [Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 33 Rev. 11/01/01]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		MANGANESE [# 001 Code: MN Rev: 11/01/01 R# 31]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-96-5
CMPB	12.00	LEAD BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 34 Rev. 05/05/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CNA	5.00	SODIUM BY FLAME AA [Ref.: SM3500-NAD]
		Sample Kit: 32, 33 Holding Limit: 180 days Lab Group: METALS [Rec# 35 Rev. 04/16/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		SODIUM [# 002 Code: NA Rev: 04/16/97 R# 33]
		PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7440-23-5
CNI	16.00	NICKEL BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 37 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		NICKEL [# 001 Code: NI Rev: 07/01/96 R# 35]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 7440-02-0

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP
CPB	16.00	LEAD (TOTAL) BY ICP/MS [Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 40 Rev. 12/10/99]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		LEAD BY ICP/MS [# 001 Code: PB Rev: 12/10/99 R# 38]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 7439-92-1
CPM1	20.00	IRON/MANGANESE/COPPER/ZINC BY ICP/MS [Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 42 Rev. 01/14/02]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		COPPER [# 004 Code: CU Rev: 01/14/02 R# 40]
		PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: NONE ESTABLISHED CAS: 7440-50-8
		IRON [# 003 Code: FE Rev: 01/14/02 R# 41]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6
		MANGANESE [# 002 Code: MN Rev: 01/14/02 R# 42]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-96-5
		ZINC [# 001 Code: ZN Rev: 01/14/02 R# 43]
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7440-66-6
CPM2	18.00	CALCIUM/MAGNESIUM/SODIUM BY FLAME AA [Ref.: SM3111B, SM3500]
		Sample Kit: 32, 33 Holding Limit: 180 days Lab Group: METALS [Rec# 43 Rev. 07/01/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		CALCIUM [# 001 Code: CA Rev: 07/01/97 R# 44]
		PQL: 0.3 mg/L Min DL: 0.3 mg/L RMCL: NONE ESTABLISHED CAS: 7440-70-2
		MAGNESIUM [# 002 Code: MG Rev: 07/01/97 R# 45]
		PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7439-95-4
		SODIUM [# 003 Code: NA Rev: 07/01/97 R# 46]
		PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7440-23-5
CSB	16.00	ANTIMONY BY ICP/MS [Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 48 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		ANTIMONY [# 001 Code: SB Rev: 07/01/96 R# 63]
		PQL: 0.0006 mg/L Min DL: 0.0006 mg/L RMCL: 0.006 mg/L REGULATORY MCL CAS: 7440-36-0

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP

CSE 16.00 SELENIUM BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 49 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

SELENIUM [# 001 Code: SE Rev: 07/01/96 R# 64]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.05 mg/L REGULATORY MCL CAS: 7782-49-2

CSN 16.00 TIN BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 52 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

TIN [# 001 Code: SN Rev: 07/01/96 R# 67]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 7440-31-5

CSR 16.00 STRONTIUM BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 53 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

STRONTIUM [# 001 Code: SR Rev: 07/01/96 R# 68]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7440-24-6

CTL 16.00 THALLIUM BY ICP/MS [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 56 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

THALLIUM [# 001 Code: TL Rev: 07/01/96 R# 71]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7440-28-0

CTURA 0.00 Turbidity for Acidified Samples [Ref.: EPA180.1]
Sample Kit: 36ME 36C Holding Limit: NONE Lab Group: METALS [Rec# 58 Rev. 11/30/99]

REPORTED ANALYTES FOR TEST PROCEDURE:

TURBIDITY FOR ACIDIFIED SAMPLES [# 001 Code: CTURA Rev: 11/30/99 R# 73]
PQL: 1 NTU Min DL: 1 NTU RMCL: NONE ESTABLISHED CAS:

CU 16.00 URANIUM [Ref.: EPA200.8]
Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS [Rec# 59 Rev. 11/03/98]

REPORTED ANALYTES FOR TEST PROCEDURE:

URANIUM [# 001 Code: U Rev: 11/03/98 R# 74]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.03 mg/L REGULATORY MCL CAS: 7440-61-1

TEST CODE	TEST FEE	METHOD INFORMATION - METALS LAB GROUP	
CU-235	16.00	URANIUM 235	[Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS	[Rec# 60 Rev. 06/26/01]
		REPORTED ANALYTES FOR TEST PROCEDURE:	
CU235	16.00	URANIUM 235	[Ref.: EPA200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS	[Rec# 61 Rev. 05/10/01]
		REPORTED ANALYTES FOR TEST PROCEDURE:	
CV	16.00	VANADIUM	[Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS	[Rec# 62 Rev. 01/24/03]
		REPORTED ANALYTES FOR TEST PROCEDURE:	
		VANADIUM [# 001 Code: V Rev: 01/24/03 R# 75]	
		PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED	CAS: 7440-62-2
CZN	5.00	ZINC BY ICP/MS	[Ref.: EPA 200.8]
		Sample Kit: 36ME Holding Limit: 180 days Lab Group: METALS	[Rec# 82 Rev. 11/01/01]
		REPORTED ANALYTES FOR TEST PROCEDURE:	
		ZINC [# 001 Code: ZN Rev: 11/01/01 R# 296]	
		PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED	CAS: 7440-66-6

TEST CODE	TEST FEE	METHOD INFORMATION - INORG LAB GROUP
CCARB	10.00	CARBONATE AS CaCO3 BY TITRATION [Ref.: EPA310.1]
		Sample Kit: 32 Holding Limit: ASAP Lab Group: INORG [Rec# 12 Rev. 05/09/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CCHS	30.00	HYDROGEN SULFIDE BY TITRATION [Ref.: SM4500-S-D]
		Sample Kit: 36HS Holding Limit: 28 days Lab Group: INORG [Rec# 14 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		HYDROGEN SULFIDE (QUANT) [# 001 Code: CHS Rev: 07/01/96 R# 11]
		PQL: 1 mg/L Min DL: 1 mg/L RMCL: NONE ESTABLISHED CAS: 7783-06-4
CCL2	0.00	RESIDUAL CHLORINE [Ref.:]
		Sample Kit: 32 Holding Limit: ASAP Lab Group: INORG [Rec# 15 Rev. 05/13/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CCLO4	75.00	PERCHLORATE [Ref.: EPA 314.0]
		Sample Kit: 32 Holding Limit: 28 days Lab Group: INORG [Rec# 16 Rev. 08/21/00]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		PERCHLORATE [# 001 Code: CLO4 Rev: 08/21/00 R# 12]
		PQL: 0.004 mg/L Min DL: 0.004 mg/L RMCL: NONE ESTABLISHED CAS: 14797-73-0
CCN	25.00	CYANIDE BY DISTILLATION/COLORIMETRY [Ref.: EPA335.2]
		Sample Kit: 36CN(a) Holding Limit: 14 days Lab Group: INORG [Rec# 17 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		CYANIDE [# 001 Code: CN Rev: 07/01/96 R# 13]
		PQL: 0.02 mg/L Min DL: 0.02 mg/L RMCL: 0.2 mg/L REGULATORY MCL CAS: 57-12-5
CCON	12.00	SPECIFIC CONDUCTANCE [Ref.: EPA120.1]
		Sample Kit: 32,33 Holding Limit: 28 days Lab Group: INORG [Rec# 18 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		CONDUCTIVITY [# 001 Code: CON Rev: 07/01/96 R# 14]
		PQL: 1 umhos Min DL: 1 umhos RMCL: NONE ESTABLISHED CAS: COND-00-C
CD	13.00	TBAS SCREENING [Ref.: IN-HOUSE]
		Sample Kit: 32 Holding Limit: 24 days Lab Group: INORG [Rec# 21 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		TBAS SCREENING [# 001 Code: D Rev: 07/01/96 R# 17]
		PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: CD-00-C

TEST CODE	TEST FEE	METHOD INFORMATION - INORG LAB GROUP

CDBP 75.00 INORGANIC DISINFECTION BYPRODUCTS [Ref.: EPA 300.1]
Sample Kit: 32a Holding Limit: 14 days Lab Group: INORG [Rec# 22 Rev. 08/21/00]

REPORTED ANALYTES FOR TEST PROCEDURE:

BROMIDE [# 003 Code: BR Rev: 08/21/00 R# 18]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS:

BROMATE [# 002 Code: BRO3 Rev: 08/21/00 R# 19]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: 0.01 mg/L MCL CAS:

CHLORITE [# 001 Code: CLO2 Rev: 08/21/00 R# 20]
PQL: 0.006 mg/L Min DL: 0.006 mg/L RMCL: 1.0 mg/L MCL CAS:

CHLORATE [# 004 Code: CLO3 Rev: 08/21/00 R# 21]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS:

CFDY 17.00 FLUORESCENT DYE (PRESENCE/ABSENCE) [Ref.: MDEQ]
Sample Kit: 36FY Holding Limit: 24 days Lab Group: INORG [Rec# 24 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

FLUORESCENT DYE (QUAL.) [# 001 Code: FDY Rev: 07/01/96 R# 23]
PQL: Min DL: RMCL: NONE ESTABLISHED CAS: FDY-00-C

CH2S 23.00 HYDROGEN SULFIDE (PRESENCE/ABSENCE) [Ref.: IN-HOUSE]
Sample Kit: 32 Holding Limit: 24 days Lab Group: INORG [Rec# 26 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

HYDROGEN SULFIDE (QUAL.) [# 001 Code: H2S Rev: 07/01/96 R# 25]
PQL: Min DL: RMCL: NONE ESTABLISHED CAS: 7783-06-4

CNH3 30.00 AMMONIA BY SPECIFIC ION ELECTRODE [Ref.: SM4500NH3-F]
Sample Kit: 36AC Holding Limit: 28 days Lab Group: INORG [Rec# 36 Rev. 04/01/97]

REPORTED ANALYTES FOR TEST PROCEDURE:

AMMONIA as N [# 001 Code: NH3 Rev: 07/01/96 R# 34]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7664-41-7

CPH 13.00 PH DETERMINATION [Ref.: EPA150.1]
Sample Kit: 32, 33 Holding Limit: ASAP Lab Group: INORG [Rec# 41 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

pH [# 001 Code: PH Rev: 07/01/96 R# 39]
PQL: 2.0 Min DL: 2.0 RMCL: NONE ESTABLISHED CAS: PH-00-C

TEST CODE	TEST FEE	METHOD INFORMATION - INORG LAB GROUP

CPO4 17.00 PHOSPHATE,ORTHO- TESTING BY COLORIMETRY [Ref.: SM4500P-E]
Sample Kit: 32, 33 Holding Limit: 2 days Lab Group: INORG [Rec# 44 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

ORTHO-PHOSPHATE AS P [# 001 Code: PO4 Rev: 07/01/96 R# 47]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7664-38-2

CRA 14.00 AUTOMATED PARTIAL CHEMICAL BATTERY [Ref.: SM4500NO3H, SM3]
Sample Kit: 32 Holding Limit: 2 days Lab Group: INORG [Rec# 45 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

FLUORIDE (AUTOMATED) [# 005 Code: AF Rev: 07/01/96 R# 48]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: 4.0 mg/L REGULATORY MCL CAS: 16984-48-8

IRON (AUTOMATED) [# 007 Code: AFE Rev: 07/01/96 R# 49]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6

HARDNESS AS CaCO3 [# 006 Code: AHA Rev: 07/01/96 R# 50]
PQL: 10 mg/L Min DL: 10 mg/L RMCL: NONE ESTABLISHED CAS: HARD-00-C

SODIUM (AUTOMATED) [# 009 Code: ANA Rev: 07/01/96 R# 51]
PQL: 5 mg/L Min DL: 5 mg/L RMCL: NONE ESTABLISHED CAS: 7440-23-5

CHLORIDE (AUTOMATED) [# 004 Code: CL Rev: 07/01/96 R# 52]
PQL: 4 mg/L Min DL: 4 mg/L RMCL: NONE ESTABLISHED CAS: 7647-14-5

NITRITE AS N (AUTOMATED) [# 003 Code: NO2 Rev: 07/01/96 R# 53]
PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: 1 mg/L REGULATORY MCL CAS: 14797-65-0

NITRATE AS N (AUTOMATED) [# 001 Code: NO3 Rev: 07/01/96 R# 54]
PQL: 0.4 mg/L Min DL: 0.4 mg/L RMCL: 10 mg/L REGULATORY MCL CAS: 14797-55-8

SULFATE (AUTOMATED) [# 008 Code: SO4 Rev: 07/01/96 R# 55]
PQL: 5 mg/L Min DL: 5 mg/L RMCL: NONE ESTABLISHED CAS: 14808-79-8

CRES 10.00 RESISTANCE FOR DEMINERALIZED WATER [Ref.: EPA 120.1]
Sample Kit: 32,33 Holding Limit: ASAP Lab Group: INORG [Rec# 46 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

RESISTANCE [# 001 Code: RES Rev: 07/01/96 R# 56]
PQL: 1 ohms Min DL: 1 ohms RMCL: NONE ESTABLISHED CAS: RES-00-C

TEST CODE	TEST FEE	METHOD INFORMATION - INORG LAB GROUP

CRM 14.00 AUTOMATED CHEMISTRY FOR COMPLETE MINERALS [Ref.: EPA335.2, SM350]
Sample Kit: 33 Holding Limit: 2 days Lab Group: INORG [Rec# 47 Rev. 05/05/97]

REPORTED ANALYTES FOR TEST PROCEDURE:

FLUORIDE (AUTOMATED) [# 004 Code: AF Rev: 05/05/97 R# 57]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: 4.0 mg/L REGULATORY MCL CAS: 16984-48-8

HARDNESS AS CaCO3 [# 005 Code: AHA Rev: 05/05/97 R# 58]
PQL: 10 mg/L Min DL: 10 mg/L RMCL: NONE ESTABLISHED CAS: HARD-00-C

CHLORIDE (AUTOMATED) [# 003 Code: CL Rev: 05/05/97 R# 59]
PQL: 4 mg/L Min DL: 4 mg/L RMCL: NONE ESTABLISHED CAS: 7647-14-5

NITRITE AS N (AUTOMATED) [# 002 Code: NO2 Rev: 05/05/97 R# 60]
PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: 1 mg/L REGULATORY MCL CAS: 14797-65-0

NITRATE AS N (AUTOMATED) [# 001 Code: NO3 Rev: 05/05/97 R# 61]
PQL: 0.4 mg/L Min DL: 0.4 mg/L RMCL: 10 mg/L REGULATORY MCL CAS: 14797-55-8

SULFATE (AUTOMATED) [# 006 Code: SO4 Rev: 05/05/97 R# 62]
PQL: 5 mg/L Min DL: 5 mg/L RMCL: NONE ESTABLISHED CAS: 14808-79-8

CSI 14.00 SILICA AS SIO2 BY COLORIMETRY [Ref.: SM4500SIO2-C]
Sample Kit: 32,33 Holding Limit: 28 days Lab Group: INORG [Rec# 50 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

SILICA AS SiO2 [# 001 Code: SI Rev: 07/01/96 R# 65]
PQL: 0.2 mg/L Min DL: 0.2 mg/L RMCL: NONE ESTABLISHED CAS: 7440-21-3

CTALK 16.00 TOTAL ALKALINITY AS CaCO3 BY TITRATION [Ref.: SM2320 B]
Sample Kit: 32, 33 Holding Limit: 14 days Lab Group: INORG [Rec# 54 Rev. 05/15/97]

REPORTED ANALYTES FOR TEST PROCEDURE:

TOTAL ALKALINITY AS CaCO3 [# 001 Code: TOTAL AL Rev: 05/15/97 R# 69]
PQL: 1 mg/L Min DL: 1 mg/L RMCL: NONE ESTABLISHED CAS: TALK-00-C

CTAN 11.00 TANNATES (PRESENCE/ABSENCE) [Ref.: IN-HOUSE]
Sample Kit: 32 Holding Limit: ASAP Lab Group: INORG [Rec# 55 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

TANNATES(QUAL) [# 001 Code: TAN Rev: 07/01/96 R# 70]
PQL: Min DL: RMCL: NONE ESTABLISHED CAS: 1401-55-4

TEST CODE	TEST FEE	METHOD INFORMATION - INORG LAB GROUP	
CTOC	30.00	TOTAL ORGANIC CARBON	[Ref.: SM 5310C]
		Sample Kit: 36TO Holding Limit: 28 days Lab Group: INORG	[Rec# 57 Rev. 08/22/00]
		REPORTED ANALYTES FOR TEST PROCEDURE:	
		TOTAL ORGANIC CARBON	[# 001 Code: TOC Rev: 08/22/00 R# 72]
		PQL: 0.5 mg/L Min DL: 0.5 mg/L RMCL: NONE ESTABLISHED	CAS: TOC-00-C

TEST CODE	TEST FEE	METHOD INFORMATION - VOC LAB GROUP

CXEV 70.00 EDB AND DBCP BY ECD [Ref.: EPA504.1]
Sample Kit: 36VO Holding Limit: 28 days Lab Group: VOC [Rec# 68 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

DIBROMO-3-CHLOROPROPANE, 1,2- [# 002 Code: DBCP Rev: 07/01/96 R# 95]
PQL: 0.00005 mg/L Min DL: 0.00005 mg/L RMCL: 0.0002 mg/L REGULATORY MCL
CAS: 96-12-8

DIBROMOETHANE, 1,2 [# 001 Code: EDB Rev: 07/01/96 R# 96]
PQL: 0.00005 mg/L Min DL: 0.00005 mg/L RMCL: 0.00005 mg/L REGULATORY MCL
CAS: 106-93-4

CXMP 55.00 MAX POTENTIAL TTHM FORMATION BY GC/MS [Ref.: EPA524.2]
Sample Kit: 36VOc Holding Limit: 7 days Lab Group: VOC [Rec# 74 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

MPF CHLORODIBROMOMETHANE [# 003 Code: CHBR2CL Rev: 07/01/96 R# 133]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.1000 mg/L REGULATORY MCL
CAS: 124-48-1

MPF BROMOFORM [# 004 Code: CHBR3 Rev: 07/01/96 R# 134]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.1000 mg/L REGULATORY MCL
CAS: 75-25-2

MPF DICHLOROBROMOMETHANE [# 002 Code: CHBRCL2 Rev: 07/01/96 R# 135]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.1000 mg/L REGULATORY MCL
CAS: 75-27-4

MPF CHLOROFORM [# 001 Code: CHCL3 Rev: 07/01/96 R# 136]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.1000 mg/L REGULATORY MCL
CAS: 67-66-3

MAX POTENTIAL TRIHALOMETHANES [# 005 Code: TTHM Rev: 07/01/96 R# 137]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.1000 mg/L REGULATORY MCL
CAS: MPTHM-00-C

CXPD 115.00 P-DIOXANE BY ITD - MAGNUM [Ref.: IN-HOUSE]
Sample Kit: 36VO Holding Limit: 14 days Lab Group: VOC [Rec# 77 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

DIOXANE,1,4- [# 001 Code: PDIOXANE Rev: 07/01/96 R# 160]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 123-91-1

CXTM 55.00 TOTAL TRIHALOMETHANE MONITORING [Ref.: EPA524.2]
Sample Kit: 36VO Holding Limit: 14 days Lab Group: VOC [Rec# 80 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CHLORODIBROMOMETHANE [# 003 Code: CHBR2CL Rev: 07/01/96 R# 228]

PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 124-48-1

BROMOFORM [# 004 Code: CHBR3 Rev: 07/01/96 R# 229]

PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 75-25-2

TEST CODE | TEST FEE | METHOD INFORMATION - VOC | LAB GROUP

CXTM (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

DICHLOROBROMOMETHANE [# 002 Code: CHBRCL2 Rev: 07/01/96 R# 230]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 75-27-4

CHLOROFORM [# 001 Code: CHCL3 Rev: 07/01/96 R# 231]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 67-66-3

TOTAL TRIHALOMETHANES [# 005 Code: TTHM Rev: 07/01/96 R# 232]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: TTHM-00-C

CXVO 90.00 ORGANIC SOLVENTS BY GC/MS [Ref.: EPA524.2]
Sample Kit: 36VO Holding Limit: 14 days Lab Group: VOC [Rec# 81 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

BROMOBENZENE [# 039 Code: BRBZ Rev: 07/01/96 R# 233]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 108-86-1

BENZENE [# 038 Code: BZ Rev: 07/01/96 R# 234]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 71-43-2

DICHLOROETHYLENE,1,2-CIS [# 016 Code: C12DCE Rev: 07/01/96 R# 235]
PQL: 0.0004 mg/L Min DL: 0.0002 mg/L RMCL: 0.07 mg/L REGULATORY MCL CAS: 156-59-2

DICHLOROPROPENE,1,3-CIS [# 035 Code: C13DCPE Rev: 07/01/96 R# 236]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 10061-01-5

HEXACHLOROBUTADIENE [# 024 Code: C46 Rev: 07/01/96 R# 237]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 87-68-3

CARBON TETRACHLORIDE [# 004 Code: CCL4 Rev: 07/01/96 R# 238]
PQL: 0.0004 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 56-23-5

DICHLORODIFLUOROMETHANE [# 012 Code: CF2CL2 Rev: 07/01/96 R# 239]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 75-71-8

FLUOROTRICHLOROMETHANE [# 023 Code: CFCL3 Rev: 07/01/96 R# 240]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 75-69-4

DIBROMOMETHANE [# 010 Code: CH2BR2 Rev: 07/01/96 R# 241]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 74-95-3

BROMOCHLOROMETHANE [# 001 Code: CH2BRCL Rev: 07/01/96 R# 242]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 74-97-5

TEST CODE	TEST FEE	METHOD INFORMATION - VOC	LAB GROUP
CXVO		(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

METHYLENE CHLORIDE [# 026 Code: CH2CL2 Rev: 07/01/96 R# 243]
PQL: 0.0006 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 75-09-2

BROMOMETHANE [# 003 Code: CH3BR Rev: 07/01/96 R# 244]
PQL: 0.001 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 74-83-9

CHLORODIBROMOMETHANE [# 006 Code: CHBR2CL Rev: 07/01/96 R# 245]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 124-48-1

BROMOFORM [# 002 Code: CHBR3 Rev: 07/01/96 R# 246]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 75-25-2

DICHLOROBROMOMETHANE [# 011 Code: CHBRCL2 Rev: 07/01/96 R# 247]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 75 27 4

CHLOROFORM [# 008 Code: CHCL3 Rev: 07/01/96 R# 248]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: 67-66-3

CHLOROBENZENE [# 005 Code: CLBZ Rev: 07/01/96 R# 249]
PQL: 0.0005 mg/L Min DL: 0.0003 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 108-90-7

CHLOROTOLUENE (COMBINED) [# 043 Code: CLTOL4 Rev: 07/01/96 R# 250]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 100-44-7

DICHLOROBENZENE,1,2- [# 048 Code: DCBZ12 Rev: 07/01/96 R# 251]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.6 mg/L REGULATORY MCL CAS: 95-50-1

DICHLOROBENZENE,1,3- [# 047 Code: DCBZ13 Rev: 07/01/96 R# 252]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 541-73-1

DICHLOROBENZENE,1,4- [# 046 Code: DCBZ14 Rev: 07/01/96 R# 253]
PQL: 0.0004 mg/L Min DL: 0.0003 mg/L RMCL: 0.075 mg/L REGULATORY MCL CAS: 106-46-7

DICHLOROETHYLENE,1,1- [# 015 Code: DCE11 Rev: 07/01/96 R# 254]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.007 mg/L REGULATORY MCL CAS: 75-35-4

DICHLOROETHANE,1,1- [# 013 Code: DCEA11 Rev: 07/01/96 R# 255]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 75-34-3

DICHLOROETHANE,1,2- [# 014 Code: DCEA12 Rev: 07/01/96 R# 256]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 107-06-2

DICHLOROPROPANE,1,2- [# 018 Code: DCPA12 Rev: 07/01/96 R# 257]
PQL: 0.0004 mg/L Min DL: 0.0002 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 78-87 5

TEST CODE | TEST FEE | METHOD INFORMATION - VOC | LAB GROUP

CXVO (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

DICHLOROPROPANE,1,3- [# 019 Code: DCPA13 Rev: 07/01/96 R# 258]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 142-28-9

DICHLOROPROPANE,2,2- [# 020 Code: DCPA22 Rev: 07/01/96 R# 259]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 590-20-7

DICHLOROPROPENE,1,1- [# 021 Code: DCPE11 Rev: 07/01/96 R# 260]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 563-58-6

ETHYLBENZENE [# 049 Code: ETBZ Rev: 07/01/96 R# 261]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.7 mg/L REGULATORY MCL CAS: 100-41-4

CHLOROETHANE [# 007 Code: ETCL Rev: 07/01/96 R# 262]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 75-00-3

ISOPROPYL BENZENE [# 053 Code: IPRBZ Rev: 07/01/96 R# 263]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 98-82-8

ISOPROPYL TOLUENE, PARA- [# 057 Code: IPRTOL Rev: 07/01/96 R# 264]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 99-87-6

CHLOROMETHANE [# 009 Code: MECL Rev: 07/01/96 R# 265]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 74-87-3

METHYL ETHYL KETONE [# 050 Code: MEK Rev: 07/01/96 R# 266]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 78-93-3

METHYL ISOBUTYL KETONE [# 051 Code: MIBK Rev: 07/01/96 R# 267]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 108-10-1

METHYL TERT-BUTYL ETHER [# 065 Code: MTBE Rev: 07/01/96 R# 268]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1634-04-4

NAPHTHALENE [# 052 Code: NAPH Rev: 07/01/96 R# 269]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 91-20-3

BUTYLBENZENE, NORMAL- [# 042 Code: NBUBZ Rev: 07/01/96 R# 270]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 104-51-8

NITROBENZENE [# 067 Code: NBZ Rev: 07/01/96 R# 271]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 98-95-3

PROPYLBENZENE, NORMAL- [# 054 Code: NPRBZ Rev: 07/01/96 R# 272]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 103-65-1

TEST CODE | TEST FEE | METHOD INFORMATION - VOC | LAB GROUP

CXVO (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

TETRACHLOROETHYLENE [# 029 Code: PCE Rev: 07/01/96 R# 273]
PQL: 0.0005 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 127-18-4

BUTYLBENZENE, SEC- [# 041 Code: SBUBZ Rev: 07/01/96 R# 274]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 135-98-8

STYRENE [# 055 Code: STYRN Rev: 07/01/96 R# 275]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 100-42-5

DICHLOROETHYLENE,1,2-TRANS [# 017 Code: T12DCE Rev: 07/01/96 R# 276]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 156-60-5

DICHLOROPROPENE,1,3-TRANS [# 036 Code: T13DCPE Rev: 07/01/96 R# 277]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 10061-02-6

BUTYLBENZENE, TERT- [# 040 Code: TBUBZ Rev: 07/01/96 R# 278]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 98-06-6

TRICHLOROBENZENE,1,2,3- [# 059 Code: TCBZ123 Rev: 07/01/96 R# 279]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 87-61-6

TRICHLOROBENZENE,1,2,4- [# 058 Code: TCBZ124 Rev: 07/01/96 R# 280]
PQL: 0.0005 mg/L Min DL: 0.0003 mg/L RMCL: 0.07 mg/L REGULATORY MCL CAS: 120-82-1

TRICHLOROETHYLENE [# 033 Code: TCE Rev: 07/01/96 R# 281]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 79-01-6

TETRACHLOROETHANE,1,1,1,2- [# 027 Code: TCE1112 Rev: 07/01/96 R# 282]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 630-20-6

TETRACHLOROETHANE,1,1,2,2- [# 028 Code: TCE1122 Rev: 07/01/96 R# 283]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 79-34-5

TRICHLOROETHANE,1,1,1- [# 031 Code: TCEA111 Rev: 07/01/96 R# 284]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 0.2 mg/L REGULATORY MCL CAS: 71-55-6

TRICHLOROETHANE,1,1,2- [# 032 Code: TCEA112 Rev: 07/01/96 R# 285]
PQL: 0.0005 mg/L Min DL: 0.0004 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 79-00-5

TRICHLOROPROPANE,1,2,3- [# 034 Code: TCPA123 Rev: 07/01/96 R# 286]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 96-18-4

TETRAHYDROFURAN [# 066 Code: THF Rev: 07/01/96 R# 287]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 109-99-9

TEST CODE | TEST FEE | METHOD INFORMATION - VOC | LAB GROUP

CXVO (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

TRIMETHYLBENZENE,1,2,4- [# 060 Code: TMBZ124 Rev: 07/01/96 R# 288]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 95-63-6

TRIMETHYLBENZENE,1,3,5- [# 061 Code: TMBZ135 Rev: 07/01/96 R# 289]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 108-67-8

TOLUENE [# 056 Code: TOL Rev: 07/01/96 R# 290]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 1 mg/L REGULATORY MCL CAS: 108-88-3

TOTAL TRIHALOMETHANES [# 030 Code: TTHM Rev: 07/01/96 R# 291]
PQL: 0.0005 mg/L Min DL: 0.0002 mg/L RMCL: 0.080 mg/L REGULATORY MCL CAS: TTHM-00-C

VINYL CHLORIDE [# 037 Code: VC Rev: 07/01/96 R# 292]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 75-01-4

XYLENES (TOTAL) [# 064 Code: XYLENS Rev: 07/01/96 R# 293]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 10 mg/L REGULATORY MCL CAS: 1330-20-7

XYLENE,META-&PARA- [# 062 Code: XYLMP Rev: 07/01/96 R# 294]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 10 mg/L REGULATORY MCL CAS: 1330-20-7

XYLENE, ORTHO- [# 063 Code: XYLO Rev: 07/01/96 R# 295]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: 10 mg/L REGULATORY MCL CAS: 95-47-6

TEST CODE	TEST FEE	METHOD INFORMATION - SOC LAB GROUP

CDCPA 95.00 TOTAL DCPA, mono and di-acid degradates [Ref.: EPA 515.4]
Sample Kit: 36NV Holding Limit: 14 days Lab Group: SOC [Rec# 23 Rev. 06/05/01]

REPORTED ANALYTES FOR TEST PROCEDURE:

TOTAL DCPA, MONO & DI-ACID DEGRADATES [# 001 Code: DCPA Rev: 06/05/01 R# 22]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1861-32-1

CXAC 150.00 ACIDIC PHENOLS BY ITD [Ref.: IN-HOUSE]
Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 63 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CHLORO-M-CRESOL,4- [# 001 Code: CLMCRL4 Rev: 07/01/96 R# 76]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 1321-10-4

CHLOROPHENOL,2- [# 002 Code: CLPHL2 Rev: 07/01/96 R# 77]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 95-57-8

CHLOROPHENOL,3- [# 003 Code: CLPHL3 Rev: 07/01/96 R# 78]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 108-43-0

DICHLOROPHENOL,3,5- [# 007 Code: DCLPHL35 Rev: 07/01/96 R# 79]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 591-35-5

DICHLOROPHENOL,2,4- [# 004 Code: DCPHL24 Rev: 07/01/96 R# 80]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 120-83-2

DICHLOROPHENOL,2,5- [# 005 Code: DCPHL25 Rev: 07/01/96 R# 81]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 583-78-8

DICHLOROPHENOL,3,4- [# 006 Code: DCPHL34 Rev: 07/01/96 R# 82]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 95-77-2

DIMETHYLPHENOL,2,3- [# 008 Code: DMPHL23 Rev: 07/01/96 R# 83]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 526-75-0

DIMETHYLPHENOL,2,4- [# 009 Code: DMPHL24 Rev: 07/01/96 R# 84]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 105-67-9

DIMETHYLPHENOL,2,5- [# 010 Code: DMPHL25 Rev: 07/01/96 R# 85]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 95-87-4

ETHYLPHENOL [# 013 Code: ETPHL Rev: 07/01/96 R# 86]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 90-00-6

ISOPHORONE [# 014 Code: IPHOR Rev: 07/01/96 R# 87]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 78-59-1

NITRO-P-CRESOL,2- [# 015 Code: NOPCRL2 Rev: 07/01/96 R# 88]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 119-33-5

TEST CODE | TEST FEE | METHOD INFORMATION - SOC LAB GROUP

CXAC (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

NITROPHENOL,2- [# 016 Code: NOPHL2 Rev: 07/01/96 R# 89]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 88-75-5

NITROPHENOL,4- [# 017 Code: NOPHL4 Rev: 07/01/96 R# 90]
PQL: 0.02 mg/L Min DL: 0.02 mg/L RMCL: NONE ESTABLISHED CAS: 100-02-7

PHENOL [# 019 Code: PHL Rev: 07/01/96 R# 91]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 108-95-2

TRICHLOROPHENOL,2,4,6- [# 020 Code: TCP246 Rev: 07/01/96 R# 92]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 88-06-2

CXBN 80.00 AROMATIC AMINES BY ECD [Ref.: IN-HOUSE]
Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 64 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CXDQ 150.00 DIQUAT BY HPLC [Ref.: EPA549.2]
Sample Kit: 36DQ Holding Limit: 7 days Lab Group: SOC [Rec# 65 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

DIQUAT [# 001 Code: DIQUAT Rev: 07/01/96 R# 93]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.02 mg/L REGULATORY MCL CAS: 2764-72-9

CXEN 150.00 ENDOTHALL BY GC/ITD [Ref.: EPA548.1]
Sample Kit: 36EN Holding Limit: 7 days Lab Group: SOC [Rec# 66 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

ENDOTHALL [# 001 Code: ENDOTHAL Rev: 07/01/96 R# 94]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 129-67-9

CXET 80.00 HALOGENATED ETHERS BY ITD [Ref.: IN-HOUSE]
Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 67 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

TEST CODE	TEST FEE	METHOD INFORMATION - SCC LAB GROUP

CXGY 100.00 GLYPHOSATE BY HPLC/PCD [Ref.: EPA547]
Sample Kit: 36GY Holding Limit: 14 days Lab Group: SOC [Rec# 69 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

GLYPHOSATE [# 001 Code: GLYFOSAT Rev: 07/01/96 R# 97]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: 0.7 mg/L REGULATORY MCL CAS: 1071-83-6

CXHA 120.00 DALAPON & HALOACETIC ACIDS BY GC/ECD [Ref.: EPA552.1]
Sample Kit: 36HA Holding Limit: 28 days Lab Group: SOC [Rec# 70 Rev. 01/14/02]

REPORTED ANALYTES FOR TEST PROCEDURE:

BROMOACETIC ACID [# 002 Code: BAA Rev: 01/14/02 R# 98]
PQL: 0.004 mg/L Min DL: 0.004 mg/L RMCL: 0.06 mg/L MCL CAS: 79-08-3

BROMOCHLOROACETIC ACID [# 007 Code: BCAA Rev: 01/14/02 R# 99]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 5589-96-3

CHLOROACETIC ACID [# 001 Code: CAA Rev: 01/14/02 R# 100]
PQL: 0.004 mg/L Min DL: 0.004 mg/L RMCL: NONE ESTABLISHED CAS: 79-11-8

DALAPON [# 006 Code: DALAPON Rev: 01/14/02 R# 101]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.2 mg/L REGULATORY MCL CAS: 75-99-0

DIBROMOACETIC ACID [# 005 Code: DBAA Rev: 01/14/02 R# 102]
PQL: 0.001 mg/L Min DL: 0.0005 mg/L RMCL: 0.06 mg/L MCL CAS: 631-64-1

DICHLOROACETIC ACID [# 003 Code: DCAA Rev: 01/14/02 R# 103]
PQL: 0.002 mg/L Min DL: 0.001 mg/L RMCL: 0.06 mg/L MCL CAS: 79-43-6

TRICHLOROACETIC ACID [# 004 Code: TCAA Rev: 01/14/02 R# 104]
PQL: 0.001 mg/L Min DL: 0.0004 mg/L RMCL: 0.06 mg/L MCL CAS: 76-03-9

TOTAL HALOACETIC ACIDS (FIVE) [# 008 Code: THA Rev: 01/14/02 R# 105]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.06 mg/L MCL CAS:

CXHB 95.00 CHLORINATED ACID HERBICIDES BY GC/ECD [Ref.: EPA515.2]
Sample Kit: 36NV Holding Limit: 14 days Lab Group: SOC [Rec# 71 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

2,4,5-T [# 003 Code: 245T Rev: 07/01/96 R# 106]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 93-76-5

2,4,5-TP (SILVEX) [# 005 Code: 245TP Rev: 07/01/96 R# 107]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.05 mg/L REGULATORY MCL CAS: 93-72-1

2,4-D [# 008 Code: 24D Rev: 07/01/96 R# 108]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.07 mg/L REGULATORY MCL CAS: 94-75-7

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXHB (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

ACIFLUORFEN [# 006 Code: ACFLO Rev: 07/01/96 R# 109]
PQL: 0.004 mg/L Min DL: 0.004 mg/L RMCL: NONE ESTABLISHED CAS: 50594-66-6

BENTAZON [# 002 Code: BENTAZON Rev: 07/01/96 R# 110]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 25057-89-0

DCPA, MONO [# 010 Code: DACTHAL Rev: 07/01/96 R# 111]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 867-54-7

DICAMBA [# 007 Code: DICAMBA Rev: 07/01/96 R# 112]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 1918-00-9

DINOSEB [# 004 Code: DINOSEB Rev: 07/01/96 R# 113]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.007 mg/L REGULATORY MCL CAS: 88-85-7

PENTACHLOROPHENOL [# 009 Code: PCP Rev: 07/01/96 R# 114]
PQL: 0.00006 mg/L Min DL: 0.00006 mg/L RMCL: 0.001 mg/L REGULATORY MCL CAS: 87-86-5

PICLORAM [# 001 Code: PICLORAM Rev: 07/01/96 R# 115]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.5 mg/L REGULATORY MCL CAS: 1918-02-1

CXLP 95.00 CARBAMATES BY HPLC/PCD [Ref.: EPA531.2]
Sample Kit: 36LP(a) Holding Limit: 28 days Lab Group: SOC [Rec# 72 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

ALDICARB [# 001 Code: ALDICARB Rev: 07/01/96 R# 116]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 116-06-3

ALDICARB SULFOXIDE [# 003 Code: ALDSFOXD Rev: 07/01/96 R# 117]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1646-87-3

ALDICARB SULFONE [# 002 Code: ALDSUFON Rev: 07/01/96 R# 118]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1646-88-4

HYDROXYCARBOFURAN, 3- [# 010 Code: CARB3OH Rev: 07/01/96 R# 119]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 16655-82-6

CARBARYL [# 005 Code: CARBARYL Rev: 07/01/96 R# 120]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 63-25-2

CARBOFURAN [# 006 Code: CARBFURN Rev: 07/01/96 R# 121]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.04 mg/L REGULATORY MCL CAS: 1563-66-2

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXLP (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

METHIOCARB [# 007 Code: METHCARB Rev: 07/01/96 R# 122]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 2032-65-7

METHOMYL [# 008 Code: METHOMYL Rev: 07/01/96 R# 123]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 16752-77-5

OXAMYL [# 009 Code: OXAMYL Rev: 07/01/96 R# 124]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.2 mg/L REGULATORY MCL CAS: 23135-22-0

PROPOXUR (BAYGON) [# 004 Code: PROPOXUR Rev: 07/01/96 R# 125]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 114-26-1

CXLU 110.00 UV ACTIVE PESTICIDES BY HPLC/UV [Ref.: IN-HOUSE]
Sample Kit: 36NV Holding Limit: 28 days Lab Group: SOC [Rec# 73 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

BARBAN [# 001 Code: BARBAN Rev: 07/01/96 R# 126]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 101-27-9

DIURON [# 003 Code: DIURON Rev: 07/01/96 R# 127]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 330-54-1

FLUOMETURON [# 004 Code: FLUMTRON Rev: 07/01/96 R# 128]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 2164-17-2

LINURON [# 005 Code: LINURON Rev: 07/01/96 R# 129]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 330-55-2

NEBURON [# 007 Code: NEBURON Rev: 07/01/96 R# 130]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 555-37-3

PROPANIL [# 008 Code: PROPANIL Rev: 07/01/96 R# 131]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 709-98-8

PROPHAM [# 009 Code: PROPHAM Rev: 07/01/96 R# 132]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 122-42-9

TEST CODE	TEST FEE	METHOD INFORMATION - SOC LAB GROUP
CXNP	80.00	NITROGEN CONTAINING PESTICIDES BY GC/MS [Ref.: EPA525.2]
		Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 75 Rev. 05/01/97]
		REPORTED ANALYTES FOR TEST PROCEDURE:
CXPA	110.00	AROMATICS BY GC/MS [Ref.: EPA525.2]
		Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 76 Rev. 01/12/00]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		ACENAPHTHENE [# 001 Code: ACNPHEN Rev: 01/12/00 R# 138]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 83-32-9
		ACENAPHTHYLENE [# 002 Code: ACNPHYN Rev: 01/12/00 R# 139]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 208-96-8
		ANTHRACENE [# 003 Code: ANTH Rev: 01/12/00 R# 140]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 120-12-7
		BENZO(A)ANTHRACENE [# 004 Code: BZAANTH Rev: 01/12/00 R# 141]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 56-55-3
		BENZO(A)PYRENE [# 005 Code: BZAPYR Rev: 01/12/00 R# 142]
		PQL: 0.00006 mg/L Min DL: 0.00006 mg/L RMCL: 0.0002 mg/L REGULATORY MCL CAS: 50-32-8
		BENZO(b)FLUORANTHENE [# 006 Code: BZBFLRN Rev: 01/12/00 R# 143]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 205-82-3
		BENZO(g,h,i)PERYLENE [# 007 Code: BZGHIPR Rev: 01/12/00 R# 144]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 191-24-2
		BENZO(k)FLUORANTHENE [# 008 Code: BZKFLRN Rev: 01/12/00 R# 145]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 207-08-9
		CHRYSENE [# 011 Code: CHRYSN Rev: 01/12/00 R# 146]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 218-01-9
		CHLORONAPHTHALENE, 2- [# 010 Code: CLNAPH2 Rev: 01/12/00 R# 147]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 91-58-7
		DIBENZ(a,h)ANTHRACENE [# 012 Code: DBZANTH Rev: 01/12/00 R# 148]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 53-70-3
		DI(ETHYLHEXYL)ADIPATE [# 029 Code: DEHADI Rev: 01/12/00 R# 149]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.4 mg/L REGULATORY MCL CAS: 103-23-1
		BIS(2-ETHYLHEXYL)PHTHALATE [# 013 Code: DEHP Rev: 01/12/00 R# 150]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.006 mg/L REGULATORY MCL CAS: 117-81-7
		DINITROTOLUENE, 2, 4 [# 019 Code: DNTOL24 Rev: 01/12/00 R# 151]
		PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 121-14-2

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXPA (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

DINITROTOLUENE, 2, 6- [# 018 Code: DNTOL26 Rev: 01/12/00 R# 152]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 606-20-2

FLUORENE [# 022 Code: FLRENE Rev: 01/12/00 R# 153]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 86-73-7

FLUORANTHENE [# 021 Code: FLRN Rev: 01/12/00 R# 154]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 206-44-0

INDENO(1,2,3-CD)PYRENE [# 023 Code: INDENO Rev: 01/12/00 R# 155]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 193-39-5

METHYLNAPHTHALENE,1- [# 024 Code: MENAPH1 Rev: 07/01/96 R# 156]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 90-12-0

METHYLNAPHTHALENE,2- [# 025 Code: MENAPH2 Rev: 07/01/96 R# 157]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 91-57-6

PHENANTHRENE [# 027 Code: PHENAN Rev: 01/12/00 R# 158]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 85-01-8

PYRENE [# 028 Code: PYR Rev: 01/12/00 R# 159]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 129-00-0

CXPO 150.00 ORGANOPHOSPHATE PESTICIDES BY GC/MS [Ref.: IN-HOUSE]
Sample Kit: 36NV Holding Limit: NONE Lab Group: SOC [Rec# 78 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

CHLORPYRIFOS [# 012 Code: CHLRPYRF Rev: 07/01/96 R# 161]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 05598-15-2

DIAZINON [# 001 Code: DAZNON Rev: 07/01/96 R# 162]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 333-41-5

DIMETHOATE [# 011 Code: DIMETATE Rev: 07/01/96 R# 163]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 60-51-5

DISULFOTON [# 002 Code: DSULFTON Rev: 07/01/96 R# 164]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 298-04-4

ETHION [# 004 Code: ETHION Rev: 07/01/96 R# 165]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 563-12-2

TEST CODE	TEST FEE	METHOD INFORMATION - SOC LAB GROUP

CXPO {CONTINUED}

REPORTED ANALYTES FOR TEST PROCEDURE:

ETHYL PARATHION [# 005 Code: ETPTHON Rev: 07/01/96 R# 166]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 56-38-2

FENAMINPHOS [# 010 Code: FNMNPHOS Rev: 07/01/96 R# 167]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 22224-92-6

FONOFOS [# 003 Code: FONFOS Rev: 07/01/96 R# 168]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 944-22-9

AZINOPHOS,METHYL- [# 006 Code: GUTHION Rev: 07/01/96 R# 169]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 86-50-0

METHYL PARATHION [# 007 Code: MEPTHON Rev: 07/01/96 R# 170]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 298-00-0

MALATHION [# 008 Code: MLTHON Rev: 07/01/96 R# 171]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 121-75 5

CARBOPHENOTHION (TRITHION) [# 009 Code: TRITHON Rev: 07/01/96 R# 172]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 786-19-6

CXPT 120.00 PESTICIDES SCREENING BY ECD & NPD [Ref.: EPA525.2]
Sample Kit: 36NV Holding Limit: 7 days Lab Group: SOC [Rec# 79 Rev. 07/01/96]

REPORTED ANALYTES FOR TEST PROCEDURE:

ACETOCHLOR [# 057 Code: ACTCHLOR Rev: 07/01/96 R# 173]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 34256-82-1

ALACHLOR [# 037 Code: ALACHLOR Rev: 07/01/96 R# 174]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 15972-60-8

ALDRIN [# 004 Code: ALDRIN Rev: 07/01/96 R# 175]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: NONE ESTABLISHED CAS: 309-00-2

AMETRYN [# 036 Code: AMETRYN Rev: 07/01/96 R# 176]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 834-12-8

ATRAZINE [# 038 Code: ATRAZINE Rev: 07/01/96 R# 177]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.003 mg/L REGULATORY MCL CAS: 1912-24-9

HEXACHLOROCYCLOHEXANE (ALPHA-BHC) [# 005 Code: BHC1 Rev: 07/01/96 R# 178]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 319-84-6

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXPT (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

HEXACHLOROCYCLOHEXANE (BETA-BHC) [# 006 Code: BHC2 Rev: 07/01/96 R# 179]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 319-85-7

LINDANE (GAMMA-BHC) [# 002 Code: BHC3 Rev: 07/01/96 R# 180]
PQL: 0.00004 mg/L Min DL: 0.00004 mg/L RMCL: 0.0002 mg/L REGULATORY MCL CAS: 58-89-9

HEXACHLOROCYCLOHEXANE (DELTA-BHC) [# 007 Code: BHC4 Rev: 07/01/96 R# 181]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 319-86-8

BROMACIL [# 032 Code: BROMACIL Rev: 07/01/96 R# 182]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 314-40-9

BUTACHLOR [# 051 Code: BUTACHLO Rev: 07/01/96 R# 183]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 23184-66-9

BUTYLATE [# 040 Code: BUTYLATE Rev: 07/01/96 R# 184]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 2008-41-5

HEXACHLOROCYCLOPENTADIENE [# 020 Code: C56 Rev: 07/01/96 R# 185]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.05 mg/L REGULATORY MCL CAS: 77-47-4

OCTACHLOROCYCLOPENTENE [# 021 Code: C58 Rev: 07/01/96 R# 186]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 706-78-5

HEXACHLOROBENZENE [# 018 Code: C66 Rev: 07/01/96 R# 187]
PQL: 0.0001 mg/L Min DL: 0.0001 mg/L RMCL: 0.001 mg/L REGULATORY MCL CAS: 118-74-1

CARBOXIN [# 041 Code: CARBOXIN Rev: 07/01/96 R# 188]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 5234-68-4

CHLOROTHALONIL [# 033 Code: CHLRTHNL Rev: 07/01/96 R# 189]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1897-45-6

CHLORDANE,alpha [# 008 Code: CLRDNA Rev: 07/01/96 R# 190]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 5103-71-9

CHLORDANE,gamma- [# 009 Code: CLRDNG Rev: 07/01/96 R# 191]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 5103-74-2

CYCLOATE [# 039 Code: CYCLOATE Rev: 07/01/96 R# 192]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 1134-23-2

CYPRAZINE [# 054 Code: CYPRAZIN Rev: 07/01/96 R# 193]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 22936-86-3

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXPT (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

DDD,4,4`- [# 010 Code: DDD44 Rev: 07/01/96 R# 194]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 72-54-8

DDE,4,4`- [# 011 Code: DDE44 Rev: 07/01/96 R# 195]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 72-55-9

DDT,4,4`- [# 012 Code: DDT44 Rev: 07/01/96 R# 196]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 50-29-3

DIPHENAMID [# 042 Code: DIPHNMID Rev: 07/01/96 R# 197]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 957-51-7

DIELDRIN [# 030 Code: DLDRN Rev: 07/01/96 R# 198]
PQL: 0.0005 mg/L Min DL: 0.0005 mg/L RMCL: NONE ESTABLISHED CAS: 60-57-1

ENDOSULFAN,alpha [# 013 Code: ENDOSLA Rev: 07/01/96 R# 199]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 959-98-8

ENDOSULFAN,beta [# 014 Code: ENDOSLB Rev: 07/01/96 R# 200]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 33213-65-9

ENDRIN ALDEHYDE [# 015 Code: ENDRHYD Rev: 07/01/96 R# 201]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 7421-93-4

ENDRIN [# 001 Code: ENDRIN Rev: 07/01/96 R# 202]
PQL: 0.00005 mg/L Min DL: 0.00005 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 72-20-8

EPTC [# 055 Code: EPTAM Rev: 07/01/96 R# 203]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 759-94-4

HEXAZINONE [# 043 Code: HEXAZNON Rev: 07/01/96 R# 204]
PQL: 0.003 mg/L Min DL: 0.003 mg/L RMCL: NONE ESTABLISHED CAS: 51235-04-2

HEPTACHLOR [# 016 Code: HPTCL Rev: 07/01/96 R# 205]
PQL: 0.00008 mg/L Min DL: 0.00008 mg/L RMCL: 0.0004 mg/L REGULATORY MCL
CAS: 76-44-8

HEPTACHLOR EPOXIDE [# 017 Code: HPTCLOX Rev: 07/01/96 R# 206]
PQL: 0.00004 mg/L Min DL: 0.00004 mg/L RMCL: 0.0002 mg/L REGULATORY MCL
CAS: 1024-57-3

METOLACHLOR [# 044 Code: METLCHLR Rev: 07/01/96 R# 207]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 51218-45-2

METHOXYCHLOR [# 003 Code: METOXCL Rev: 07/01/96 R# 208]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.04 mg/L REGULATORY MCL CAS: 72-43-5

TEST CODE | TEST FEE | METHOD INFORMATION - SOC | LAB GROUP

CXPT (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

METRIBUZIN [# 045 Code: METRBUZN Rev: 07/01/96 R# 209]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 21087-64-9

MOLINATE [# 058 Code: MOLINATE Rev: 07/01/96 R# 210]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 2212-67-1

POLYBROMINATED BIPHENYLS [# 022 Code: PBB Rev: 07/01/96 R# 211]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 59536-65-1

PCB (AROCLOR 1016) [# 023 Code: PCB1016 Rev: 07/01/96 R# 212]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 12674-11-2

PCB (AROCLOR 1221) [# 024 Code: PCB1221 Rev: 07/01/96 R# 213]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 11104-28-2

PCB (AROCLOR 1232) [# 025 Code: PCB1232 Rev: 07/01/96 R# 214]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 11141-16-5

PCB (AROCLOR 1242) [# 026 Code: PCB1242 Rev: 07/01/96 R# 215]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 53469-21-9

PCB (AROCLOR 1248) [# 027 Code: PCB1248 Rev: 07/01/96 R# 216]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 12672-29-6

PCB (AROCLOR 1254) [# 028 Code: PCB1254 Rev: 07/01/96 R# 217]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 11097-69-1

PCB (AROCLOR 1260) [# 029 Code: PCB1260 Rev: 07/01/96 R# 218]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.0005 mg/L REGULATORY MCL
CAS: 11096-82-5

PROMETON [# 046 Code: PROMETON Rev: 07/01/96 R# 219]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1610-18-0

PRONAMIDE [# 047 Code: PRONAMID Rev: 07/01/96 R# 220]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 23950-58-5

PROPACHLOR [# 052 Code: PROPACHL Rev: 07/01/96 R# 221]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1918-16-7

PROPAZINE [# 048 Code: PROPAZIN Rev: 07/01/96 R# 222]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 139-40-2

SIMAZINE [# 049 Code: SIMAZINE Rev: 07/01/96 R# 223]

PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.004 mg/L REGULATORY MCL CAS: 122-34-9

TEST CODE	TEST FEE	METHOD INFORMATION - SOC	LAB GROUP

CXPT (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

TEBUTHIURON [# 050 Code: TEBTHURN Rev: 07/01/96 R# 224]
PQL: 0.005 mg/L Min DL: 0.005 mg/L RMCL: NONE ESTABLISHED CAS: 34014-18-1

TERBACIL [# 035 Code: TERBACIL Rev: 07/01/96 R# 225]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: NONE ESTABLISHED CAS: 5902-51-2

TOXAPHENE [# 031 Code: TOXAPHN Rev: 07/01/96 R# 226]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.003 mg/L REGULATORY MCL CAS: 8001-35-2

TRIFLURALIN [# 056 Code: TRIFLAN Rev: 07/01/96 R# 227]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1582-09-8

TEST CODE	TEST FEE	METHOD INFORMATION - BACTI LAB GROUP
BIRON	0.00	IRON BACTERIA BY BART TEST [Ref.: IN-HOUSE]
		Sample Kit: 32 Holding Limit: NONE Lab Group: BACTI [Rec# 1 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		IRON BACTERIA ANALYSIS [# 001 Code: BIRON Rev: 07/01/96 R# 1]
		PQL: Min DL: RMCL: NONE ESTABLISHED CAS: BIRON-00-B
BPTC	12.00	DRINKING WATER COLIFORMS [Ref.: SM9223B]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 3 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		COLIFORM ORGANISMS PER 100ml [# 001 Code: PTC Rev: 07/01/96 R# 3]
		PQL: Min DL: RMCL: NONE ESTABLISHED CAS: TC-00-B
BSPC	12.00	HETEROTROPHIC PLATE COUNT [Ref.: SIMPLATE]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 4 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		HETEROTROPHIC PLATE COUNT PER 1ml [# 001 Code: 24 HR Rev: 07/01/96 R# 4]
		PQL: MPN Min DL: MPN RMCL: NONE ESTABLISHED CAS:
NPEC	15.00	E COLI FROM SURFACE/WASTEWATER [Ref.: EPA1103.1]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 84 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		E. COLI PER 100ml [# 001 Code: EC COUNT Rev: 07/01/96 R# 298]
		PQL: Min DL: RMCL: NONE ESTABLISHED CAS: EC-00-B
NPFC	15.00	FECAL COLIFORMS FOR SURFACE/WASTEWATER [Ref.: SM9222D]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 85 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		FECAL COLIFORM ORGANISMS PER 100ml [# 001 Code: FC COUNT Rev: 07/01/96 R# 299]
		PQL: Min DL: RMCL: NONE ESTABLISHED CAS: FC-00-B
NPFS	5.00	FECAL STREPTOCOCCI FOR SURFACE/WASTEWATER [Ref.: SM9230C]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 86 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:

TEST CODE	TEST FEE	METHOD INFORMATION - BACTI LAB GROUP
NPPC	12.00	SWIMMING POOL HETEROTROPHIC PLATE COUNT [Ref.: SIMPLATE]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 87 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		HETEROTROPHIC PLATE COUNT PER 1ml [# 001 Code: SPC Rev: 07/01/96 R# 300]
		PQL: MPN Min DL: MPN RMCL: NONE ESTABLISHED CAS:
NSEC	15.00	E. COLI FROM SEDIMENTS [Ref.: EPA1103.1]
		Sample Kit: 30 Holding Limit: 3 days Lab Group: BACTI [Rec# 88 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
NSFC	15.00	FECAL COLIFORMS FOR SEDIMENTS [Ref.: SM9222D]
		Sample Kit: 30 Holding Limit: 3 days Lab Group: BACTI [Rec# 89 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
NSFS	15.00	FECAL STREPTOCOCCI IN SEDIMENTS [Ref.: SM9230C]
		Sample Kit: 30 Holding Limit: 3 days Lab Group: BACTI [Rec# 90 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
NSPC	12.00	SWIMMING POOLS WATER COLIFORM [Ref.: SM9221D9222B]
		Sample Kit: 30 Holding Limit: 1 days Lab Group: BACTI [Rec# 91 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:
		COLIFORM ORGANISMS PER 100ml [# 001 Code: PTC Rev: 07/01/96 R# 301]
		PQL: Min DL: RMCL: NONE ESTABLISHED CAS: TC-00-B
SID	0.00	SOLIDS IDENTIFICATION INVESTIGATION [Ref.: IN-HOUSE]
		Sample Kit: 32 Holding Limit: NONE Lab Group: BACTI [Rec# 92 Rev. 07/01/96]
		REPORTED ANALYTES FOR TEST PROCEDURE:

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP			
B	12.00	BPTC			
		REPORTED ANALYTES FOR TEST PROCEDURE:			
		COLIFORM ORGANISMS PER 100ml		[# 001 Code: PTC	Rev: 07/01/96 R# 3]
		PQL:	Min DL:	RMCL: NONE ESTABLISHED	CAS: TC-00-B
CCUB	21.00	CPB CMCU			
		REPORTED ANALYTES FOR TEST PROCEDURE:			
		LEAD BY ICP/MS		[# 001 Code: PB	Rev: 12/10/99 R# 38]
		PQL: 0.001 mg/L	Min DL: 0.001 mg/L	RMCL: NONE ESTABLISHED	CAS: 7439-92-1
		COPPER		[# 001 Code: CU	Rev: 01/04/00 R# 29]
		PQL: 0.05 mg/L	Min DL: 0.05 mg/L	RMCL: NONE ESTABLISHED	CAS: 7440-50-8
CDHB	190.00	CXHB CDCPA			
		REPORTED ANALYTES FOR TEST PROCEDURE:			
		2,4,5-T		[# 003 Code: 245T	Rev: 07/01/96 R# 106]
		PQL: 0.001 mg/L	Min DL: 0.001 mg/L	RMCL: NONE ESTABLISHED	CAS: 93-76-5
		2,4,5-TP (SILVEX)		[# 005 Code: 245TP	Rev: 07/01/96 R# 107]
		PQL: 0.0003 mg/L	Min DL: 0.0003 mg/L	RMCL: 0.05 mg/L REGULATORY MCL	CAS: 93-72-1
		2,4-D		[# 008 Code: 24D	Rev: 07/01/96 R# 108]
		PQL: 0.002 mg/L	Min DL: 0.002 mg/L	RMCL: 0.07 mg/L REGULATORY MCL	CAS: 94-75-7
		ACIFLUORFEN		[# 006 Code: ACFLO	Rev: 07/01/96 R# 109]
		PQL: 0.004 mg/L	Min DL: 0.004 mg/L	RMCL: NONE ESTABLISHED	CAS: 50594-66-6
		BENTAZON		[# 002 Code: BENTAZON	Rev: 07/01/96 R# 110]
		PQL: 0.002 mg/L	Min DL: 0.002 mg/L	RMCL: NONE ESTABLISHED	CAS: 25057-89-0
		DCPA, MONO		[# 010 Code: DACTHAL	Rev: 07/01/96 R# 111]
		PQL: 0.001 mg/L	Min DL: 0.001 mg/L	RMCL: NONE ESTABLISHED	CAS: 867-54-7
		DICAMBA		[# 007 Code: DICAMBA	Rev: 07/01/96 R# 112]
		PQL: 0.002 mg/L	Min DL: 0.002 mg/L	RMCL: NONE ESTABLISHED	CAS: 1918-00-9
		DINOSEB		[# 004 Code: DINOSEB	Rev: 07/01/96 R# 113]
		PQL: 0.0003 mg/L	Min DL: 0.0003 mg/L	RMCL: 0.007 mg/L REGULATORY MCL	CAS: 88-85-7
		PENTACHLOROPHENOL		[# 009 Code: PCP	Rev: 07/01/96 R# 114]
		PQL: 0.00006 mg/L	Min DL: 0.00006 mg/L	RMCL: 0.001 mg/L REGULATORY MCL	CAS: 87-86-5
		PICLORAM		[# 001 Code: PICLORAM	Rev: 07/01/96 R# 115]
		PQL: 0.002 mg/L	Min DL: 0.002 mg/L	RMCL: 0.5 mg/L REGULATORY MCL	CAS: 1918-02-1

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP
CDHB	(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

TOTAL DCPA, MONO & DI-ACID DEGRADATES [# 001 Code: DCPA Rev: 06/05/01 R# 22]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 1861-32-1

CLMT	64.00	CBE CNI CTL CSB

REPORTED ANALYTES FOR TEST PROCEDURE:

BERYLLIUM [# 001 Code: BE Rev: 07/01/96 R# 8]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.004 mg/L REGULATORY MCL CAS: 7440-41-7

NICKEL [# 001 Code: NI Rev: 07/01/96 R# 35]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 7440-02-0

THALLIUM [# 001 Code: TL Rev: 07/01/96 R# 71]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7440-28-0

ANTIMONY [# 001 Code: SB Rev: 07/01/96 R# 63]
PQL: 0.0006 mg/L Min DL: 0.0006 mg/L RMCL: 0.006 mg/L REGULATORY MCL CAS: 7440-36-0

CMET	132.00	CBA CAS CCR CCD CPB CSE CCU CZN CMN CFE CHG

REPORTED ANALYTES FOR TEST PROCEDURE:

BARIUM [# 001 Code: BA Rev: 07/01/96 R# 7]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 2 mg/L REGULATORY MCL CAS: 7440-39-3

ARSENIC [# 002 Code: AS Rev: 04/15/97 R# 6]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.01 mg/L REGULATORY MCL CAS: 7440-38-2

CHROMIUM [# 001 Code: CR Rev: 07/01/96 R# 15]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 7440-47-3

CADMIUM [# 001 Code: CD Rev: 07/01/96 R# 10]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 7440-43-9

LEAD BY ICP/MS [# 001 Code: PB Rev: 12/10/99 R# 38]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 7439-92-1

SELENIUM [# 001 Code: SE Rev: 07/01/96 R# 64]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.05 mg/L REGULATORY MCL CAS: 7782-49-2

COPPER [# 001 Code: CU Rev: 11/01/01 R# 16]
PQL: 0.05 mg/L Min DL: 0.05 mg/L RMCL: NONE ESTABLISHED CAS: 7440-50-8

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP

CMET (CONTINUED)

REPORTED ANALYTES FOR TEST PROCEDURE:

ZINC [# 001 Code: ZN Rev: 11/01/01 R# 296]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7440-66-6

MANGANESE [# 001 Code: MN Rev: 11/01/01 R# 31]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-96-5

IRON [# 001 Code: FE Rev: 11/01/01 R# 24]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6

MERCURY [# 002 Code: HG Rev: 04/16/97 R# 26]
PQL: 0.0001 mg/L Min DL: 0.0001 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7439-97-6

CMET2 176.00 CHG CBA CSE CAS CCR CCD CPB CBE CTL CNI CSB

REPORTED ANALYTES FOR TEST PROCEDURE:

MERCURY [# 002 Code: HG Rev: 04/16/97 R# 26]
PQL: 0.0001 mg/L Min DL: 0.0001 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7439-97-6

BARIUM [# 001 Code: BA Rev: 07/01/96 R# 7]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 2 mg/L REGULATORY MCL CAS: 7440-39-3

SELENIUM [# 001 Code: SE Rev: 07/01/96 R# 64]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: 0.05 mg/L REGULATORY MCL CAS: 7782-49-2

ARSENIC [# 002 Code: AS Rev: 04/15/97 R# 6]
PQL: 0.002 mg/L Min DL: 0.002 mg/L RMCL: 0.01 mg/L REGULATORY MCL CAS: 7440-38-2

CHROMIUM [# 001 Code: CR Rev: 07/01/96 R# 15]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: 0.1 mg/L REGULATORY MCL CAS: 7440-47-3

CADMIUM [# 001 Code: CD Rev: 07/01/96 R# 10]
PQL: 0.0003 mg/L Min DL: 0.0003 mg/L RMCL: 0.005 mg/L REGULATORY MCL CAS: 7440-43-9

LEAD BY ICP/MS [# 001 Code: PB Rev: 12/10/99 R# 38]
PQL: 0.001 mg/L Min DL: 0.001 mg/L RMCL: NONE ESTABLISHED CAS: 7439-92-1

BERYLLIUM [# 001 Code: BE Rev: 07/01/96 R# 8]
PQL: 0.0004 mg/L Min DL: 0.0004 mg/L RMCL: 0.004 mg/L REGULATORY MCL CAS: 7440-41-7

THALLIUM [# 001 Code: TL Rev: 07/01/96 R# 71]
PQL: 0.0002 mg/L Min DL: 0.0002 mg/L RMCL: 0.002 mg/L REGULATORY MCL CAS: 7440-28-0

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP
CMET2	(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

NICKEL		[# 001 Code: NI	Rev: 07/01/96 R# 35]
PQL: 0.01 mg/L	Min DL: 0.01 mg/L	RMCL: 0.1 mg/L REGULATORY MCL	CAS: 7440-02-0
ANTIMONY		[# 001 Code: SB	Rev: 07/01/96 R# 63]
PQL: 0.0006 mg/L	Min DL: 0.0006 mg/L	RMCL: 0.006 mg/L REGULATORY MCL	CAS: 7440-36-0

CMIN	110.00	CTALK CRM CSI CK CCON CPH CCA CMG CNA

REPORTED ANALYTES FOR TEST PROCEDURE:

TOTAL ALKALINITY AS CaCO3		[# 001 Code: TOTAL AL	Rev: 05/15/97 R# 69]
PQL: 1 mg/L	Min DL: 1 mg/L	RMCL: NONE ESTABLISHED	CAS: TALK-00-C
FLUORIDE (AUTOMATED)		[# 004 Code: AF	Rev: 05/05/97 R# 57]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: 4.0 mg/L REGULATORY MCL	CAS: 16984-48-8
HARDNESS AS CaCO3		[# 005 Code: AHA	Rev: 05/05/97 R# 58]
PQL: 10 mg/L	Min DL: 10 mg/L	RMCL: NONE ESTABLISHED	CAS: HARD-00-C
CHLORIDE (AUTOMATED)		[# 003 Code: CL	Rev: 05/05/97 R# 59]
PQL: 4 mg/L	Min DL: 4 mg/L	RMCL: NONE ESTABLISHED	CAS: 7647-14-5
NITRITE AS N (AUTOMATED)		[# 002 Code: NO2	Rev: 05/05/97 R# 60]
PQL: 0.05 mg/L	Min DL: 0.05 mg/L	RMCL: 1 mg/L REGULATORY MCL	CAS: 14797-65-0
NITRATE AS N (AUTOMATED)		[# 001 Code: NO3	Rev: 05/05/97 R# 61]
PQL: 0.4 mg/L	Min DL: 0.4 mg/L	RMCL: 10 mg/L REGULATORY MCL	CAS: 14797-55-8
SULFATE (AUTOMATED)		[# 006 Code: SO4	Rev: 05/05/97 R# 62]
PQL: 5 mg/L	Min DL: 5 mg/L	RMCL: NONE ESTABLISHED	CAS: 14808-79-8
SILICA AS SiO2		[# 001 Code: SI	Rev: 07/01/96 R# 65]
PQL: 0.2 mg/L	Min DL: 0.2 mg/L	RMCL: NONE ESTABLISHED	CAS: 7440-21-3
POTASSIUM		[# 001 Code: K	Rev: 07/01/96 R# 28]
PQL: 0.03 mg/L	Min DL: 0.03 mg/L	RMCL: NONE ESTABLISHED	CAS: 7440-09-7
CONDUCTIVITY		[# 001 Code: CON	Rev: 07/01/96 R# 14]
PQL: 1 umhos	Min DL: 1 umhos	RMCL: NONE ESTABLISHED	CAS: COND-00-C
pH		[# 001 Code: PH	Rev: 07/01/96 R# 39]
PQL: 2.0	Min DL: 2.0	RMCL: NONE ESTABLISHED	CAS: PH-00-C

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP
CMIN	(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

CALCIUM		[# 002 Code: CA	Rev: 04/15/97	R# 9]
PQL: 0.3 mg/L	Min DL: 0.3 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-70-2
MAGNESIUM		[# 002 Code: MG	Rev: 04/16/97	R# 30]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: NONE ESTABLISHED		CAS: 7439-95-4
SODIUM		[# 002 Code: NA	Rev: 04/16/97	R# 33]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-23-5

CORR	73.00	CTALK CCON CPO4 CCA CMG CNA

REPORTED ANALYTES FOR TEST PROCEDURE:

TOTAL ALKALINITY AS CaCO3		[# 001 Code: TOTAL AL	Rev: 05/15/97	R# 69]
PQL: 1 mg/L	Min DL: 1 mg/L	RMCL: NONE ESTABLISHED		CAS: TALK-00-C
CONDUCTIVITY		[# 001 Code: CON	Rev: 07/01/96	R# 14]
PQL: 1 umhos	Min DL: 1 umhos	RMCL: NONE ESTABLISHED		CAS: COND-00-C
ORTHO-PHOSPHATE AS P		[# 001 Code: PO4	Rev: 07/01/96	R# 47]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: NONE ESTABLISHED		CAS: 7664-38-2
CALCIUM		[# 002 Code: CA	Rev: 04/15/97	R# 9]
PQL: 0.3 mg/L	Min DL: 0.3 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-70-2
MAGNESIUM		[# 002 Code: MG	Rev: 04/16/97	R# 30]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: NONE ESTABLISHED		CAS: 7439-95-4
SODIUM		[# 002 Code: NA	Rev: 04/16/97	R# 33]
PQL: 0.1 mg/L	Min DL: 0.1 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-23-5

CPM1	20.00	CCU CZN CMN CFE

REPORTED ANALYTES FOR TEST PROCEDURE:

COPPER		[# 001 Code: CU	Rev: 11/01/01	R# 16]
PQL: 0.05 mg/L	Min DL: 0.05 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-50-8
ZINC		[# 001 Code: ZN	Rev: 11/01/01	R# 296]
PQL: 0.01 mg/L	Min DL: 0.01 mg/L	RMCL: NONE ESTABLISHED		CAS: 7440-66-6
MANGANESE		[# 001 Code: MN	Rev: 11/01/01	R# 31]
PQL: 0.01 mg/L	Min DL: 0.01 mg/L	RMCL: NONE ESTABLISHED		CAS: 7439-96-5

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP
CPM1	(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

IRON [# 001 Code: FE Rev: 11/01/01 R# 24]
PQL: 0.01 mg/L Min DL: 0.01 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6

CPM2	28.00	CCA CMG CNA

REPORTED ANALYTES FOR TEST PROCEDURE:

CALCIUM [# 002 Code: CA Rev: 04/15/97 R# 9]
PQL: 0.3 mg/L Min DL: 0.3 mg/L RMCL: NONE ESTABLISHED CAS: 7440-70-2

MAGNESIUM [# 002 Code: MG Rev: 04/16/97 R# 30]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7439-95-4

SODIUM [# 002 Code: NA Rev: 04/16/97 R# 33]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7440-23-5

N	15.00	NPFC

REPORTED ANALYTES FOR TEST PROCEDURE:

FECAL COLIFORM ORGANISMS PER 100ml [# 001 Code: FC COUNT Rev: 07/01/96 R# 299]
PQL: Min DL: RMCL: NONE ESTABLISHED CAS: FC-00-B

NSED	45.00	NSEC NSFC NSFS

REPORTED ANALYTES FOR TEST PROCEDURE:

R	14.00	CRA

REPORTED ANALYTES FOR TEST PROCEDURE:

FLUORIDE (AUTOMATED) [# 005 Code: AF Rev: 07/01/96 R# 48]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: 4.0 mg/L REGULATORY MCL CAS: 16984-48-8

IRON (AUTOMATED) [# 007 Code: AFE Rev: 07/01/96 R# 49]
PQL: 0.1 mg/L Min DL: 0.1 mg/L RMCL: NONE ESTABLISHED CAS: 7439-89-6

HARDNESS AS CaCO3 [# 006 Code: AHA Rev: 07/01/96 R# 50]
PQL: 10 mg/L Min DL: 10 mg/L RMCL: NONE ESTABLISHED CAS: HARD-00-C

SODIUM (AUTOMATED) [# 009 Code: ANA Rev: 07/01/96 R# 51]
PQL: 5 mg/L Min DL: 5 mg/L RMCL: NONE ESTABLISHED CAS: 7440-23-5

TEST CODE	TEST FEE	METHOD INFORMATION - GROUP LAB GROUP
R	(CONTINUED)	

REPORTED ANALYTES FOR TEST PROCEDURE:

CHLORIDE (AUTOMATED)			[# 004 Code: CL	Rev: 07/01/96 R# 52]
PQL: 4 mg/L	Min DL: 4 mg/L	RMCL: NONE ESTABLISHED		CAS: 7647-14-5
NITRITE AS N (AUTOMATED)			[# 003 Code: NO2	Rev: 07/01/96 R# 53]
PQL: 0.05 mg/L	Min DL: 0.05 mg/L	RMCL: 1 mg/L REGULATORY MCL		CAS: 14797-65-0
NITRATE AS N (AUTOMATED)			[# 001 Code: NO3	Rev: 07/01/96 R# 54]
PQL: 0.4 mg/L	Min DL: 0.4 mg/L	RMCL: 10 mg/L REGULATORY MCL		CAS: 14797-55-8
SULFATE (AUTOMATED)			[# 008 Code: SO4	Rev: 07/01/96 R# 55]
PQL: 5 mg/L	Min DL: 5 mg/L	RMCL: NONE ESTABLISHED		CAS: 14808-79-8

SW	12.00	NSPC

REPORTED ANALYTES FOR TEST PROCEDURE:

COLIFORM ORGANISMS PER 100ml			[# 001 Code: PTC	Rev: 07/01/96 R# 301]
PQL:	Min DL:	RMCL: NONE ESTABLISHED		CAS: TC-00-B

MICHIGAN DEPARTMENT
OF
ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX F

Drinking Water Sampling Procedures Manual

QAPP-Ver2.0, Revison 0
May 5, 2003

Drinking Water Unit
Sampling Procedures Manual

Table of Contents

Introduction. 2

Training. 2

Sampling Directions 3

Sample Submission Forms. 9

Field Blanks. 11

Transporting Samples. 12

Introduction

It is the sample collector's responsibility to use the correct sample container and sampling technique. If the wrong unit or technique are used, the sample's validity is questionable. These sampling errors may result in monitoring violations, a waste of the laboratory's time, and the squandering of the state's resources.

Although many of the contaminants utilize the same sampling unit, similar contaminants, such as the total trihalomethanes (TTHM) and the volatile organic chemicals (VOC), may use different sampling units. The difference between similar units is the preservatives in the container prior to sample collection or added to the sample container during sample collection. Typically, the preservatives are dechlorinating agents. These chemicals must remain in the bottle and must not be rinsed out. If the chemicals spill on to your skin or clothing, the effected area must be immediately flushed with water for several minutes.

In the attached "MDEQ Analysis Section Testing Catalog", the proper sample container is listed for each contaminant. After you receive your bottle(s), check to see that the sample unit label on the unit box or container shows the same unit number as indicated in the catalog. Different tests may require different sample units.

Following the proper sampling protocol is just as important as selecting the right container. The requirements of the lead and copper rules are an excellent example where the technique requires a first draw sample versus the standard of letting the water run for several minutes prior to sample collection. Other examples include the choice of a chlorinated or unchlorinated sampling tap. For a few of the techniques, such as for the TTHM and VOC, the sample collector may be required to obtain a trip or field blank from the laboratory prior to leaving on his/her sampling trip. Also, the collector must be aware of maximum transit times permitted between sample collection and its delivery to the laboratory and requirements to cool the sample, as described in the catalog. Coolers are available for the use of the DEQ staff for the purpose of transporting the samples from the sampling site to the laboratory.

The issues on sample collection are discussed in other sections of this manual. Tables 1 and 2 have been included in this manual to allow a comparison between the procedures used by the MDEQ laboratory and the approved U.S. EPA techniques. Also, these tables should be consulted for the selection of the proper sampling unit. Either Table 1 or 2 and the "MDEQ Water Analysis Section Testing Catalog" should be consulted for the correct bottles to be used and the maximum holding times allowed by the laboratory.

Training

At the bare minimum, the sample collector must read and understand the directions for each type of sample. The collector may need to be familiar with field chlorine residual monitoring, aseptic sampling procedures, safe procedures for handling corrosive materials, and specific on-site training regarding sample tap locations.

Training on sample collection is available through many of the MDEQ/Michigan Section AWWA short courses, which include the Michigan State University Bacteriology Short Course, the Limited Treatment Short Course, Distribution System Operator Short

Course, and the Complete Treatment Short Courses I and II. The matter has been discussed in a few of the recent Michigan Section AWWA Regional Meetings and in several of the MDEQ training manuals. Also, sample collection training is directly available from the senior MDEQ staff members.

Sample Unit Directions

Directions for Sample Unit 30

1. Do not open the bottle until ready to collect the sample. Do not touch the inside of the cap or bottle. Retain the cap in your hand, and do not set the cap down.

2. Do not rinse the bottle with sample. The bottle contains sodium thiosulfate for the deactivation of chlorine. If not collecting sample from a tap (lake, pool, etc.), plunge bottle mouth down and move in continuous arc down and back up from water. Discard top half-inch of sample. Go to step three (3) if using a sample tap.

3. Select a clean faucet and remove such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (until cold) at full flow from the sampling tap. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle only to the bottom of the neck. Replace cap.

Directions for Sample Units 32, 33 and 36ME

1. Do not open the bottle until ready to collect the sample. Do not touch the inside of the cap or bottle.

2. Do not rinse the bottle with sample. Select a clean faucet and remove such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (until cold) at full flow at the sampling point.

3. Reduce flow and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Avoid splashing. Fill bottle to the bottom of the neck. Replace cap.

Directions for Sample Unit 36CC

1. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

2. Sampling point should not have been used for a minimum of six hours prior to sampling. Do not flush the sample tap before sample collection.

3. Place bottle mouth below tap and turn on water filling bottle to the bottom of the neck. Replace cap.

Directions for Sample Unit 36AC

1. This testing unit contains a diluted sulfuric acid preservative in the sample bottle and caution should be exercised. Tap sample bottle in upright position to drain preservatives from cap. Do not rinse bottle before collection. If preservative is spilled, immediately flush skin with large amounts of water.

2. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

3. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (until cold) at full flow from the sampling tap.

4. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle to one-half inch below the bottom of the neck. Cap and invert five times to mix sample with the preservative.

Directions for Sample Unit 36CN

1. Use a field chlorine residual test kit to confirm the absence of a free or combined chlorine residual. If no chlorine residual is present, proceed with the collection of the sample using Unit 36CN. If a chlorine residual is present, Unit 36CNa should be used.
2. This testing unit contains caustic 10N sodium hydroxide preservatives and caution should be exercised. Tap unit in upright position to drain preservatives from cap. Do not rinse bottle before collection. If preservative is spilled, immediately flush skin with large amounts of water.

3. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

4. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (or until cold) at full flow at the sampling point.

5. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle to the bottom of the neck. Cap and invert five times to mix sample with preservative.

Directions for Sample Unit 36CNa

1. This testing unit contains ascorbic acid. A separate vial with caustic 10N sodium hydroxide preservative is needed with this sampling unit. Caution should be exercised in the collection of the sample. Tap unit in upright position to drain any of the acid preservative from cap. Do not rinse bottle before collection. If the acid preservative is spilled, immediately flush skin with large amounts of water.

2. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

3. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.

4. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle to one-half inch below the bottom of the neck. Cap and invert five times to mix sample with preservatives.

5. Remove sample bottle cap and add all sodium hydroxide preservative solution in vial to sample bottle. Recap and invert five times to mix. Immediately flush skin with large amounts of water if the preservative is spilled.

Directions for Sampling Units 36LP

1. Use a field chlorine residual test kit to confirm the absence of a free or a total chlorine residual. If no chlorine residual is present, proceed with the collection of the sample using Unit 36LP. If a chlorine residual is present, collect the sample using unit 36LPa.

2. This testing unit contains monochloracetic acid as a preservative and caution should be exercised. Shake unit in upright position to drain preservatives from cap. Do not rinse bottle before collection. Immediately flush skin with large amounts of water if spill occurs.

3. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

4. Do not rinse the bottle with sample. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.

5. Reduce flow and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Avoid splashing. Fill bottle to the bottom of the neck. Cap and invert five times to mix sample with preservatives.

Directions for Sampling Unit 36LPa

1. Use a field chlorine residual test kit to confirm the absence of a free or a total chlorine residual. If a chlorine residual is present, proceed with the collection of the sample using Unit 36LPa. If a chlorine residual is absent, use Unit 36LP to collect the sample.

2. The test unit contains sodium thiosulfate as a preservative and caution should be exercised. A separate vial containing monochloracetic acid is required with this unit. Shake unit in upright position to drain preservatives from cap of the sample bottle. Do not rinse bottle before collection. Immediately flush skin with large amounts of water if spill occurs.

3. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

4. Do not rinse the bottle with sample. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.
5. Reduce flow and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Avoid splashing. Fill bottle to the bottom of the neck. Cap and invert five times to mix sample with preservative.

6. Remove the bottle's cap and add the contents of the accompanying vial, which contains monochloracetic acid. Recap and invert five times to mix the sample with the preservatives. In the event of a spill, immediately flush the skin with large amounts of water.

Directions for Sampling Unit 36NV

1. This testing unit contains sodium sulfite as a preservative and caution should be exercised. This unit is used for both chlorinated and unchlorinated samples. Shake unit in upright position to drain the preservative from cap. Do not rinse bottle before collection. Immediately flush skin with large amounts of water if spill occurs.

2. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

3. Do not rinse the bottle with sample. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.

4. Reduce flow and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Avoid splashing. Fill bottle to the bottom of the neck. Cap and invert five times to mix sample with the preservative.

Directions for Sampling Unit 36VO

1. These sample vials contain a diluted ascorbic acid preservative and caution should be exercised. Each sample set consists of two bottles. This sampling unit should be used for both chlorinated and unchlorinated samples. Tap each vial while in an upright position to drain the preservative from cap. Do not rinse vials before collection. Immediately flush skin with large amount of water if spill occurs.

2. Do not open the first vial until ready to collect the sample. Do not touch the inside of the cap or vial.

3. Do not rinse the vial with sample. Select a clean faucet removing such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.

4. Reduce flow and collect the sample directly into the vial. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the vials. Avoid splashing. Fill the vial until water rounds at the top of vial. Cap and invert to check for air in vial. THE SEPTA (RUBBER PART INSIDE CAP RING) MUST BE SMOOTH SIDE DOWN IN CONTACT WITH SAMPLE - RUBBER SIDE UP TO AVOID POSSIBLE CONTAMINATION.

5. If air is observed in inverted sample, remove cap, add water (DON'T DUMP SAMPLE), and recap as instructed in (4) above.

6. Immediately fill the second vial in the same manner as the first.

Directions for Sampling Unit 36MP

1. These sample vials contain 0.75% hypochlorite solution. Tap each vial in upright position to drain solution from cap. Each sampling unit consists of two vials. Do not rinse the vials before collection.

2. Do not open the vials until ready to collect the sample. Do not touch the inside of caps or vials.

3. Do not rinse the vials with sample. Select a clean faucet removing such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes at full flow at the sampling point.

4. Reduce flow and collect the sample directly into the first vial. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the vial. Avoid splashing. Fill vial until water rounds at the top of vial. Cap and invert to check for air in vial. THE SEPTA (RUBBER PART INSIDE CAP RING) MUST BE SMOOTH SIDE DOWN IN CONTACT WITH SAMPLE - RUBBER SIDE UP TO AVOID POSSIBLE CONTAMINATION.

5. If air is observed in inverted sample, remove cap, add water (DON'T DUMP SAMPLE), and recap as instructed in (4) above.

6. Fill the second vial provided in the same way.

Directions for Sample Unit 36HS

1. Use a field chlorine residual test kit to determine the presence or absence of free chlorine. If free chlorine is absent, proceed with the collection of the sample using Unit 36HS. If a free chlorine residual is present, hydrogen sulfide will not be present.

2. This testing unit contains a diluted zinc acetate preservative in the sample bottle and caution should be exercised. Tap sample bottle in upright position to drain preservatives from cap. Do not rinse bottle before collection. If preservative is spilled, immediately flush skin with large amounts of water.

3. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

4. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (until cold) at full flow from the sampling tap.

5. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle to one-half inch below the bottom of the neck. Cap and invert five times to mix sample with the preservative.

Directions for Sample Unit 36GY

1. Use a field chlorine residual test kit to confirm the absence of a free or combined chlorine residual. If no chlorine residual is present, proceed with the collection of the sample using Unit 36GY. If a free chlorine residual is present, glyphosate will not be present.

2. This testing unit may contain caustic sodium thiosulfate preservatives and caution should be exercised. Tap unit in upright position to drain preservatives from cap. Do not rinse bottle before collection. If preservative is spilled, immediately flush skin with large amounts of water.
3. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle.

4. Select a clean faucet avoiding such attachments as aerators, dishwasher connectors, etc. Allow water to run for ten minutes (or until cold) at full flow at the sampling point.

5. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. Fill bottle to the bottom of the neck. Cap and invert five times to mix sample with preservatives.

Sample Submission Forms

A separate submission form, which is included in the appendix, is required for each sample container in order to identify it for reporting. Enter all known information. Type or print legibly using soft lead or waterproof ink. Attach comments regarding testing needs on a separate sheet. The sample forms relay all the important data to the laboratory and users of the analytical results. If the form is not completed properly, the laboratory may delay the analysis or even "dump" the sample. Also, improperly completed paper work may cause monitoring or MCL violations.

The following discussion describes information requested on the sample submission form (left to right, top to bottom) which may not be obvious from the form information:

1. Circle number codes given on submission form for - SAMPLE SOURCE CODE, that best describes water supply or other sample source. SAMPLING PURPOSE CODE, the primary reason for doing the testing. SAMPLE POINT CODE, treatment and location in water supply (other for nonpotable sources).

2. WSSN - Enter WSSN, (Water Supply Serial Number), if sample source code is 1 or 2.

3. Indicate if the sample contains chlorine.

4. REPORT RESULTS AND BILLING TO - Only a single address (Reporting/Billing) can be accommodated for reporting and billing of any testing fees. Use address best able to distribute information to other persons involved.

5. Sample Collector Name - Include first initial after name if more than one person at reporting address has the same last name.

6. Date Collected - Enter the month/day/year when the sample was collected.

7. Time Collected - Enter the time of sample collection to nearest hour and circle AM or PM.

8. Who Collected Sample? - Circle code number from COLLECTOR CODES on form which best describes person collecting the sample.

9. System/Owner Name - Enter name of source (public water system, lake, river, pool, etc.) or name of owner of sample source (homeowner, pool owner, etc.) which best identifies the source.

10. Collection Site - Enter the street address, if applicable. Otherwise describe sampling location, such as Well No. 1. Public water systems may enter Sampling Station Nos.

11. Township, Well-Key - Enter the township name. Public water systems may enter a well-key number

12. Section - Enter standard survey section number if known. Public water systems may disregard this data element.

13. City - Enter the city name of the mailing address for the sampling site.

14. County - Enter the county name for the sampling site.

15. Zip - Enter the zip code for the sampling site.

16. Well Number - For public water systems, enter your well number for the sampling site, if applicable. For all other sampling sites, disregard this data element.

17. Sampling Point - Describe the sampling point, such as kitchen faucet.

18. Site Code - Enter local area site code designation if known. This is generally used to designate sites related to areas under investigation by state/county environmental health programs. Public water systems should consult the state or county health department for this information. All other samplers may disregard this data element.

19. Test Code and Fee - Codes and related test fees are given on the laboratory fee schedule. A partial listing of the schedule is given on the submission form. The full fee schedule is available from state and county health departments. A complete listing of codes is listed in the "Water Analysis Section Testing Catalog".

Note: Private well owners should consult local county or district health department personnel regarding needed testing and proper arrangements to obtain types of testing not given on submission form.

20. Sample Unit # - Enter the Sample Unit Number given on the label of the sample unit used to collect the sample (label will be on bottle used for sample unit). Note that this should match the sample unit numbers required in the fee schedule.

21. Amount Enclosed - If payment of testing fees is submitted with the sample, enter the amount of the check enclosed with the sample (make check payable to State of Michigan). Payment should be made by check or money order. DO NOT SEND CASH. Public water supplies with established charge accounts and Customer Numbers may disregard this data element.

22. Customer Number - Supplies with established charge accounts not submitting payment with samples should enter their unique customer number. All others disregard this data element.

Field Blanks

The use of field (trip) blanks are required by several of the U.S. EPA approved methods for the analysis of organics, such as MDEQ laboratory scans CXTM, CXMP, CXVO, CXEV, and CXPT. Although required by the method, the use of trip blanks will be restricted to situations where there are high probabilities for detecting VOC or SOC. These situations include analyzing samples from locations of known or suspected ground water contamination, inland streams during the peak runoff seasons, or as part of the resampling activity for previously positive results. Also, field blanks will be used as part of the TTHM sampling effort from public water supplies when the results are expected to approach or exceed the MCL.

If field blanks are used and the results from the regular VOC or SOC sample results are negative, the field blank will not be analyzed. On occasion, the field blanks may be analyzed from these sample sets in place of the method blank. When used with TTHM samples, the field blank will only be analyzed when the TTHM results exceed fifty percent of the MCL.

The restricted use of field blanks is due to practicality, economics, and the predictability of sample results from many of the public water supplies. The practicality issue is related to shipping water to and from sample sites. The MDEQ routinely relies on the U.S. Postal Service or other commercial delivery services to ship bottles to many of its users. This delivery method increases the probability of breakage. In addition, many of the local health departments and public water supplies maintain a supply of MDEQ bottles to be used in routine monitoring programs. One of the economic issues is related to the shipping costs of blanks. The main economic issue is the added cost of analysis of samples that yield little useful information. The predictability factor is due to the long monitoring history from the public water supplies, where previous sample results may be used as a guide to speculate on the results from a new sample set.

Also, the restricted use is associated with the reasons field blank analyses were incorporated into the methods' quality control procedures by the U.S. EPA. According to the individuals involved with the development of the U.S. EPA approved methods, field blank analyses were initially required to detect the contamination of TTHM samples by freon leaking from the storage refrigerators. As additional methods were developed, the requirements for the analyses of the field blanks were carried over to the quality control procedures for the VOC due to the similarity of the methods and contaminants. The requirements were added to the SOC quality control procedures without any thought on why the field blank analyses were first required.

The decision to use a field blank will be made by the sample collector. Therefore, the sample collector must order the field blank from the MDEQ laboratory prior to the collection of the samples. When the field blank is received, it must be stored with the routine sample containers. As the name implies, the field blank is transported into the field and shipped backed to the laboratory with the sample containers.

Transporting Samples

Pack samples for shipment using any packaging components supplied with the sample container. If possible, ship sample units together in a single box. Be sure each container has the correct form within (ATTACHED TO OR IN SAME BOX AS SAMPLE BOTTLE).

All bacteriological samples must be delivered directly to the laboratory within thirty hours of collection. The samples may be delivered by the sample collector, a courier, or one of the overnight delivery services. Whenever practical, the samples should be transported in an ice chest or cooler. Frozen samples will not be accepted by the laboratory for analysis. Samples waiting for delivery should be refrigerated.

The transit or holding time for other types of samples varies, as shown in the "Water Analysis Section Testing Catalog". The samples must arrive at the MDEQ laboratory well in advance of the holding time and preferably within twenty four hours of collection. Rapid delivery back to the laboratory is suggested to allow the laboratory a sufficient amount of time to schedule the analysis of the samples. The scheduling of the analysis is exceptionally difficult for the laboratory due to the high volume of samples and variable work load.

For all chemical samples, except for the metals, the U.S. EPA requires the cooling of the sample to 4^{0}C on the same day as collection. If the samples will be mailed to the laboratory, they must be sent by a guaranteed overnight delivery service on the same day as collection. If the samples will be delivered to the laboratory, it is suggested that the samples be transported to the laboratory in a cooler or ice chest. Prior to transporting the samples, they should be stored in a refrigerator. Coolers are provided for the MDEQ staff to transport the samples to the laboratory.

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SCIENCE AND SERVICES DIVISION, DRINKING WATER LABORATORY

REQUISITION FOR WATER SAMPLE UNITS

By authority of PA 368, 1978

ORDER INFORMATION

Name			WSSN(public supply)
Street Address			Date
City	State	Zip code	Area Code & Phone Number

INSTRUCTIONS

- Determine TEST CODE and UNIT NUMBER for desired analysis using the Testing Fee Schedule on reverse side.
- Indicate QUANTITY NEEDED next to appropriate UNIT NUMBER. **DO NOT ORDER MORE SUPPLIES THAN WILL BE USED IN 3 MONTHS.**
- Testing is available only for determining the quality of drinking water, swimming pools and surface water.

UNIT NUMBER	Quantity Of SINGLES Needed	Quantity Of CASES Needed	UNIT PURPOSE (Preservatives - if any)
30			Bacteriological Testing - (10% Sodium Thiosulfate) *40 bottles per case - **limit 2***
30a	*cartons*		Bacteriological Testing - Six bottle carton (no mailing supplies included)
31			Bacteriological & Automated Partial Chemistry - Two Bottles *20 sets per case*
32			Automated Partial Chemistry *40 bottles per case*
32a			Disinfection Byproducts - (0.125mL of 5% Ethylenediamine)
33			Complete Minerals and Corrosion Control
36AC			Ammonia Testing - (0.5mL 1+1 Sulfuric Acid)
36CC			Lead & Copper Testing
36CN			Cyanide Testing, Unchlorinated Sources - (2.0mL of 10N Sodium Hydroxide)
36CNa			Cyanide Testing, Chlorinated Sources - (0.2g of Ascorbic Acid & 1 vial containing 2.0mL 10N Sodium Hydroxide)
36DQ			Diquat & Paraquat Testing - (0.1g sodium thiosulfate)
36EN			Endothall Testing - (0.02g sodium thiosulfate)
36FY			Fluorescent Dye Testing (Charcoal Packets)
36GY			Glyphosate Testing - (0.012g sodium thiosulfate)
36HA			Dalapon & Haloacetic Acids Testing (0.025g ammonium chloride)
36HS			Sulfide Testing - (2.5 mL of Zinc Acetate)
36LP			Carbamate Pesticides, Unchlorinated Sources - (3.6mL Monochloracetic Acid)
36LPa			Carbamate Pesticides, Chlorinated Sources - (0.01g of Sodium Thiosulfate & 1 vial containing 3.6 mL Monochloracetic Acid)
36ME			Metals, Except "first draw" lead copper samples requiring Unit 36CC
36NV			Synthetic organic compounds and Chlorinated Pesticides/Herbicides - (0.05g Sodium Sulfite)
36MP			Trihalomethane Formation Potential - (0.11mL 15:100 bleach) **One Month Expiration Made to Order**
36TO			Total Organic Carbon - (2 drops of 1+1 Phosphoric Acid)
36VO			Volatile Organic Substances - (0.025g Ascorbic Acid) *25 sets per case*
36VOb			Field blank - *14 Day Expiration* - MADE TO ORDER
37			Regulatory Monitoring for Public Water Supplies - includes: 36ME, 36VO, 36NV(2), 36LP, 36CN, 32
38			Unregulated Contaminate Monitoring Rule - includes: 36VO(2), 36NV(3), 32
			Other (please specify)

Orders may be telephoned to (517) 335-8184 or faxed (517) 335-8562.

This requisition may also be mailed to: **WATER SAMPLE UNIT ORDERS**
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
P O BOX 30270
LANSING MI 48909

DEQ

DRINKING WATER LABORATORY - **LANSING**
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

REQUEST FOR WATER ANALYSIS

- A form is required for **each sample site** (Collection Site and Sampling Point must be the same for all samples with this form).
- **PREPAYMENT OR CUSTOMER ACCOUNT NUMBER IS REQUIRED FOR TESTING.**
- **Complete all parts of this form which apply.** Samples not properly identified or not having clear test requests MAY NOT be tested.
- Fee amounts are subject to annual changes.

Customer Account Number	**OR**	Check # (payable to **State of Michigan**)	Amount enclosed

WSSN (Type I-II Public Water) or Pool Serial Number	Does sample contain chlorine? ☐ Yes ☐ No

DO NOT SEND CASH!

SAMPLE SOURCE - ***Circle One***

0 - Single Family Dwelling
1 - TYPE I (community, apartment, subdivision, mobile home park, etc., with 25 or more residents year round)
2 - TYPE II (school, industry, restaurant, office, etc., serving 25 or more persons - 60 days or more per year)
3 - TYPE III (all other public supplies, duplex, small office, etc.)
7 - Surface Water (includes bathing beach and waste water discharge)
8 - Swimming pool or Spa
9 - Other

SAMPLING PURPOSE - ***Circle One***

0 - Routine Monitoring
1 - Real Estate Transaction
2 - Repeat Sample
3 - Repair/Construction/New Well
5 - Water Quality Problem
9 - Other

SAMPLE POINT - ***Circle One***

1 - Public System Well
2 - Public System Surface Water
3 - Untreated Public Distribution System
4 - Treated Public Distribution System
5 - Untreated Private Well
6 - Treated/Softened Private Well
7 - Pressure Tank/Plant Tap
9 - Other

REPORT RESULTS TO: *PLEASE PRINT*

Name	E-mail address		Sample Collector Name
Mailing Address	Area Code & Phone number		Date Collected
City	State	Zip	Time Collected AM PM

SAMPLE COLLECTION INFORMATION *PLEASE PRINT*

Collector Code *Circle One*: 0 - County Personnel 1 - Water Supply Operator 2 - MDEQ WD staff 3 - Private Citizen 4 - MDEQ Staff other than WD 5 - MDNR Staff 6 - MDA Staff 9 - Other		System/Owner Name	
Collection Site (Street Address)		Township (If known)	Section (If known)
City	County	Zip	Well (If more than one) Number
Sampling Point (kitchen, bath, etc.)		Site Code (If known)	

TESTING REQUEST INFORMATION (REQUIRED)

INSTRUCTIONS: Check box next to Test Code(s) of desired analysis. Check the UNIT # on bottle to ensure you have the REQUIRED UNIT for desired analysis. For other types of testing, enter the TEST CODE, UNIT # (located on the sample bottle) and FEE in the area on the right side of this section. Refer to the full Testing Fee Schedule available from county health departments and DEQ Drinking Water Laboratory for other types of testing. **Fee amounts are subject to annual changes.**

☑	TEST CODE	REQUIRED UNIT #	TEST	FEE
	B	30	Drinking Water Coliforms (Bacteriology)	**$12.00**
	SW	30	Swimming Pool Water Coliform	**$12.00**
	NPEC	30	E. coli for **Surface/Wastewater**	**$15.00**
	N	30	Fecal Coliforms for **Surface/Wastewater**	**$15.00**
	R	32	Automated Partial Chemistry, *including Fluoride, Chloride, Hardness, Nitrate, Nitrite, Sulfate, Sodium and Iron*	**$14.00**
	CAS	36ME	Arsenic	**$16.00**
	CPM1	36ME	Iron, Manganese, Copper and Zinc	**$20.00**
	CPB	36ME	Lead	**$16.00**
	CCUB	36CC	Lead/Copper for corrosion control	**$22.00**
	CXVO	36VO	Organic Solvents Screen	**$90.00**

TEST CODE	UNIT#	FEE
TOTAL OF ALL FEES ⏩		

EQP 2500 (Front) 01/2003

Submit White Copy With Sample - Keep Yellow Copy For Your Records

For additional information contact your local county health department or the Drinking Water Laboratory, telephone (517) 335-8184 or visit our web site: http://www.michigan.gov/deq

Allow two weeks for results on most testing.

SAMPLE COLLECTION INSTRUCTIONS

UNIT#	INSTRUCTIONS
30	1. ***This testing unit contains preservatives in the sample bottle.*** Do not rinse the bottle with sample. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle. 2. If not collecting sample from a tap (lake, pool, etc.), plunge bottle mouth down, move in continuous arc down and back up from water, discard top half-inch or to 100 ml line. 3. If using a sample tap, select a clean faucet and remove such attachments as aerators, dishwasher connectors, etc. Allow water to run for about ten minutes (until cold) at full flow from the sampling tap. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. **Fill bottle only to the bottom of neck, or to 100 ml line.**
32, 32a 33, 36AC 36CN, 36DQ 36EN, 36GY 36HA, 36HS 36LP, 36ME 36NV	1. **Sample bottle may contain preservative** (refer to unit label on bottle). Do not rinse bottle with sample. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle. 2. Select a clean faucet and remove such attachments as aerators, dishwasher connectors, etc. Allow water to run for about ten minutes (until cold) at full flow from the sampling tap. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. Do not allow water from the outside surface of the faucet to drip into the bottle. **Fill bottle to the bottom of neck.**
36MP 36TO 36VO	1. **The sample vials contain preservative. Tap each vial in upright position to drain preservatives from cap. Do not rinse vial before collection.** 2. Do not open the vial until ready to collect the sample. Do not touch the inside of cap or vial. Select a clean faucet without attachments or leaking stem. Allow water to run for ten minutes (until cold) at full flow. 3. Reduce flow and collect the sample directly into all vials provided. **Fill vial until water rounds at the top of vial. Cap and invert to check for air in vial. THE SEPTA (RUBBER PART INSIDE CAP RING) MUST BE SMOOTH SIDE DOWN IN CONTACT WITH SAMPLE TO AVOID POSSIBLE CONTAMINATION.** 4. If air is observed in inverted sample, remove cap, add water (**DON'T DUMP SAMPLE**) and recap as instructed.
36CNa 36LPa	1. **Enclosed vial contains dilute preservative and caution should be exercised. This testing unit also contains preservatives in the sample bottle. Tap unit in upright position to drain preservatives from cap. Do not rinse bottle before collection.** 2. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle. 3. Do not rinse the bottle with sample. Select a clean faucet without attachments or leaking stem. Allow water to run for about ten minutes (until cold) at full flow from the sampling tap. 4. Reduce flow to avoid splashing, and collect the sample directly into the bottle. Do not use an intermediate container. **Fill to 1" below top of bottle. Cap and invert 5 times to mix sample with preservatives. Carefully add all preservative in vial to sample bottle. Cap the sample and mix sample. Rinse vial and return.**
36CC	1. Do not open the bottle until ready to collect the sample. Do not touch the inside of cap or bottle. 2. **Sampling point should not have been used for a minimum of six hours prior to sampling.** Do not flush the sample tap before sample collection. 3. Place bottle mouth below tap and turn on water filling bottle to the bottom of the neck.

DEQ

Jennifer M. Granholm, Governor

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SCIENCE & SERVICES DIVISION, DRINKING WATER LABORATORY
http://www.michigan.gov/deq/

Steven E. Chester, Director

TESTING FEE SCHEDULE

- **This Fee Schedule is effective January 1, 2002.** Fee amounts are subject to annual changes.
- See reverse side for description of sample unit codes and unit ordering information.
- **TEST CODE must be indicated in the TESTING REQUEST INFORMATION section of the form submitted with the sample.**

INORGANIC CHEMISTRY

TEST DESCRIPTION	FEE	UNIT NUMBER(S)	TEST CODE
Automated Partial Chemistry (Fluoride, Chloride, Hardness, Nitrate, Nitrite, Sulfate, Sodium, Iron)	$ 14.00	32	R
Cyanide by distillation/colorimetry (unchlorinated)	$ 25.00	36CN	CCN
Cyanide by distillation/colorimetry (chlorinated)		36CNa	
Hydrogen Sulfide by Titration	$ 30.00	36HS	CCHS
Specific Conductance	$ 12.00	32,33	CCON
Ammonia by Specific Ion Electrode	$ 30.00	36AC	CNH3
pH Determination	$ 13.00	32,33	CPH
Resistance for Demineralized Water	$ 10.00	32,33	CRES
Total Alkalinity as CaCO3	$ 16.00	32,33	CTALK
Silica as SiO2 by Colorimetry	$ 14.00	32,33	CSI
Tannates (Presence/Absence)	$ 11.00	32,33	CTAN
Hydrogen Sulfide (Presence/Absence)	$ 23.00	32	CH2S
Fluorescent Dye (Presence/Absence)	$ 17.00	36FY	CFDY
TBAS Screening	$ 13.00	32	CTBAS
Complete Minerals (TALK, Cl, F, NO3, NO2, SO4, SI, PM2, K, CON, PH, Hardness)	$100.00	33	CMIN
Ortho Phospate by Colorimetry	$ 17.00	32	CPO4
CCON, CTALK, CPO4, Calcium	$ 63.00	33	CORR
Disinfection Byproducts	$ 75.00	32a	CDBP
Perchlorate	$ 75.00	32	CCLO4
Total Organic Carbon	$ 30.00	36TO	CTOC

NOTE: Do not request more than **three test procedures** for each unit 32. Larger units may be used for more extensive requests, ie. unit 33 (more than three procedures).

METALS CHEMISTRY

TEST DESCRIPTION	FEE	UNIT NUMBER(S)	TEST CODE
Aluminum	$ 16.00	36ME	CAL
Antimony	$ 16.00	36ME	CSB
Arsenic	$ 16.00	36ME	CAS
Barium	$ 16.00	36ME	CBA
Beryllium	$ 16.00	36ME	CBE
Cadmium	$ 16.00	36ME	CCD
Chromium	$ 16.00	36ME	CCR
Lead	$ 16.00	36ME	CPB
Lead/Copper for corrosion control	$ 22.00	36CC	CCUB
Mercury	$ 16.00	36ME	CHG
Nickel	$ 16.00	36ME	CNI
Potassium	$ 13.00	32,33	CK
Selenium	$ 16.00	36ME	CSE
Strontium	$ 16.00	36ME	CSR
Thallium	$ 16.00	36ME	CTL
Tin	$ 16.00	36ME	CSN
Calcium/Magnesium/Sodium	$ 18.00	32,33	CPM2
Iron/Manganese/Copper/Zinc	$ 20.00	36ME	CPM1
Complete Metals for Private Wells (AS,SE,BA,CD,CR,HG,PB,PM1)	$ 70.00	36ME	CMET
Complete Metals for Public Supplies (SB,AS BA,BE,CD,CR,HG,PB,SE,NI,TL)	$ 80.00	36ME	CMET2

VOLATILE ORGANIC (VOC) CHEMISTRY

TEST DESCRIPTION	FEE	UNIT NUMBER(S)	TEST CODE
EDB and DBCP by GC/MS	$ 70.00	36VO	CXEV
Max Potential TTHM Formation	$ 55.00	36MP	CXMP
Organic Solvents Screen by ITD	$ 90.00	36VO	CXVO
Trihalomethanes	$ 55.00	36VO	CXTM
p-Dioxane	$115.00	36VO	CXPD

NOTE: Each test procedure requires a **separate sample unit**. Where possible, all detected substances will be identified by mass spectral examination. Names of specific compounds of concern should be provided along with sample and test request.

NON-VOLATILE ORGANIC (SOC) CHEMISTRY

TEST DESCRIPTION	FEE	UNIT NUMBER(S)	TEST CODE
Acidic Phenols by ITD	$150.00	36NV	CXAC
Aromatics by ITD	$110.00	36NV	CXPA
Organophosphate Pesticides by NPD	$150.00	36NV	CXPO
UV Active Pesticides by HPLC/UV	$110.00	36NV	CXL!
Carbamates by HPLC/PCD(unchlorinated)	$ 95.00	36LP	CXL.
Carbamates by HPLC/PCD(chlorinated)		36LPa	
Chlorinated Acid Herbicides	$ 95.00	36NV	CXHB
Pesticides Screening by ECD & NPD	$120.00	36NV	CXPT
Dalapon & Haloacetic Acids	$120.00	36HA	CXHA
Diquat	$150.00	36DQ	CXDQ
Glyphosate	$100.00	36GY	CXGY
Endothall	$150.00	36EN	CXEN

NOTE: Generally each test procedure requires a **separate sample unit**. If more than one type of testing is needed, contact the laboratory to determine the number of different units needed. Where possible, all detected substances will be identified by mass spectral examination. Names of specific compounds of concern should be provided with sample and test request(s).

MICROBIOLOGY

TEST DESCRIPTION	FEE	UNIT NUMBER(S)	TEST CODE
Drinking Water Coliforms(total & E. coli)	$12.00	30,30a	BPTC
Standard Plate Count(48 hours)	$12.00	30,30a	BSPC
Fecal Coliforms for Surface/Wastewater	$15.00	30,30a	NPFC
E. coli for Surface/Wastewater	$15.00	30,30a	NPEC
Swimming Pool Water Coliform	$12.00	30,30a	NSPC
Non-Potable Water Standard Plate Count (pools)	$12.00	30,30a	NPPC

NOTE: Surface water bacteriology is intended only to estimate bacterial group populations.

For questions regarding testing, contact
Drinking Water Laboratory
(517) 335-8184 - Lansing
(906) 482-3011 - Houghton

MICHIGAN DEPARTMENT
OF
ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

APPENDIX G

Laboratory Certification Program for Chemical and Microbiological Analysis of Drinking Water

QAPP-Ver2.0, Revison 0
May 5, 2003

Laboratory Certification Program For Chemical and Microbiological Analysis of Drinking Water Laboratories

Drinking Water Authority:

The Michigan Safe Drinking Water Act (Act 399, P.A. 1976, as amended) and Administrative Rules promulgated under the Act authorizes the Michigan Department of Environmental Quality to review and certify laboratories used or intended for use in the testing of water from public water supplies for determining compliance with state drinking water standards.

Scope and Applicability:

This certification program is applicable to all laboratories performing analysis of drinking water for the purposes of fulfilling the monitoring and reporting requirements of the rules and regulations promulgated under the Michigan Safe Drinking Water Act, the Federal Safe Drinking Water Act, or any subsequent state act requiring the use of a certified laboratory for drinking water analysis. The program will not prevent uncertified laboratories from performing any quality control or other tests when the state has not required such tests to be performed by a certified laboratory.

Definitions:

Analyst: Any person who performs analysis for certain or all parameters on samples submitted to the environmental laboratory and who meets the qualifications set in this program.

Certification: Official recognition by the Michigan Department of Environmental Quality of a laboratory's ability to perform analysis of public drinking water supply samples under the Safe Drinking Water Act. The recognition is based on the Michigan Department of Environmental Quality's determination that a laboratory has met all the minimum requirements of the Michigan Department of Environmental Quality's policies and procedures, the critical elements in the U.S. EPA Manual for the Certification of Analyzing Drinking Water, April 1990, or any subsequent revised editions of the manual and any requirements published by the U.S. EPA in the Federal Register. Certification is accompanied by a letter of certification and issuance of an official certificate.

Certified Laboratory: A laboratory that has successfully analyzed required performance evaluation samples, passed the on-site inspection, and has been granted certification by the Michigan Department of Environmental Quality.

Certification Officer: Any person designated by the Michigan Department of Environmental Quality to inspect and evaluate environmental laboratories and/or review the laboratory inspection reports generated by the third party for compliance in meeting the criteria set forth in this program.

Consultant: A person who is retained by a written agreement to provide professional consultation services.

Contaminant: The known substance contained in the performance evaluation or environmental sample for which an analysis is performed.

Environmental Laboratory: Any facility that performs analysis on environmental samples to determine the quality of public drinking water supplies, surface water, ground water, and recreational waters.

Laboratory Director: The person who is responsible for the operation of an environmental laboratory and who meets the qualifications set forth in this program.

Laboratory Supervisor: A person who supervises the performance of the analytical procedures within an environmental laboratory and who meets the qualifications set forth in this program.

Major Change in Personnel: The loss or replacement of the laboratory supervisor or a situation in which a trained and experienced analyst is no longer available to analyze a particular contaminant for which certification has been granted.

Major Remodeling: Remodeling of the laboratory facility that requires the acquisition of a local building permit.

Maximum Contaminant Level (MCL): A maximum permissible concentration of a contaminant in drinking water.

MDEQ: The Michigan Department of Environmental Quality

MI SDWA: The Michigan Safe Drinking Water Act (Act 399, P.A. 1976, as amended)

Noncertified Laboratory: A laboratory that possesses major deficiencies and/or cannot produce valid data as determined by the Michigan Department of Environmental Quality.

Performance Evaluation (PE) Samples: Samples that include contaminants in known concentrations (unknown to the laboratory), which are provided to laboratories for analysis to determine if the laboratory can satisfactorily perform specific analysis.

Proficiency Testing: Laboratory testing and analysis of performance evaluation and/or quality control samples provided by the Michigan Department of Environmental Quality, the third party, or other sources.

Program Manager: Designated third party representative responsible for implementing and operating the program. This individual will be responsible for on-site inspections, liaison with the Michigan Department of Environmental Quality, and consulting with certified laboratories.

Probationary Certification: A certification status granted by the Michigan Department of Environmental Quality to an environmental laboratory, which has corrected all deficiencies, but historically has several minor problems with personnel or practices.

Provisionally Certified Laboratory: A laboratory that has deficiencies, but can still produce valid data as determined by the Michigan Department of Environmental Quality.

Public Water Supply: All mains, pipes, and structures through which water is obtained and distributed to the public, including wells and well structures, intakes and cribs, pumping stations, treatment plants, reservoirs, storage tanks and appurtenances, collectively or severally, actually used or intended for use for the purpose of furnishing water for drinking or general domestic use and which serve at least 15 service connections or which regularly serve at least 25 persons at least 60 days per year.

Quality Control (QC) Samples: Water samples, which include contaminants in exact concentrations (known to the laboratory), provided to laboratories to assist them in evaluating their own performance.

Reciprocity: Mutual acceptance of a certification between the Michigan Department of Environmental Quality and other primary enforcement authorities of the Federal Safe Drinking Water Act.

SDWA: The Safe Drinking Water Act (Act 399, P.A. 1976, as amended)

Third Party: The organization(s) independent of the Michigan Department of Environmental Quality and environmental laboratories with whom the Michigan Department of Environmental Quality has a working agreement or contract for the field inspection and evaluation of environmental laboratories.

U.S. EPA: United States Environmental Protection Agency.

Certification Procedures:

A. An environmental laboratory which meets or exceeds the minimum criteria for certification may receive certification from the MDEQ for any organic chemical, inorganic chemical, or microbiological parameters for which methodologies have been specified by the drinking water regulations (40 CFR 141.21-141.25) or otherwise approved by the U.S. EPA for compliance with the SDWA.

B. The operational aspects of an environmental laboratory that will be evaluated in considering certification are:
   1. Physical facilities.
   2. Personnel.
   3. Methodology and instrumentation.
   4. Data handling.
   5. Quality control and assurance.
   6. Results of proficiency tests.

C. In seeking certification, the petitioning environmental laboratory must:
   1. Submit a formal request for certification to the MDEQ.
   2. Complete any applicable questionnaires furnished by the MDEQ giving information listed in Part B.
      a. Respond in a timely fashion to any questionnaire or inquiries from the third party or the MDEQ dealing with the operation, maintenance, or other data related to the certification of the environmental laboratory.
         1.) Environmental laboratories may be given a specified period of time to return the certification application, fee payments, and any other supporting/requested documentation.
         2.) The typical period of time for the environmental laboratories to return the requested material will be 90 days.
         3.) The time period will commence from the date the material is submitted to the environmental laboratory.
         4.) Based on a written request from the environmental laboratory, the certification officer may grant an extension to the response period.
   3. Analyze PE samples and possibly QC samples provided by the third party, the MDEQ, or the U.S. EPA, and report the results of the analysis to the MDEQ and/or the U.S. EPA.
   4. Permit an on-site inspection of the environmental laboratory by the third party or the MDEQ or a joint inspection by the third party and the MDEQ. The on-site inspection(s) will be arranged at the mutual convenience of all parties.
      a. The certification inspection of the environmental laboratory shall be scheduled to be held within 90 days after the application and fee payment has been returned to the MDEQ.

b. A written report will be submitted to the environmental laboratory from either the third party or the certification officer within 30 days following the inspection.
   1.) The written report shall state variances from the practices and requirements specified in other sections of this program which were found during the inspection or subsequent investigations.
   2.) The written report may request the environmental laboratory to implement certain actions to correct the variances.
   3.) The environmental laboratory must submit a written response regarding plans to implement any corrective measures requested in the report within 30 days of receiving the report.
   4.) The certification officer may base any decisions on the certification status of the environmental laboratory based on available information on file 30 days after the written report is submitted to the environmental laboratory.

5. Pay all fees associated with the certification process.
   a. Payment of fees for the certification inspection shall be made at the time the application is submitted to the MDEQ and prior to the on-site inspection.
   b. Environmental laboratories, where applicable, will be required to pay all fees associated with reagent water testing or obtaining proficiency samples.
   c. Fee schedules shall be formally established for all areas of the certification program.
      1.) The certification inspection and reagent water testing fee schedule and any subsequent adjustments shall be established by the state legislature. The proficiency sample fee schedule and method of payment shall be equivalent to the procedures established by the U.S. EPA or its designated contractor.

D. After the procedures in Part C have been completed, the MDEQ will:
1. Certify the environmental laboratory if appropriate.
   a. Certification will be based on the MDEQ review of the third party's or the MDEQ's inspection of the environmental laboratory.
   b. Certification will be based on the MDEQ review of any available information including information generated in Parts B and C.
   c. Certification will be effective for a three year period from the date of issue unless modified or revoked by the MDEQ.
   d. Certification will not be transferable. In the event of change of ownership, director, supervisor, analysts, or relocation or major remodeling of the physical plant of the environmental laboratory, the MDEQ and the third party must be notified in writing within 30 days.

e. Certification will be contingent upon a satisfactory quality control inspection by the third party or the MDEQ during the certification period.
   1.) Quality control inspection may or may not be made during certification period for any individual environmental laboratory.
   2.) Quality control inspection may be done randomly for all certified environmental laboratories.
   3.) Quality control inspection may be done at an individual environmental laboratory where either the third party or MDEQ suspects or has previously noted a deficiency, or as a result of a complaint.
   4.) In general, approximately 10% of all laboratory inspections performed will be quality control inspections.

2. Deny certification of the environmental laboratory.
   a. Denial of certification will be in writing.
   b. Denial of certification will list reason(s) for action.
   c. Denial of certification will include the third party or the MDEQ inspection report and information as to corrective action(s) needed.
   d. Denial of certification will not prevent the environmental laboratory from:
      1.) Reapplying for certification after corrective measures have been taken.
      2.) Seeking consultation from the MDEQ or the third party.
      3.) Performing any tests when the state has not required such tests to be performed by a certified laboratory.

3. Provisionally certify the environmental laboratory.
   a. May be issued when deviations or deficiencies from the applicable requirements are found, but the MDEQ believes the environmental laboratory can still generate acceptable results.
   b. May be issued as a result of normal certification inspection by the third party or the MDEQ.
   c. May be issued based on analytical results from any PE or QC samples.
   d. May be issued to a certified environmental laboratory as a result of a special quality control inspection performed during the normal certification period.
   e. Provisional certification may be effective up to 12 months from the date of issue unless modified, revoked, or upgraded by the MDEQ.
      1.) During the 12 month period of certification, the environmental laboratory's corrective action(s) will be reviewed.
         a.) A one-time extension of six months may be granted by the MDEQ for uncorrected deficiencies that the environmental laboratory is making a good faith effort to resolve.
         b.) If no effort to resolve the deficiencies has been made, certification will be revoked.

2.) The MDEQ may elect to keep a laboratory on provisional status after acceptable corrective action has been made, until the corrections are confirmed by an on-site visit by the third party, or MDEQ.

f. Provisional certification will not prevent the environmental laboratory from:
   1.) Reapplying for full certification after corrective measures have been taken.
   2.) Performing any tests required by the state to be performed by a certified laboratory unless restricted by the MDEQ when the provisional certificate was issued.
   3.) Seeking consultation from the MDEQ or the third party.

4. Probationary certification of the environmental laboratory.
   a. May be issued to an environmental laboratory, which has corrected all deficiencies, but historically has several problems with personnel or practices.
      1.) Probationary certification will typically be used by the MDEQ to express its concerns to an environmental laboratory regarding repeated or series of different deficiencies from one inspection to the next inspection.
      2.) Probationary certification may be used by the MDEQ to express its concerns to an environmental laboratory regarding the serious nature of a single major deficiency, which was found in a single inspection and has been corrected.
   b. Environmental laboratories issued probationary certification will receive closer scrutiny from the MDEQ or the third party.
      1.) Closer scrutiny may include special quality control inspections or special requests for information.
      2.) Closer scrutiny may include requests for the environmental laboratory to analyze additional PE samples.
   c. A probationally certified environmental laboratory has the full rights and responsibilities of a fully certified laboratory.
   d. An environmental laboratory may request upgrading to full certification after it has demonstrated its ability to maintain a deficient free facility.
      1.) The time period required for a laboratory to remain at the probationary rating will vary with the nature of the past deficiencies.
      2.) The environmental laboratory may request an explanation of the MDEQ's reasons for the probationary rating and the duration of the rating.
   e. May be issued to an environmental laboratory, which has no known current or past deficiencies.
      1.) Issuance of probationary certification under these circumstances will be done when the U.S. EPA mandates the use of restricted, conditional, or temporary certificates.

2.) Issuance may be done for any contaminant, group of contaminants, or analytical technique which is new to the environmental laboratory, or recently regulated contaminant.
   a.) Successful analysis of a set of PE samples may be required prior to certification.
   b.) Certification may be done at the request of the environmental laboratory.
   c.) Certification may be administratively issued by the MDEQ to an environmental laboratory which holds certification for similar contaminants prior to a formal on-site inspection.

f. Probationary certification will be effective for a three year period from the date of issue unless modified or revoked by the MDEQ.

Conditions of Certification

A. The environmental laboratory shall notify the third party and the Michigan Department of Environmental Quality of major changes.
   1. Major changes are considered to be:
      a. Major remodeling.
      b. Major change in personnel.
      c. Changes of laboratory director, supervisor, or owner.
      d. Relocation of the environmental laboratory.
      e. New laboratory equipment and/or changes of analytical procedures.
   2. As a result of any major changes the third party, or the MDEQ may:
      a. Request analysis of PE or QC samples.
      b. Request resumes of new personnel, director, supervisor, or owner.
      c. Make an on-site visit:
         1.) Visit may be informal.
         2.) Visit may be special quality control inspection.

B. The MDEQ may revoke or downgrade certification status. Any of the following may be cause for revocation of certification or downgrading the certification status:
   1. Failure to pass a regular certification or quality control inspection.
   2. Unsatisfactory analyses of PE or QC samples.
   3. Failure to notify the MDEQ of major changes within 30 days.
   4. Fraud or other criminal activity.
   5. Falsification of records or analytical results.
   6. Failure to respond to any MDEQ inquiry or questionnaire.
   7. Voluntary cancellation of certification.

C. The MDEQ will take several factors into account in considering actions to be taken against certified, probationally certified, or provisionally certified environmental

laboratory where deviations or deficiencies have been found. The factors include but are not limited to the following:

1. The length of time the deviation has existed.
2. The environmental laboratory's prior record of deviations and deficiencies.
3. The environmental laboratory's prior record of response in correcting deviations and deficiencies.
4. Whether the environmental laboratory knowingly caused or allowed the deviation or deficiencies.
5. The potential effect of the deviation or deficiency on the quality of the analytical data generated by the environmental laboratory.

D. Certification will be limited to the analytical procedures for which an environmental laboratory has been approved.

1. All contaminants for which the environmental laboratory has been approved will be listed on the certificate of approval.
   a. Certification will include contaminants for which compliance monitoring is mandated by the U.S. EPA or the MDEQ.
      1.) Certification will include all the regulated contaminants.
      2.) Certification may include the unregulated contaminants.
   b. Certification will not include contaminants for which compliance monitoring is not required by the U.S. EPA or MDEQ.
2. All procedures for which the environmental laboratory has been approved will be specified in writing.
3. The environmental laboratory shall not claim in any fashion that it is certified to perform any type of analysis for which it lacks the proper certification.
4. The MDEQ may elect to certify an environmental laboratory for a general analytical technique or group of contaminants versus individual parameters.
   a. The certification for a general analytical technique or a group of contaminants will be in writing.
   b. All individual contaminants accepted under the certified technique will be in writing.
   c. The certification for a general technique may be for the successful analysis of all or part of the PE or QC samples for the individual contaminants listed under the technique.
   d. The certification for partial successful analysis of the contaminants listed for a general technique will only be done within the guidelines developed by the U.S. EPA.
   e. The MDEQ may require the environmental laboratory to have been previously certified, or concurrently seeking, or to maintain certification for certain contaminants related to the general technique.
      1.) The MDEQ may require certification for total trihalomethanes as a prerequisite for the certification for the regulated volatile organic chemicals.

2.) The MDEQ may require certification for the regulated volatile organic chemicals as a prerequisite for the certification of the unregulated volatile organic chemicals.

3.) The MDEQ may require certification for other regulated chemicals as a prerequisite for certification of unregulated chemicals of the same general classification.

E. The environmental laboratory at its option may display any certificate of approval granted by the MDEQ.

1. The environmental laboratory may not claim that certification by the MDEQ is a guarantee of the validity of data generated by the environmental laboratory.
2. The environmental laboratory may not claim that certification by the MDEQ implies data generated by the environmental laboratory is superior to the data generated by another certified environmental laboratory.

F. An environmental laboratory will be required to analyze PE and possibly QC samples for initial certification or to maintain certification.

1. The environmental laboratory will be required to report the test results to the MDEQ within 30 days of receipt of the PE or QC samples.
2. Samples may be submitted to the environmental laboratory by the third party or MDEQ.
3. Samples may be submitted to the environmental laboratory by the U.S. EPA at the request of the third party or MDEQ.
4. There will be no charge to the third party or MDEQ by the environmental laboratory for the proficiency testing.
5. Failure to provide results within satisfactory precision and accuracy in PE or QC samples may be considered cause for action by the MDEQ.
   a. Action may include quality control or informal inspection by the third party and/or the MDEQ.
   b. Action may include revocation or downgrading of certification for the parameters not within satisfactory limits.
      1.) Failure of one set of PE or QC samples may be cause for the downgrading of certification.
      2.) Failure of two consecutive PE or QC samples may be cause for revocation of certification.
   c. Action may require the environmental laboratory to change equipment procedures or analysts.
   d. Action may include the submission of additional PE or QC samples.
      1.) A waiting period may be required before additional samples are submitted to the environmental laboratory.
      2.) Written assurance to the MDEQ may be required on the corrective measures undertaken by the environmental laboratory.

e. All environmental laboratories must successfully analyze at least one set of PE samples each year and one set of QC samples each quarter.
   1.) Failure to analyze either the PE or QC samples at the prescribed frequency will result in either the downgrading or revocation of the environmental laboratory's certification status.
   2.) The MDEQ may waive the requirement for the environmental laboratory to analyze PE or QC samples when the samples are not available and at the discretion of the U.S. EPA.
   3.) It is the responsibility of the environmental laboratory to submit to the MDEQ the results of the PE samples on at least an annual basis.

G. The environmental laboratory may subcontract with another environmental laboratory.
   1. The name of the environmental laboratory performing the analyses must appear on all reports of analytical results.
   2. For tests that are required to be performed by a certified laboratory, only laboratories with the proper certification may be used as a subcontractor.
   3. Any sample submitted to the environmental laboratory for proficiency testing may not be resubmitted to a subcontractor.

Authority of Certification Officer

The certification officer will have the following authority with this program in dealing with environmental laboratories:

A. To conduct on-site visits at the environmental laboratories.
   1. The third party will be primarily responsible for conducting all on-site visits.
   2. The certification officer may conduct an on-site visit.
      a. Most of the certification officer's on-site visits are expected to be as a part of a joint inspection with the third party.
      b. On-site visits may be considered a part of a certification inspection, a part or an entire quality control inspection, or an informal visit for consultation.
      c. On-site visits by the certification officer may be as a result of a request by the third party, the environmental laboratory, or other interested parties.
      d. On-site visits may be made to verify correction of deviations noted in any inspection report.

B. To act as the MDEQ's liaison with the third party.

C. To review reports generated by the third party regarding the environmental laboratory.

D. To require information relevant to the technical operation of the environmental laboratory.

1. The third party will be primarily responsible for the collection of the information.
2. The certification officer may contact either the environmental laboratory or the third party for the information.

E. To inspect quality assurance records and other pertinent records.

F. To observe and question analysts and work on parameters for which certification is sought.

G. To submit oral and written reports for granting or denying certification based on the completion of the evaluation process.

H. To require the environmental laboratory to analyze and report the results of any PE and QC samples for parameters that the environmental laboratory is certified or seeking certification to the MDEQ or the third party.

Reciprocity Agreements

The MDEQ may enter into agreements with the units of government of other states with SDWA primacy for the recognition of their environmental laboratory inspection or certification.

A. The MDEQ may elect to accept the certification of all environmental laboratories within the jurisdiction of another state.

B. The MDEQ may elect to review the inspection reports and other pertinent data generated by the primacy agency of another state for each individual environmental laboratory located outside of Michigan.

C. The MDEQ may elect to require the environmental laboratories located outside of Michigan to be inspected by the third party.

Oversight

A. The MDEQ will periodically meet with the third party.

1. Progress and criteria of laboratory certification process may be reviewed.
2. Corrections required of certain environmental laboratories may be reviewed.
3. Compliance with the MDEQ-third party contract for conducting the program may be reviewed.

B. The MDEQ will review certain laboratories on-site to determine that corrections to noted deficiencies are being made.

C. The MDEQ will conduct joint inspections of environmental laboratories with the third party from time to time to directly observe the inspection program.

D. MDEQ will investigate complaints of either the third party certification inspection program staff or the environmental laboratories.

Hearings and Appeals

A. The MDEQ will give written notice to the director or owner of an environmental laboratory on any action on revocation, partial revocation, or downgrading of the laboratory's certification.
   1. The notice will include the facts used by the MDEQ for the action.
   2. The notice will include the procedure for requesting a hearing.
   3. The notice may immediately revoke, partially revoke, or downgrade the certification of any environmental laboratory.
      a. Immediate and summary actions will be taken if there is substantial risks to the public health or safety due to laboratory deficiencies compromising the analytical results.
      b. Other actions will allow the environmental laboratory 30 days to respond to the notice.
      c. Immediate and summary actions will be based on documented evidence by the MDEQ.

B. Any hearing requested by an environmental laboratory in response to a notice from the MDEQ will be in accordance with the Michigan Administrative Procedures Act (Act 306, P.A. 1969, as amended).

Criteria for Conducting On-Site Evaluations

A. The third party will be primarily responsible for conducting the on-site evaluations based on the criteria developed by the MDEQ or jointly developed by the MDEQ and third party.
   1. The criteria developed by the third party will be subject to review and approval by the MDEQ.
   2. The criteria used by the MDEQ or the third party must, at a minimum, comply with the provisions of the U.S. EPA Manual for the Certification of Laboratories Analyzing Drinking Water, April 1990, or any subsequent revised editions of the manual, 40 CFR, Part 141 as amended, any directives issued on certification, QA/QC and analytical methodology by the MDEQ or the U.S. EPA, or published in the Federal Register by the U.S. EPA.
   3. The third party will make revisions to their criteria as amendments/revisions are made to the documents listed in A.2. above.

4. The latest U.S. EPA approved edition of Standard Methods may be used in developing the criteria.
5. In the event an MDEQ and third party contract is not in effect, the MDEQ will conduct all inspections.

B. Alternative Test Procedures (ATP).
1. Applicants who propose an ATP on a limited basis need to provide a step-by-step procedure, applicable literature citations or other references, and any available comparability data between the proposed ATP and the U.S. EPA-approved test procedure for the same contaminant.
2. In the case of new techniques where precision and accuracy data may not be available to support an application, the applicant for a limited use ATP will be asked to provide comparability data from the analysis of samples collected from one to five water supply systems most representative of those routinely analyzed. From each of these systems, three samples, in which the concentrations range from the limit of detection (LD) to the maximum contaminant level (MCL), should be collected and each sample analyzed eight times, four times each, by the proposed technique and the U.S. EPA-approved test procedures. Samples can be spiked as necessary to cover the concentration range between the LD and MCL.
3. Applicants will forward their ATP request to the MDEQ. The MDEQ will forward ATP requests for limited use with their recommendations to the Regional Administrator, Region 5, for approval. The Regional Administrator has final authority to approve limited use ATP request.

Reagent Water Testing

A. Laboratory pure water used in the microbiological analyses of drinking water shall have these characteristics:

Property	Value
pH	5.5-7.5
Conductivity	Less than 2.0 micromhos/cm (resistivity greater than 0.5 megohm cm) ± 1 percent at 25°C
Trace Metals:	
Individual Metals	Less than or equal to 0.05 mg/l
Total Metals (Pb, Cd, Cr, Cu, Ni, Zn)	Less than or equal to 0.1 mg/l
Test for Bactericidal Properties of Distilled Water	Ratio of 0.8 to 3.0

Free Chlorine Residual	None
Heterotrophic Plate Count	Less than 500 CFU's/ml

B. Laboratory pure water shall be analyzed annually by the test for bacteriological quality of distilled water as specified in the latest U.S. EPA approved edition of "Standard Methods for the Examination of Water and Wastewater" or the U.S. EPA's Manual for the Certification of Laboratories Analyzing Drinking Water, April 1990. Only satisfactorily tested water shall be used in preparing media, reagents, rinse, and dilution water. If the water tested does not meet the requirements, corrective action shall be taken and the water retested.

C. Laboratory pure water shall be analyzed monthly for conductance, pH, chlorine residual, and heterotrophic plate count. Heterotrophic plate counts shall be performed as specified in the latest U.S. EPA approved edition of "Standard Methods for the Examination of Water and Wastewater". If the water tested exceeds requirement for these properties, corrective action shall be taken and the water retested.

D. Laboratory pure water shall not be in contact with heavy metals, and shall be analyzed initially and annually thereafter for trace metals (especially Pb, Cd, Cr, Cu, Ni, and Zn). If the water tested exceeds requirements for trace metals, corrective action shall be taken and the water retested.

E. The following quality control tests for heterotrophic plate count shall be utilized:
   1. Sterility controls shall be poured for each bottle of sterile, melted, tempered medium used.
   2. Sterility of pipettes and petri dishes shall be determined.
   3. Microbial density of the air during plating procedures shall be determined for each series of samples plated. When 15 or more colonies appear on an exposed plate after a 15 minute exposure period and 48 hours of incubation at 35°C, corrective action shall be taken.

Response to Analytical Results

A. The environmental laboratory must notify the individual in charge of a public water supply when analytical results of a sample from that supply exceed a maximum contaminant level (MCL).
   1. Notification shall be made as soon as possible.
   2. Notification shall be made on any positive presumptive microbiological results.
      a. Positive presumptive results shall be listed as preliminary.
      b. Verified/confirmed results shall be reported to the public water supply.

c. The purpose of this requirement is to allow the public water supply to begin preliminary investigations and the collection of any check or resamples samples as soon as possible.

3. The initial notification may be made verbally.
4. A final written report shall be made in a timely fashion.

B. The MDEQ may request a copy of the analytical results of any sample from a public water supply.
   1. The results shall be provided in a timely fashion to the MDEQ.
   2. Any analytical results obtained by the MDEQ are open to the general public through the Michigan Freedom of Information Act.

ADDENDUM TO APPENDIX I OF THE MDEQ WATER SUPPLY SAFETY QUALITY ASSURANCE PROGRAM PLAN (EFFECTIVE MARCH 31, 2000)

Issuance of Administrative Extension

Issuance of Administrative Extension (Effective March 31, 2000):

A. In order to allow enough lead-time for a laboratory to be recertified, the Laboratory Certification Program Officer will send out the recertification package seven months in advance of a laboratory's certification expiration date. This lead-time allows for the following windows:

1. If a third party auditor is to be used to conduct the audit:
    a. The laboratory must return the application package to the State within 30 days.
    b. The State must forward the certification package to the third party auditor within seven days.
    c. The third party auditor must conduct the inspection within 90 days.
    d. The third party auditor must issue an inspection report to the laboratory within 30 days.
    e. The laboratory must provide corrective action plans for the deficiencies cited in the report within 30 days.
    f. The third party auditor must evaluate the corrective actions and make a recommendation regarding the certification status of the inspected laboratory to the State within 15 days.
    g. The State must make a final determination regarding the certification status of the inspected laboratory within seven days.
2. If the State is to conduct the audit:
    a. The lab must return the inspection package to the State within 30 days.
    b. The State must conduct the inspection within 45 days.
    c. The State must issue a report to the inspected laboratory within 15 days.
    d. The laboratory must provide corrective action plans for the deficiencies cited in the report within 30 days.
    e. The State must evaluate the corrective actions and make a final determination regarding the certification status of the inspected laboratory within 15 days.

B. Occasionally, there may be circumstances beyond the inspected laboratory's control that prevent the laboratory from finishing the recertification process prior to the expiration of their certification. In these cases, the laboratory will be issued an administrative extension of their certification so that they may continue to operate as a certified laboratory until the recertification process can be completed.

C. If an administrative extension is granted, documentation must be maintained in the laboratory's file indicating the reason for the extension. The extension shall be initially given for a period of no more than 90 days.

The laboratory may be issued another 90-day extension after the initial extension, provided that the reason for the extension is documented. The second extension may only be given in extenuating circumstances. Such circumstances include a failure on the part of the third party auditor to fulfill their contractual obligations or a failure on the part of the State to administer the time frame requirements.

D. The certification of the laboratory will lapse if the delay in the recertification process is due to a failure on the part of the laboratory to adhere to the specified deadlines. In these cases, the laboratory will not be considered certified and will be required to begin the certification process as if it were a new laboratory.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

TABLE 1

MDEQ Environmental Laboratory Capabilities and Reporting Limits

QAPP-Ver2.0, Revison 0
May 5, 2003

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

VOLATILE ORGANICS Method 624/8260	Water/TCLP/SPLP Reporting Limits (ug/L)	MeOH Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
1,1,1,2-Tetrachloroethane	1.0	50	1.0	2 - 40mL glass vial	40mL tared glass	5mL of sample
1,1,1-Trichloroethane	1.0	50	1.0	w/Teflon Septum	vial	in glass
1,1,2,2-Tetrachloroethane	1.0	50	1.0	seal	10grams sample	"
1,1,2-Trichloroethane	1.0	50	1.0	14 days HT	in 10mL MeOH	"
1,1-Dichloroethane	1.0	50	1.0	"	w/teflon sea	"
1,1-Dichloroethylene	1.0	50	1.0	"	14 days HT	"
1,2,3-Trichlorobenzene	5.0	250	5.0	"	"	"
1,2,3-Trichloropropane	1.0	50	1.0	"	"	"
1,2,4-Trichlorobenzene	5.0	250	5.0	"	"	"
1,2,4-Trimethylbenzene	1.0	50	1.0	"	"	"
1,2-Dibromo-3-chloropropane	5.0	250	5.0	"	"	"
1,2-Dibromoethane	1.0	50	1.0	"	"	"
1,2-Dichlorobenzene	1.0	50	1.0	"	"	"
1,2-Dichloroethane	1.0	50	1.0	"	"	"
1,2-Dichloroethylene (cis	1.0	50	1.0	"	"	"
1,2-Dichloroethylene (trans	1.0	50	1.0	"	"	"
1,2-Dichloropropane	1.0	50	1.0	"	"	"
1,3,5-Trimethylbenzene(Mesitylene	1.0	50	1.0	"	"	"
1,3-Dichlorobenzene	1.0	50	1.0	"	"	"
1,3-Dichloropropene (cis	1.0	50	1.0	"	"	"
1,3-Dichloropropene (trans	1.0	50	1.0	"	"	"
1,4-Dichloro-2-butene(trans)	5.0	250	5.0	"	"	"
1,4-Dichlorobenzene	1.0	50	1.0	"	"	"
2-Butanone (MEK)	5.0	250	5.0	"	"	"
2-Hexanone	5.0	250	5.0	"	"	"
2-Methylnaphthalene	5.0	250	5.0	"	"	"
Acetone (2-Propanone)	20	1,000	20	"	"	"
4-Methyl-2-Pentanone (MIBK)	5.0	250	5.0	"	"	"
Acrylonitrile	5.0	250	5.0	"	"	"
Benzene	1.0	50	1.0	"	"	"
Bromobenzene	1.0	50	1.0	"	"	"
Bromochloromethane	1.0	50	1.0	"	"	"
Bromodichloromethane	1.0	50	1.0	"	"	"
Bromoform	1.0	50	1.0	"	"	"
Bromomethane	5.0	250	5.0	"	"	"
Carbon disulfide	1.0	50	1.0	"	"	"
Carbon tetrachloride	1.0	50	1.0	"	"	"
Chlorobenzene	1.0	50	1.0	"	"	"
Chloroethane	5.0	250	5.0	"	"	"
Chloroform	1.0	50	1.0	"	"	"
Chloromethane	5.0	250	5.0	"	"	"
Dibromochloromethane	1.0	50	1.0	"	"	"
Dibromomethane	1.0	50	1.0	"	"	"
Dichlorodifluoromethane	5.0	250	5.0	"	"	"
Diethyl ether	5.0	250	5.0	"	"	"
Ethylbenzene	1.0	50	1.0	"	"	"
Hexachloroethane	5.0	250	5.0	"	"	"
Isopropylbenzene	1.0	50	1.0	"	"	"
m&p-Xylene	2.0	100	2.0	"	"	"
Methyl Iodide (Iodomethane)	1.0	50	1.0	"	"	"
Methyl Tertiary Butyl Ether (MTBE)	1.0	50	1.0	"	"	"
Methylene chloride	5.0	250	5.0	"	"	"
Naphthalene	5.0	250	5.0	"	"	"
n-Butylbenzene	1.0	50	1.0	"	"	"
n-Propylbenzene	1.0	50	1.0	"	"	"
o-Xylene	1.0	50	1.0	"	"	"
p-Isopropyl Toluene (p-Cymene	1.0	50	1.0	"	"	"
sec-Butylbenzene	1.0	50	1.0	"	"	"
Styrene	1.0	50	1.0	"	"	"
tert- Butylbenzene	1.0	50	1.0	"	"	"
Tetrachloroethylene	1.0	50	1.0	"	"	"
Tetrahydrofurar	5.0	250	5.0	"	"	"
Toluene	1.0	50	1.0	"	"	"
Trichloroethylene	1.0	50	1.0	"	"	"
Trichlorofluoromethane	1.0	50	1.0	"	"	"
Vinyl chloride	1.0	50(40)*	1.0	"	"	"

*Estimated results between 40 and 50

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

BTEX/MTBE VOLATILES Method 624/8260	Water/TCLP/SPLP Reporting Limits (ug/L)	MeOH Sediment/Soi Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soi Containers & Hold Times	Oil Containers
Benzene	1.0	50	1.0	2 - 40mL glass vial	40mL tared glass	5mL of sample
Toluene	1.0	50	1.0	w/Teflon Septum	vial	in glass
Ethylbenzene	1.0	50	1.0	seal	10grams sample	"
m & p-Xylene	2.0	100	2.0	14 days HT	in 10mL MeOH	"
0 -Xylene	1.0	50	1.0	"	w/teflon sea	"
Methyl Tertiary Butyl Ethe	1.0	50	1.0	"	14 days HT	"

Pesticides Method 608/8081	Water Reporting Limits (ug/L)	Sediment/Soi Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soi Containers & Hold Times	Oil Containers
Aldrin	0.02	20	0.2	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
a-BHC	0.02	20	0.2	amber bottles	14 days HT	"
b-BHC	0.02	20	0.2	7 days HT	"	"
d-BHC	0.02	20	0.2	"	"	"
g-BHC (lindane)	0.02	20	0.2	"	"	"
BP-6 (PPB)	0.05	250	0.7	"	"	"
a-Chlordane	0.02	50	0.2	"	"	"
g-Chlordane	0.02	50	0.2	"	"	"
4,4'-DDD	0.02	20	0.2	"	"	"
4,4'-DDE	0.02	20	0.2	"	"	"
4,4'-DDT	0.02	20	0.2	"	"	"
Dieldrin	0.02	20	0.2	"	"	"
Endosulfan I	0.02	20	0.2	"	"	"
Endosulfan II	0.05	20	0.4	"	"	"
Endosulfan Sulfate	0.05	20	0.4	"	"	"
Endrin	0.02	20	0.2	"	"	"
Endrin Aldehyde	0.05	20	0.4	"	"	"
Endrin Ketone	0.05	20	0.4	"	"	"
Heptachlor	0.02	20	0.4	"	"	"
Heptachlor epoxide	0.02	20	0.4	"	"	"
Hexabromobenzene	0.02	100	0.2	"	"	"
Methoxychlor	0.05	50	0.4	"	"	"
Mirex	0.02	50	0.2	"	"	"
Toxaphene	0.1	170	10	"	"	"

PCBs Method 608/8082	Water Reporting Limits (ug/L)	Sediment/Soi Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soi Containers & Hold Times	Oil Containers
PCB-1016	0.1	100	1.0	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
PCB-1221	0.1	100	1.0	amber bottles	14 days HT	"
PCB-1232	0.1	100	1.0	7 days HT	"	"
PCB-1242	0.1	100	1.0	"	"	"
PCB-1248	0.1	100	1.0	"	"	"
PCB-1254	0.1	100	1.0	"	"	"
PCB-1260	0.1	100	1.0	"	"	"
PCB-1262	0.1	100	1.0	"	"	"
PCB-1268	0.1	100	1.0	"	"	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

NPDES Scan 3 Method 608	Water Reporting Limits (ug/L)	Water Containers & Hold Times
Aldrin	0.01	2 - 1000mL glass
a-BHC	0.01	amber bottles
b-BHC	0.01	7 days HT
d-BHC	0.01	"
g-BHC (lindane)	0.01	"
BP-6 (PBB)	0.05	"
a-Chlordane	0.01	"
g-Chlordane	0.01	"
4,4'-DDD	0.05	"
4,4'-DDE	0.01	"
4,4'-DDT	0.01	"
Dieldrin	0.01	"
Endosulfan I	0.01	"
Endrin	0.01	"
Heptachlor	0.01	"
Heptachlor epoxide	0.01	"
Hexabromobenzene	0.01	"
Hexachlorobenzene	0.01	"
Hexachlorobutadiene	0.01	"
Hexachlorocyclopentadiene	0.01	"
Methoxychlor	0.05	"
Mirex	0.01	"
PCB 1016	0.1	"
PCB 1221	0.1	"
PCB 1232	0.1	"
PCB 1242	0.1	"
PCB 1248	0.1	"
PCB 1254	0.1	"
PCB 1260	0.1	"
PCB 1262	0.1	"
PCB 1268	0.1	"
Pentachlorobenzene	0.01	"
Pentachloronitrobenzene	0.01	"
Toxaphene	0.1	"
1,2,3,4-Tetrachlorobenzene	0.01	"
1,2,4,5-Tetrachlorobenzene	0.01	"

This scan is available for NPDES samples only.

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Polynuclear Aromatic Hydrocarbon (PNAs) Method 625/827C	Water Reporting Limits (ug/L)	Sediment/Soi Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soi Containers & Hold Times	Oil Containers
Acenaphthene	1.0	100	100	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
Acenaphthylene	1.0	100	100	amber bottles	14 days HT	"
Anthracene	1.0	100	100	7 days HT	"	"
Benz(a)anthracene	1.0	100	100	"	"	"
Benzo(b)fluoranthene	2.0	200	200	"	"	"
Benzo(k)fluoranthene	2.0	200	200	"	"	"
Benzo(a)pyrene	2.0	200	200	"	"	"
Benzo(g,h,i)perylene	2.0	200	200	"	"	"
Chrysene	1.0	100	100	"	"	"
Dibenz(a,h)anthracene	2.0	200	200	"	"	"
Fluoranthene	1.0	100	100	"	"	"
Fluorene	1.0	100	100	"	"	"
Indeno(1,2,3-cd)pyrene	2.0	200	200	"	"	"
2-Methylnaphthalene	5.0	250	500	"	"	"
Naphthalene	1.0	100	100	"	"	"
Phenanthrene	1.0	100	100	"	"	"
Pyrene	1.0	100	100	"	"	"

PHENOLS (ACIDS) Method 625/827C	Water Reporting Limits (ug/L)	Water Containers & Hold Times
2-Chlorophenol	10	2 - 1000mL glass
4-Chloro-3-methylphenol	10	amber bottles
3/4-Methylphenol (m/p-cresol	20	7 days HT
2-Methylphenol (o-cresol	10	"
2,4-Dichlorophenol	10	"
2,4-Dimethylphenol	10	"
2,4-Dinitrophenol	50	"
2-Methyl-4,6-dinitrophenol	50	"
2-Nitrophenol	10	"
4-Nitrophenol	50	"
Pentachlorophenol	50	"
Phenol	10	"
2,4,5-Trichlorophenol	10	"
2,4,6-Trichlorophenol	10	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Semivolatile Organics Base/Neutral Method 625/8270	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
1,2,4-Trichlorobenzene	2.0	200	200	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
1,2-Dichlorobenzene	1.0	100	100	amber bottles	14 days HT	"
1,3-Dichlorobenzene	1.0	100	100	7 days HT	"	"
1,4-Dichlorobenzene	1.0	100	100	"	"	"
2,4-Dinitrotoluene	5.0	330	500	"	"	"
2,6-Dinitrotoluene	5.0	330	500	"	"	"
2-Chloronaphthalene	2.0	200	200	"	"	"
2-Methylnaphthalene	5.0	250	500	"	"	"
2-Nitroaniline	20	1,700	2000	"	"	"
3-Nitroaniline	20	1,700	2000	"	"	"
4-Bromophenyl phenylether	2.0	200	200	"	"	"
4-Chlorophenyl phenylether	1.0	100	100	"	"	"
4-Nitroaniline	20	1,700	2000	"	"	"
Acenaphthene	1.0	100	100	"	"	"
Acenaphthylene	1.0	100	100	"	"	"
Anthracene	1.0	100	100	"	"	"
Azobenzene	2.0	200	200	"	"	"
Benz(a)anthracene	1.0	100	100	"	"	"
Benzo(a)pyrene	2.0	200	200	"	"	"
Benzo(b)fluoranthene	2.0	200	200	"	"	"
Benzo(g,h,i)perylene	2.0	200	200	"	"	"
Benzo(k)fluoranthene	2.0	200	200	"	"	"
Bis(2-chloroethoxy)methane	2.0	200	200	"	"	"
Bis(2-chloroethyl)ether	1.0	100	100	"	"	"
Bis(2-chloroisopropyl)ether	1.0	100	100	"	"	"
Bis(2-ethylhexyl)phthalate	2.0	200	200	"	"	"
Butyl benzyl phthalate	1.0	100	100	"	"	"
Carbazole	10	330	1000	"	"	"
Chrysene	1.0	100	100	"	"	"
Dibenz(a,h)anthracene	2.0	200	200	"	"	"
Dibenzofuran	5.0	330	500	"	"	"
Diethyl phthalate	1.0	100	100	"	"	"
Dimethyl phthalate	2.0	200	200	"	"	"
Di-n-butyl phthalate	1.0	100	100	"	"	"
Di-n-octyl phthalate	2.0	200	200	"	"	"
Fluoranthene	1.0	100	100	"	"	"
Fluorene	1.0	100	100	"	"	"
Hexachlorobenzene	2.0	200	200	"	"	"
Hexachlorobutadiene	2.0	200	200	"	"	"
Hexachlorocyclopentadiene	10	2,000	1000	"	"	"
Hexachloroethane	1.0	100	100	"	"	"
Indeno(1,2,3-cd)pyrene	2.0	200	200	"	"	"
Isophorone	1.0	100	100	"	"	"
Naphthalene	1.0	100	100	"	"	"
Nitrobenzene	2.0	200	200	"	"	"
N-Nitrosodimethylamine	5.0	330	500	"	"	"
N-Nitrosodi-n-propylamine	2.0	200	200	"	"	"
N-Nitrosodiphenylamine	2.0	200	200	"	"	"
Phenanthrene	1.0	100	100	"	"	"
Pyrene	1.0	100	100	"	"	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Semivolatile Organics Base/Neutral/Acids Method 625/8270	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
1,2,4-Trichlorobenzene	2.0	200	200	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
1,2-Dichlorobenzene	1.0	100	100	amber bottles	14 days HT	"
1,3-Dichlorobenzene	1.0	100	100	7 days HT	"	"
1,4-Dichlorobenzene	1.0	100	100	"	"	"
2,4,5-Trichlorophenol	10	330	1000	"	"	"
2,4,6-Trichlorophenol	10	330	1000	"	"	"
2,4-Dichlorophenol	10	330	1000	"	"	"
2,4-Dimethylphenol	10	330	1000	"	"	"
2,4-Dinitrophenol	50	1,700	5000	"	"	"
2,4-Dinitrotoluene	5.0	330	500	"	"	"
2,6-Dinitrotoluene	5.0	330	500	"	"	"
2-Chloronaphthalene	2.0	200	200	"	"	"
2-Chlorophenol	10	330	1000	"	"	"
2-Methyl-4,6-dinitrophenol	50	1,700	5000	"	"	"
2-Methylnaphthalene	5.0	250	500	"	"	"
2-Methylphenol	10	330	1000	"	"	"
2-Nitroaniline	20	1,700	2000	"	"	"
2-Nitrophenol	10	330	1000	"	"	"
3/4-Methylphenol	20	660	2000	"	"	"
3-Nitroaniline	20	1,700	2000	"	"	"
4-Bromophenyl phenylether	2.0	200	200	"	"	"
4-Chloro-3-methylphenol	10	330	1000	"	"	"
4-Chlorophenyl phenylether	1.0	100	100	"	"	"
4-Nitroaniline	20	1,700	2000	"	"	"
4-Nitrophenol	50	1,700	5000	"	"	"
Acenaphthene	1.0	100	100	"	"	"
Acenaphthylene	1.0	100	100	"	"	"
Anthracene	1.0	100	100	"	"	"
Azobenzene	2.0	200	200	"	"	"
Benz(a)anthracene	1.0	100	100	"	"	"
Benzo(a)pyrene	2.0	200	200	"	"	"
Benzo(b)fluoranthene	2.0	200	200	"	"	"
Benzo(g,h,i)perylene	2.0	200	200	"	"	"
Benzo(k)fluoranthene	2.0	200	200	"	"	"
Bis(2-chloroethoxy)methane	2.0	200	200	"	"	"
Bis(2-chloroethyl)ether	1.0	100	100	"	"	"
Bis(2-chloroisopropyl)ether	1.0	100	100	"	"	"
Bis(2-ethylhexyl)phthalate	2.0	200	200	"	"	"
Butyl benzyl phthalate	1.0	100	100	"	"	"
Carbazole	10	330	1000	"	"	"
Chrysene	1.0	100	100	"	"	"
Dibenz(a,h)anthracene	2.0	200	200	"	"	"
Dibenzofuran	5.0	330	500	"	"	"
Diethyl phthalate	1.0	100	100	"	"	"
Dimethyl phthalate	2.0	200	200	"	"	"
Di-n-butyl phthalate	1.0	100	100	"	"	"
Di-n-octyl phthalate	2.0	200	200	"	"	"
Fluoranthene	1.0	100	100	"	"	"
Fluorene	1.0	100	100	"	"	"
Hexachlorobenzene	2.0	200	200	"	"	"
Hexachlorobutadiene	2.0	200	200	"	"	"
Hexachlorocyclopentadiene	10	2,000	1000	"	"	"
Hexachloroethane	1.0	100	100	"	"	"
Indeno(1,2,3-cd)pyrene	2.0	200	200	"	"	"
Isophorone	1.0	100	100	"	"	"
Naphthalene	1.0	100	100	"	"	"
Nitrobenzene	2.0	200	200	"	"	"
N-Nitrosodimethylamine	5.0	330	500	"	"	"
N-Nitrosodi-n-propylamine	2.0	200	200	"	"	"
N-Nitrosodiphenylamine	2.0	200	200	"	"	"
Pentachlorophenol	50	3,400	5000	"	"	"
Phenanthrene	1.0	100	100	"	"	"
Phenol	10	330	1000	"	"	"
Pyrene	1.0	100	100	"	"	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Metals	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Analytical Method Reference EPA / SW-846^	MDEQ Technique	Water Containers & Hold Times	Sediment Containers & Hold Times
Aluminum	50	5,000	200.7/6010B	ICP	500 mL plastic	250 mL (8 oz.)
Aluminum	50		200.8/6020	ICP-MS	6 months HT	glass jar
Antimony	1		204.1/7040	Hydride	"	6 months HT
Antimony	1		200.8/6020	ICP-MS	"	"
Arsenic	1	500	206.3/7061A	Hydride	"	"
Arsenic	1	500	206.2/7060A	Furnace	"	"
Arsenic	1		200.8/6020	ICP-MS	"	"
Barium	5	1,000	200.7/6010B	ICP	"	"
Barium	5		200.8/6020	ICP-MS	"	"
Beryllium	1	200	200.7/6010B	ICP	"	"
Beryllium	1		200.8/6020	ICP-MS	"	"
Boron	20		200.7/6010B	ICP	"	"
Cadmium	5	2,000	200.7/6010B	ICP	"	"
Cadmium	0.2+		213.2/7131A	Furnace	"	"
Cadmium	0.2		200.8/6020	ICP-MS	"	"
Calcium	1,000	50,000	215.1/7140	FAAS	"	"
Chromium	20	2,000	200.7/6010B	ICP	"	"
Chromium	1		218.2/7191	Furnace	"	"
Chromium VI	5		7196A	DPC	24 hours HT	24 Hrs. after extraction HT
Cobalt	15	2,000	200.7/6010B	ICP	6 months HT	6 months HT
Cobalt	15		200.8/6020	ICP-MS	"	"
Copper	10	1,000	200.7/6010B	ICP	"	"
Copper	1		220.2/7211	Furnace	"	"
Copper	1		200.8/6020	ICP-MS	"	"
Iron	20	5,000	200.7/6010B	ICP	"	"
Lead	50	5,000	239.1/7420	FAAS	"	"
Lead	50	5,000	200.7/6010B	ICP	"	"
Lead	1		239.2/7421	Furnace	"	"
Lead	1		200.8/6020	ICP-MS	"	"
Lithium	8	2,000	200.7/6010B	ICP	"	"
Magnesium	1,000	50,000	242.1/7450	FAAS	"	"
Manganese	5	1,000	200.7/6010B	ICP	"	"
Manganese	5		200.8/6020	ICP-MS	"	"
Mercury	0.2	50	245.1/7470A,7471A	Cold Vapor	28 days HT	28 days HT
Mercury (LL)	.0005		245.7/1631	CVAFS	FP bottles - 28 days HT	
Molybdenum	25	5,000	200.7/6010B	ICP	500 mL plastic	6 months HT
Molybdenum	25		200.8/6020	ICP-MS	6 months HT	"
Nickel	25	5,000	200.7/6010B	ICP	"	"
Nickel	2		249.2/7521	Furnace	"	"
Nickel	2		200.8/6020	ICP-MS	"	"
Potasium	100	5,000	258.1/7610	FAES	"	"
Selenium	1	500	270.3/7741A	Hydride	"	"
Selenium	1	500	270.2/7740	Furnace	"	"
Silver	0.5+	250	272.2/7761	Furnace	"	"
Silver	0.5		200.8/6020	ICP-MS	"	"
Sodium	1,000	50,000	273.1/7770	FAAS	"	"
Strontium	5	1,000	200.7/6010B	ICP	"	"
Strontium	5		200.8/6020	ICP-MS	"	"
Titanium	10	1,000	200.7/6010B	ICP	"	"
Titanium	10		200.8/6020	ICP-MS	"	"
Thallium	2		272.2/7841	Furnace	"	"
Thallium	2		200.8/6020	ICP-MS	"	"
Vanadium	10	1,000	200.7/6010B	ICP	"	"
Vanadium	5		200.8/6020	ICP-MS	"	"
Zinc	10	5,000	200.7/6010B	ICP	"	"
Zinc	10		200.8/6020	ICP-MS	"	"

^EPA Methods for Chemical Analysis of Water and Wastes / SW-846 EPA Test Methods for Evaluating Solid Waste

FAAS = Flame Atomic Absorption Spectroscopy
FAES = Flame Atomic Emission Spectroscopy
ICP = Argon Plasma Emission Spectroscopy
DPC = Diphenylcarbazide
ICP-MS = Inductively Coupled Plasma - Mass Spectrometry
CVAFS = Cold Vapor Atomic Fluorescence Spectrometry

* "Standard Methods For the Examination of Water and Wastewater"
+ = Matrix Dependent
FP = Fluoropolymer Bottles

Revision: 12/2002

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Non-Metals	Water Reporting Limits (ug/L)	Analytica Method Reference EPA / SW-846^	MDEQ Technique	Sampling Containers (waters)	Hold Times
Alkalinity	20,000	310.1	Auto Analyzer	500 mL plastic	14 days
Alkalinity, Bicarbonat	10,000		Calculate	"	"
Alkalinity, Carbonat	10,000		Calculate	"	"
Ammonia	10	350.1	Auto Phenolat	"	28 days
BOD-Carb.	2000	405.1	5 Day-DO Probe	"	48 hours
BOD-Total	2000	405.1	5 Day-DO Probe	"	"
Chloride	1000	325	Auto Analyzer	"	28 days
COD (high Level)	100,000	410.4	Colorimetric	"	"
COD (low level)	5000	410.4	Colorimetric	"	"
Conductivity	1.0*	120.1	Bridge	"	"
Cyanide	5	335.2/9010	Man. Dist., Man. PBA Colo	"	14 days
Dissolved Oxyger	100	360.2	Manual Titratior	250 mL glass	8 hours
Hardness (Ca2CO3)	5000	130.2	Calculate	500 mL plastic	6 months
Nitrate + Nitrite	10	353.2	Auto Cd Reductior	"	28 days
Nitrite	10	353.2	Auto Diazotizatior	"	48 hours
Nitrogen, Kjeldah	100	351.2	BD, Auto Salicylat	"	28 days
OrthoP	10	365	Auto Ascorbic Acid Reductior	"	48 hours
Phenolics	10	420.2	Auto Dist., Auto 4AAP	500 mL glass	28 days
Phenolics	10	420.2/9066	Manual Dist., Auto 4AAF	"	"
Phosphorous, Tota	10	365.4	BD Auto Ascorbic Acid Reduc	500 mL plastic	28 days
Residue	20,000	160.1	Total Filt-TDS 180C	"	7 days
Residue	4000	160.2	Non Filt-Susp. Sol. 105C	"	"
Silicates	50	370.1	Auto Ascorbic Acid Reductior	"	28 days
Sulfate	2000	375.1	Auto Analyzer	"	"
Sulfide	20	376.2	Methylene blue	250 mL plastic	7 days
TOC	500	415.2	UV/Persulfate (DC-80)	500 mL plastic	28 days
Turbidity	0.4#	180.1	Turbidimeter	"	48 hours
Oil & Grease	10,000	1664	SPE	2-250 mL glass	28 days

^EPA Methods for Chemical Analysis of Water and Wastes / SW-846 EPA Test Methods for Evaluating Solid Was

* = umhos/cm
\# = NTU

Calculate = Value is calculated from existing dat
Bridge = Conductivity mete
DO Probe = Dissolved Oxygen (YSI) Prob
Cd Reduc. = Cadmium Reductior
BD = Block Digeste
Man. Dist.= Manual Distillatio
SPE = Solid Phase Extractio

4AAP = 4 Amino Antipyrene
BOD = Biochemical Oxygen Deman
COD = Chemical Oxygen Deman
TOC = Total Organic Carbor
TDS = Total Dissolved Solid
Auto Dist.= Automated Distillatio

Table 1: ENVIRONMENTAL REPORTING LIMITS(RL) FOR DEQ-DWRP LABORATORY SECTION

VOLATILE ORGANICS Method TO-15	Air Reporting Limits (ppbv)	Air Reporting Limits (ug/M3)	Air Containers
Dichlorodifluoromethane	0.3	1.5	6L Canister
Chloromethane	0.3	0.6	"
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.3	2.1	"
1,3-Butadiene	0.3	0.7	"
Vinyl Chloride	0.3	0.8	"
Bromomethane	0.3	1.1	"
Chloroethane	0.3	0.8	"
Acetonitrile	1.0	1.7	"
Trichlorofluoromethane	0.3	1.7	"
Acrylonitrile	0.5	1.1	"
1,1-Dichloroethylene	0.3	1.2	"
Methylene Chloride	0.3	1.0	"
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.3	2.3	"
Trans-1,2-Dichloroethylene	0.3	1.2	"
1,1-Dichloroethane	0.3	1.2	"
Methyl Tert-Butyl Ether	0.5	1.8	"
Methyl Ethyl Ketone	5.0	14.5	"
2-Chloro-1,3-Butadiene	0.3	1.1	"
Cis-1,2-Dichloroethylene	0.3	1.2	"
Hexane	1.0	3.5	"
Chloroform	0.3	1.4	"
1,2-Dichloroethane	0.3	1.2	"
1,1,1-Trichloroethane	0.3	1.6	"
Benzene	0.3	0.9	"
Carbontetrachloride	0.3	1.9	"
1,2-Dichloropropane	0.3	1.4	"
Bromodichloromethane	0.3	2.0	"
Trichloroethylene	0.3	1.6	"
2,2,4-Trimethylpentane	0.3	1.4	"
Cis-1,3-Dichloropropylene	0.3	1.3	"
Methyl Isobutyl Ketone	1.0	4.0	"
Trans-1,3-Dichloropropylene	0.3	1.3	"
1,1,2-Trichloroethane	0.3	1.6	"
Toluene	0.3	1.1	"
Dibromochloromethane	0.3	2.5	"
1,2-Dibromoethane	0.3	2.3	"
Tetrachloroethylene	0.3	2.0	"
Chlorobenzene	0.3	1.4	"
Ethylbenzene	0.3	1.3	"
m&p-Xylene	0.3	1.3	"
Bromoform	0.3	3.0	"
Styrene	0.3	1.3	"
1,1,2,2-Tetrachloroethane	0.3	2.0	"
o-Xylene	0.3	1.3	"
1,3,5-Trimethylbenzene	0.3	1.4	"
1,2,4-Trimethylbenzene	0.3	1.4	"
Benzyl Chloride	0.3	1.5	"
1,3-Dichlorobenzene	0.3	1.8	"
1,4-Dichlorobenzene	0.3	1.8	"
1,2-Dichlorobenzene	0.3	1.8	"
1,2,4-Trichlorobenzene	0.3	2.2	"
Hexachloro-1,3-Butadiene	0.3	3.1	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Aldehydes Method TO-11	Air Reporting Limits (ug)	Containers Hold Time
Formaldehyde	0.30	DNPH Cartridges
Acetaldehyde	0.30	14 Days for Extraction
Acetone	0.30	"
Propionaldehyde	0.30	"
Crotonaldehyde	0.30	"
n-Butyraldehyde	0.30	"
Benzaldehyde	0.40	"
Isovaleraldehyde	0.40	"
Valeraldehyde	0.40	"
o-Tolualdehyde	0.40	"
m,p-Tolualdehyde	0.40	"
Hexanaldehyde	0.40	"
2,5-Dimethylbenzaldehyde	0.40	"

MICHIGAN DEPARTMENT
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ENVIRONMENTAL QUALITY

LABORATORY SERVICES SECTION
ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE PROGRAM PLAN

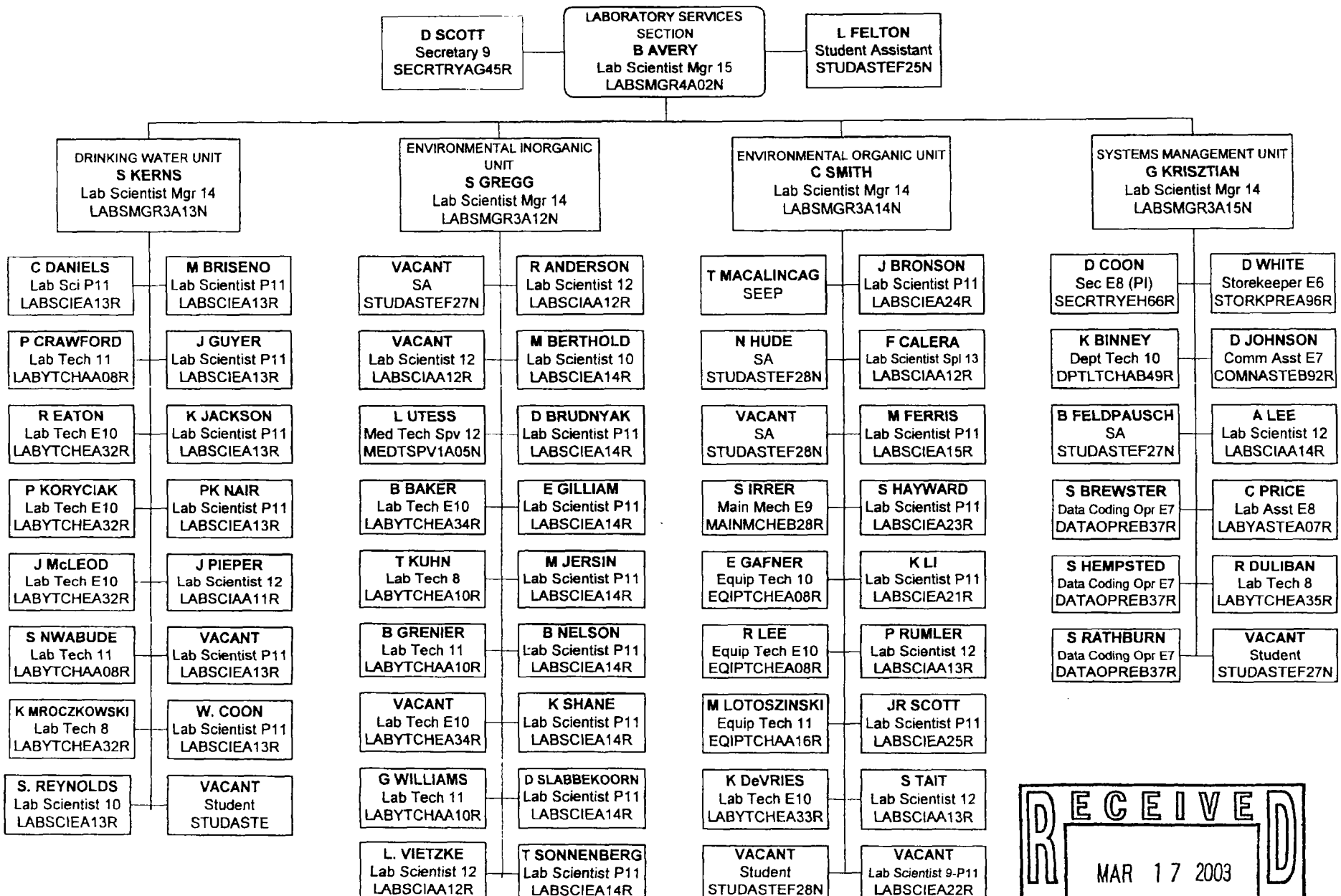
Figure 2-1

Organization Chart

QAPP-Ver2.0, Revison 0
May 5, 2003

LABORATORY SERVICES SECTION

March 3, 2003



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LAB SERVICES SECTION

ACID DIGESTION OF DRINKING WATER, WASTE WATER, AND EXTRACTS FOR METALS AQUOUS - DIGIBLOCK METHOD

Table of Contents

1.0 Applicable Analytical Methods 1
2.0 Matrix or Matrices 2
3.0 Method Detection Limits (MDLs) 2
4.0 Scope and Application 2
5.0 Method Summary 3
6.0 Definitions 3
7.0 Interferences 3
8.0 Safety 4
9.0 Equipment and Supplies 4
10.0 Reagents and Standards 5
11.0 Sample Collection, Preservation, Shipment, and Storage 6
12.0 Quality Control (QC) 6
13.0 Calibration and Standardization 6
14.0 Procedure 7
15.0 Calculations 8
16.0 Method Performance 9
17.0 Pollution Prevention 9
18.0 Data Assessment 9
19.0 Corrective Actions 9
20.0 Waste Management 9
21.0 References 10
22.0 Attachments 10
Signature Page 11

1.0 Applicable Analytical Methods

1.1 Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements, U.S. Environmental Protection Agency, Method 200.2, Revision 2.8, Cincinnati, Ohio,1994.

1.2 Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, U.S. Environmental Protection Agency, Method 200.7, Cincinnati, Ohio, 1982.

1.3 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Revision 5.4, Cincinnati, Ohio, 1994.

1.4 Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, U.S. Environmental Protection Agency, Method 3005A, Revision 1, Washington, DC, 1992.

1.5 Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy, U.S. Environmental Protection Agency, Method 3010A, Revision 1, Washington, DC, 1992.

1.6 DigiBLOC Digestion System Operation Manual, SCP Science, Revision 1.3, Champlain, NY, 2000.

2.0 Matrix or Matrices

2.1 Drinking water, surface water, ground water, and saline water.

2.2 Domestic and industrial wastewater.

2.3 ASTM, TCLP, SPLP extracts.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See SOP 103.

3.2 The MDL is prepared by digesting seven replicates of various concentrations that are provided by the analysts, and are based upon the limits of the instruments. Samples are analyzed through the use of ICP, Furnace, and ICP-MS instrumentation and further tabulated statistically.

3.3 The MDL for this method is determined annually or whenever there is a significant change in the procedure including a change in the technician or analyst.

4.0 Scope and Application

4.1 This method applies to drinking, surface, ground and saline water, extracts, and domestic and industrial waste.

4.2 All samples to be analyzed need to be preserved with nitric acid such that the pH of the overall sample is at or below 2.

5.0 Method Summary

5.1 A well mixed, aqueous sample is digested with nitric and hydrochloric acids in a 95°C digestion block. The sample is then evaporated to approximately 20 mL in order to concentrate the analytes in solution. It is then refluxed for 30 minutes, and finally diluted back up to volume with DI water.

5.2 Prepared samples are then given to analysts for metals analysis on each respective instrument.

6.0 Definitions

6.1 Analyte – Total recoverable and dissolved metals.

6.2 Matrix Spike/Matrix Spike Duplicate – A quality control audit consisting of a sample spiked with two multi-element metal standards (MS) and a duplicate consisting of the sample spiked with the same two multi-element metal standards (MSD).

6.3 Reagent Blank (RB) - Prepared by adding reagents to blank water in the same concentration as the samples and standards.

6.4 Laboratory Control Sample (LCS) - An aliquot of reagent water or other blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is analyzed and prepared exactly like a sample. Its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements.

6.5 MDL - The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. See internal procedure SOP 103 for details.

7.0 Interferences

7.1 Samples should be checked to ensure the proper pH is at or below 2. Samples with a pH higher than this can potentially alter the results of the analysis.

7.2 Failure to prepare a well-mixed sample could lead to inaccurate results obtained from the sample. Adequate shaking of the sample is required to achieve a representative aliquot.

7.3 Wearing powdered gloves may have the potential to contaminate samples. This could cause the samples to produce false positive metal concentrations when analyzed. Non-powdered gloves should be used when digesting samples for metal analyses.

8.0 Safety

8.1 Safety glasses and shoes that cover the feet are required in all designated laboratory areas.

8.2 It is recommended that the analyst wear gloves and a lab coat when performing this procedure (see Section 7.3 for details regarding gloves).

8.3 The analyst must be familiar with the Laboratory Chemical Hygiene Plan.

8.4 The analyst must be familiar with the Laboratory Safety Policy (SOP 100).

8.5 The analyst must be familiar with any material safety data sheets applicable to this method.

8.6 The analyst must be familiar with the location of safety equipment including showers, eye wash stations, and spill kits.

8.7 The analyst should always thoroughly wash hands in warm soapy water when leaving the work area and before handling food or drink.

8.8 The analyst should assume that all samples have the potential to be hazardous and should always exercise caution when transporting, handling, and/or opening any samples.

8.9 General good laboratory practices are required. The analyst should take all necessary precautions in order to minimize the potential of exposure to samples and reagents used in this method.

9.0 Equipment and Supplies

9.1 Disposable digestion vials – 50 mL with screw caps (Environmental Express Catalog #SC475, Stock #2T05) or equivalent.

9.2 ColorpHast™ pH strips (range of 0-14, Stock #2P35).

9.3 Disposable watch glasses (Environmental Express Catalog #SC505) or equivalent.

9.4 Disposable watch glass with hole for temperature probe (SCP Catalog #010-500-019) or equivalent.

9.5 DigiBLOC Digestor with temperature probe and tube racks.

9.6 Pipette, automatic dispensing (two - 1mL maximum volume deliverable).

9.7 Pipette, 0.25 mL capacity.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with the date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with the date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. Original certificates are kept by the Laboratory's Quality Assurance/Quality Control Officer.

10.6 All reagents are prepared with DI water. DI water is normal tap water that has been passed through a Millipore, Super Q™ water purification system and has an industry standard resistivity of 18 MΩ.

10.7 Nitric acid, concentrated, trace metal grade for use on ICP-MS (Malinckrodt Catalog #6623-46 or equivalent).

10.8 Hydrochloric acid, concentrated, trace metal grade for use on ICP-MS. (Malinckrodt Catalog #5587-46 or equivalent).

10.9 Single element Stock Standard Solutions (Purchased)

10.9.1 Antimony (Sb) – 1000 mg/L.
10.9.2 Molybdenum (Mo) – 1000 mg/L.
10.9.3 Titanium (Ti) – 1000 mg/L.
10.9.4 Lithium (Li) – 1000 mg/L.
10.9.5 Boron (B) – 1000 mg/L.
10.9.6 Iron (Fe) – 1000 mg/L.

10.10 Multi Element Stock Standard Solutions

10.10.1 Metals Standard 1 - Multi-Element Solution 2A - 10 ug/mL of Silver (Ag), Aluminum (Al), Arsenic (As), Barium (Ba), Beryllium (Be), Calcium (Ca), Cadmium (Cd), Cobolt (Co), Chromium (Cr), Cesium (Cs), Copper (Cu), Iron (Fe), Gallium (Ga), Potassium (K), Lithium (Li), Manganese (Mn), Magnesium (Mg), Sodium (Na), Nickel (Ni), Lead (Pb), Rubidium (Rb), Selenium (Se), Strontium (Sr), Thallium (Tl), Uranium (U), Vanadium (V), and Zinc (Zn), (Spex CLMS-2A).

10.10.2 Metals Standard 2 – 10 mg/L of Sb, Mo, Ti, Li; 20 mg/L of B; 90 mg/L of Fe.

10.10.2.1 Prepare by filing a 100 mL volumetric flask with about 50 mL of DI water. Add 1 mL each of Sb, Mo, Ti and Li, 2 mL of B and 9 mL of Fe single element stock standard solutions from above and 2 mL of concentrated nitric acid. Bring to volume with DI water.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Samples are collected in 500 mL high-density polyethylene screw cap bottles. The bottles should be filled completely. The proper bottle code is MA for total metals, MAD for dissolved metal samples, and MD for laboratory filtered dissolved metal samples. Drinking water samples that need analysis are provided in 50 mL sample vials.

11.2 A minimum of 150 mL of sample is required.

11.3 Samples are stored at room temperature and should be preserved with nitric acid to a pH < 2.

11.4 The recommended maximum holding time is six months.

12.0 Quality Control (QC)

12.1 The minimum QC for this method includes an initial demonstration of capability (IDOC) and MDL determination.

12.2 One reagent blank, one laboratory control sample, and one Matrix Spike (MS) and one Matrix Spike Duplicate are required, at a minimum, for every 20 samples.

12.3 IDOC

12.3.1 Prior to analyzing samples by this method, the technician must prepare four DI water samples spiked with metal standard 1 and 2 at the same levels used for MS, MSD and laboratory control samples. These samples are then digested in the same manner as normal samples. The results are statistically tabulated to obtain the average percent recovery (X) and the standard deviation (s) of the percent recoveries. If both s and X are acceptable, this method may be used to generate data. If s or X fails, the technician/analyst must take corrective action and repeat the IDOC. The technician/analyst must repeat the above steps until acceptable values for s and X are obtained.

13.0 Calibration and Standardization (Information obtained from DigiBLOC Operations Manual)

13.1 Temperature Controller (Calibrate only with an N.I.S.T. calibrated thermometer.)

13.1.1 Place the thermometer in sample tube and heat sample to temperature. Ensure that the thermometer is suspended in sample and not touching tube wall.

13.1.2 After the temperature is achieved, wait 10 minutes for thermal equilibrium.
13.1.3 Press ▼and ▲ together for 3 seconds to enter program mode.
13.1.4 Press ▼ to scroll to level option.
13.1.5 Holding ж, press ▲ to move to control level 3.
13.1.6 Press ▲ to scroll to zero adjustment.
13.1.7 Holding ж, use ▲ or ▼ to set the correct zero offset (°thermometer - °DigiBLOC = offset).
13.1.8 Press ▲ and ▼ together for 3 seconds to exit program mode.

13.2 DigiPROBE

13.2.1 Use same procedure as for temperature controller expect for Section 13.1.7 where the zero offset for the probe would be the following: (°thermometer - °DigiPROBE = offset).

14.0 Procedure

14.1 Prepare run sheet (see attachment) and collect samples from storage. A complete batch contains 48 vials with 40 samples plus 8 QC samples.

14.2 Prior to digestion, check the pH of all 40 samples to be run to ensure the pH is less than 2.

14.2.1 If the pH is less than 2, samples are ready for digesting.
14.2.2 If the pH is greater than 2, adjust with nitric acid such that the pH will be less than 2. Allow the sample bottles to sit for a minimum of 16 hours. Recheck the pH again just prior to use to confirm it is less than 2. Repeat the procedure if necessary until a sample pH of less than 2 is achieved after holding the sample for 16 hours.

14.3 Turn on DigiBLOC and set temperature to 95°C.

14.3.1 Turn DigiBLOC on by moving the switch on the right-hand side to "On."
14.3.2 Set the temperature set-point as follows (information obtained from DigiBLOC Operations Manual):

14.3.2.1 Press and hold the ж button.
14.3.2.2 Use the ▲ or ▼ buttons to enter the new temperature.
14.3.2.3 Release buttons, the instrument will begin adjusting to the new control temperature.

14.4 Label 48 disposable digestion vials with sample ID and place in DigiBLOC racks.

14.5 Fill the blank and control vials with 50 mL of DI water.

14.6 Shake sample bottle vigorously and pour 50 mL into respective vial. Repeat for all 40 samples.

14.6.1 Transfer drinking water samples into digestion vials.

14.6.2 Pick two homogeneous samples to be used for MS and MSD.

14.6.3 For samples that appear to be extremely heterogeneous, a dilution may be needed. Pipet an amount of sample according to how contaminated it appears to be. Dilute the sample with DI water bringing the final volume up to 50 mL. Note any dilutions on run sheet.

14.7 Pipet 0.250 mL of both metal spike standards into laboratory control(s), MS and MSDs.

14.8 Add 1 mL of concentrated nitric acid, from automatic pipette dispenser, to all 48 sample vials.

14.9 Add 0.1 mL of concentrated hydrochloric acid, from automatic pipette dispenser, to all 48 sample vials.

14.9.1 Do not add hydrochloric acid to drinking water samples.

14.10 Place digestion rack containing sample vials into digestion block set at 95°C. Place the clean temperature probe into a homogeneous sample.

14.11 Allow samples to evaporate to a volume of 15-20 mL. Approximate time will be 4 hours.

14.12 Once 15-20 mL is reached, place watch glasses onto each vial and let reflux for 30 minutes. Place watch glass with hole on the sample with the temperature probe.

14.13 Remove samples from block and allow them to cool for a minimum of 30 minutes.

14.14 Dispose of watch glasses. Fill each sample vial with DI water to a final volume of 50 mL. Screw the cap on the sample vial.

14.15 Invert sample vial to mix and place into sample vial rack.

14.16 Give batch and completed run sheet to analysts for testing.

15.0 Calculations

15.1 No calculations are tabulated during the digestion preparation.

15.2 LIMS Data Entry

15.2.1 Upon completion of digestion preparation, the following information is to be inputted into LIMS: result field enter completed, start date enter date of digestion, and analyst enter initials of technician/analyst performing the digestion with digestion run number.

16.0 Method Performance

16.1 See individual analytical SOPs for each analytical instrument.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Whenever feasible, staff should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

17.3 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Not applicable

19.0 Corrective Actions

19.1 Samples with a pH greater than 2 must be adjusted with nitric acid to achieve a pH less than 2. The adjusted sample must sit for a minimum of 16 hours and the pH rechecked. If the pH is not less than 2 the procedure is repeated until a sample pH of less than 2 is maintained after holding the sample for 16 hours.

19.2 Any sample not analyzed within 6 months is coded "HT." See MDEQ Laboratory SOP 106.

19.3 If the quality control audits are not met, the digestion run may need to be repeated.

20.0 Waste Management

20.1 Generated acid waste (nitric and hydrochloric acid) and samples can be collected in a container labeled as "waste" if the samples do not contain identified hazardous material (i.e., samples from an industrial site, etc.) that require handling and proper disposal as a hazardous waste. When the waste container is full, the contents are neutralized with soda ash and flushed down the drain with copious amounts of water.

20.2 Broken/waste glass is collected at the bench in a plastic pail until transferred to a collection barrel for disposal.

20.3 Excess samples can be disposed of down the drain with copious amounts of water if they do not contain identified hazardous levels of metal(s) or other hazardous materials (i.e., samples from an industrial site, etc.) that requires handling and proper disposal as a hazardous waste.

21.0 References

21.1 Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements, U.S. Environmental Protection Agency, Method 200.2, Revision 2.8, Cincinnati, Ohio,1994.

21.2 Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, U.S. Environmental Protection Agency, Method 200.7, Cincinnati, Ohio, 1982.

21.3 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Revision 5.4, Cincinnati, Ohio, 1994.

21.4 Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy, U.S. Environmental Protection Agency, Method 3005A, Revision 1, Washington, DC, 1992.

21.5 Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy, U.S. Environmental Protection Agency, Method 3010A, Revision 1, Washington, DC, 1992.

21.6 DigiBLOC Digestion System Operation Manual, SCP Science, Revision 1.3, Champlain, NY, 2000.

22.0 Attachments

22.1 Sample batch run sheet.

APPROVED BY _____ DATE 2/23/05
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 2/18/05
COMPLIANCE OFFICER

APPROVED BY _____ DATE 2/10/05
QA OFFICER

APPROVED BY Sandra K. Grigg DATE 2-8-2005
UNIT MANAGER

APPROVED BY Jerri R. Kuhn DATE 2/8/05
ANALYST

Date: _____

Technician: _____

Analyst: _____

WATER DIGESTION FOR METALS
EPA Method: 3015 - DigiBlock

Run # _____

Block Temperature:_____C
HNO3: EL-1565-11
HCL: EL-1553-7
Control / AC Spikes: EL-1657-2, MD-2714

Seq #	Sample ID	Matrix	Initial Volume mL	Final Volume mL	Sample pH	Comments
1	BLANK1		50	50	<2	
2	CONTROL1		50	50	<2	
3			50	50	<2	
4			50	50	<2	
5			50	50	<2	
6			50	50	<2	
7			50	50	<2	
8			50	50	<2	
9			50	50	<2	
10			50	50	<2	
11			50	50	<2	
12			50	50	<2	
13			50	50	<2	
14			50	50	<2	
15			50	50	<2	
16			50	50	<2	
17			50	50	<2	
18			50	50	<2	
19			50	50	<2	
20			50	50	<2	
21			50	50	<2	
22			50	50	<2	
23	MS1		50	50	<2	
24	MSD1		50	50	<2	
25	BLANK2		50	50	<2	
26	CONTROL2		50	50	<2	
27			50	50	<2	
28			50	50	<2	
29			50	50	<2	
30			50	50	<2	
31			50	50	<2	
32			50	50	<2	
33			50	50	<2	
34			50	50	<2	
35			50	50	<2	
36			50	50	<2	
37			50	50	<2	
38			50	50	<2	
39			50	50	<2	
40			50	50	<2	
41			50	50	<2	
42			50	50	<2	
43			50	50	<2	
44			50	50	<2	
45			50	50	<2	
46			50	50	<2	
47	MS2		50	50	<2	
48	MSD2		50	50	<2	

DEQ

ENVIRONMENTAL LAB MDEQ SOP # 203 REVISION # ____

EFFECTIVE DATE 02/05

ACID DIGESTION OF DRINKING WATER, WASTE WATER, AND EXTRACTS FOR METALS AQUOUS - DIGIBLOCK METHOD

Table of Contents

1.0 Applicable Analytical Methods 1
2.0 Matrix or Matrices 2
3.0 Method Detection Limits (MDLs) 2
4.0 Scope and Application 2
5.0 Method Summary 3
6.0 Definitions 3
7.0 Interferences 3
8.0 Safety 4
9.0 Equipment and Supplies 4
10.0 Reagents and Standards 5
11.0 Sample Collection, Preservation, Shipment, and Storage 6
12.0 Quality Control (QC) 6
13.0 Calibration and Standardization 6
14.0 Procedure 7
15.0 Calculations 8
16.0 Method Performance 9
17.0 Pollution Prevention 9
18.0 Data Assessment 9
19.0 Corrective Actions 9
20.0 Waste Management 9
21.0 References 10
22.0 Attachments 10
Signature Page 11

1.0 Applicable Analytical Methods

1.1 Sample Preparation Procedure for Spectrochemical Determination of Total Recoverable Elements, U.S. Environmental Protection Agency, Method 200.2, Revision 2.8, Cincinnati, Ohio,1994.

1.0 Applicable Analytical Methods

1.1 Acid Digestion of Sediments, Sludges, and Soils, Method 3050B Revision 2, U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, December 1996, SW-846, On-line, Office of Solid Waste and Emergency Response, Washington, DC.

1.2 Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, U.S. Environmental Protection Agency, Method 200.7, Cincinnati, Ohio, 1982.

1.3 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Revision 5.4, Cincinnati, Ohio, 1994.

1.4 DigiBLOC™ Digestion System Operation Manual, SCP Science, Revision 1.3, Champlain, NY, 2000.

2.0 Matrix or Matrices

2.1 Sediments, sludges and soils.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136; Appendix B. See SOP 103.

3.2 The MDL is prepared by digesting seven replicates of various concentrations of metals that are provided by the analysts, and are based upon the limits of the instruments. Samples are analyzed through the use of ICP, Furnace, and/or ICP-MS instrumentation and further tabulated statistically.

3.3 The MDL for this method is determined annually or whenever there is a significant change in the procedure including a change in the technician or analyst.

4.0 Scope and Application

4.1 This method provides the digestion procedure for sediment, sludge, and soil samples. Samples prepared by this method may be analyzed by inductively coupled plasma atomic emission spectrometry (ICP), graphite furnace atomic absorption spectrometry (GFAA), flame atomic absorption spectrometry (FAA), and/or inductively coupled plasma mass spectrometry (ICP-MS).

4.2 This method is not a total digestion for most samples. It is a very strong acid digestion that will dissolve almost all elements that could become "environmentally available."

5.0 Method Summary

5.1 A well-mixed dried and ground sample is digested with nitric acid, hydrochloric acid, and hydrogen peroxide in a 95°C digestion block. It is then refluxed, and diluted to a final volume with DI water.

5.2 Prepared samples are then analyzed for metals on each respective instrument.

6.0 Definitions

6.1 Analyte – Total recoverable metals from sediment, sludge and soil samples.

6.2 Accuracy Control (AC) or Matrix Spike (MS) and Matrix Spike Duplicate (MSD) – A quality control audit consisting of a sample spiked with a known concentration of the appropriate standard(s). The MSD is a quality control audit consisting of the same sample spiked a second time with a known concentration of the appropriate standard(s).

6.3 Laboratory Reagent Blank (LRB) – An aliquot of reagent water containing all reagents used during sample preparation. The LRB should be prepared in the same way that samples are prepared and is used to determine if any contamination occurs during the sample preparation process.

6.4 Laboratory Fortified Blank (LFB or Laboratory Control Sample LCS) - An aliquot of reagent water containing all reagents and fortified with a known amount of method analyte(s) used during sample preparation. The LFB should be prepared in the same way that samples are prepared and is used to verify the accuracy and efficiency of the sample preparation process.

6.5 MDL - The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. See internal procedure SOP 103 for details.

6.6 Laboratory Fortified Matrix (LFM, MS, MSD, QC Spike, AC) - An aliquot of sample fortified with a known amount of analyte(s), prepared and analyzed using the same procedure as the original sample. The LFM is used to indicate whether or not sample matrix has an effect on the quantification of analyte(s).

6.7 Precision Control (PC) or Laboratory Duplicate (LD) – A quality control audit consisting of two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of LD1 and LD2 indicate precision associated with laboratory procedures but not with sample collection, preservation, or storage procedures.

7.0 Interferences

7.1 A non-homogeneous sample may give varying results depending on the portion analyzed.

7.2 Failure to prepare a well-mixed sample could lead to inaccurate results obtained from the sample. Adequate mixing of the sample is required to achieve a representative aliquot.

8.0 Safety

8.1 Safety glasses and shoes that cover the feet are required in all designated laboratory areas.

8.2 It is recommended that the analyst wear gloves and a lab coat when performing this procedure.

8.3 The analyst must be familiar with the Laboratory Chemical Hygiene Plan.

8.4 The analyst must be familiar with the Laboratory Safety Policy (SOP 100).

8.5 The analyst must be familiar with any material safety data sheets applicable to this method.

8.6 The analyst must be familiar with the location of safety equipment including showers, eye wash stations, and spill kits.

8.7 The analyst should always thoroughly wash hands in warm soapy water when leaving the work area and before handling food or drink.

8.8 The analyst should assume that all samples have the potential to be hazardous and should always exercise caution when transporting, handling, and/or opening any samples.

8.9 General good laboratory practices are required. The analyst should take all necessary precautions in order to minimize the potential of exposure to samples and reagents used in this method.

9.0 Equipment and Supplies

9.1 Digestion vessels - 50 mL disposable digestion vials with screw caps (Environmental Express Catalog #SC475, Stock #2T05) or equivalent.

9.2 Disposable reflux caps (Environmental Express Catalog #SC506) or equivalent.

9.3 Heating source – Block digestor (DigiBLOC™) able to maintain a temperature of 90-95°C.

9.4 Temperature measuring device capable of measuring to at least 125°C with suitable precision and accuracy (e.g. thermometer, IR sensor, thermocouple, thermister, etc.).

9.5 Racks able to hold 50 mL vials and able to fit the block digestor.

9.6 Analytical balance - capable of accurate weighing to 0.01 g.

9.7 Graduated cylinder or equivalent volume measuring device.

9.8 Volumetric flasks – various sizes.

9.9 Pipettes – various sizes.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory-tracking log.

10.2 All reagents, solvents, and standards must be labeled with the date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with the date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. Original certificates are kept by the Laboratory's Quality Assurance/Quality Control Officer.

10.6 All reagents are prepared with DI water. DI water is normal tap water that has been passed through a Millipore, Super Q™ water purification system and has an industry standard resistivity of 18 MΩ.

10.7 Nitric acid, concentrated, HNO_3, select grade for use on ICP. Acid should be analyzed to determine level of impurities. If the method blank is < MDL, the acid can be used.

10.8 Hydrochloric acid, concentrated, HCl, select grade for use on ICP. Acid should be analyzed to determine level of impurities. If the method blank is < MDL, the acid can be used.

10.9 Hydrogen Peroxide, 30%, H_2O_2. Oxidant should be analyzed to determine level of impurities. If method blank is < MDL, the peroxide can be used.

10.10 Metals Standard for solids digestions, prepared from the following elemental standards available from VWR, Ultra-grade single element standards or equivalent, 1000 ppm.

10.11 The **Mixed Metal Standard** for solid digestion is made with 5% nitric acid containing 10 ppm of Be; 25 ppm of Cd, Co, Li, Mo, V; 50 ppm of Ba, Cr, Cu, Mn, Ni, Pb, Sr; and 250 ppm Zn. To prepare, use a clean 200 mL volumetric flask, add 10 mL nitric acid. Pipet 2 mL of the 1000 ppm Be standard. Pipet 5 mL of the 1000 ppm Cd, Co, Li, Mo, and V standards. Pipet 10 mL of the 1000 ppm Ba, Cr, Cu, Mn, Ni, Pb, and Sr standards. Pipet 50 mL of the 1000 ppm Zn standard. Bring volumetric flask to a final volume of 200 mL with DI water.

10.12 The **As-Se Standard** for solids digestion is made with 5% nitric acid containing 10 ppm of As and Se. To prepare use a clean 100 mL volumetric flask; add 5 mL of nitric acid. Pipet 1 mL of the 1000 ppm As and Se standard. Bring volumetric flask to 100 mL with DI water.

10.13 The **Ag Standard** for solids digestion is made with 5% nitric acid containing 10 ppm of the Ag. To prepare use a clean 100 mL volumetric flask; add 5 mL of nitric acid. Pipet 1 mL of the 1000 ppm Ag standard. Bring volumetric flask to 100 mL with DI water.

10.14 The **Fe, Ti, and Al** standards for solids digestion are purchased and used as 1000 ppm stock standards.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Samples are collected in either 4 ounce or 8 ounce glass jars with Teflon screw cap.

11. 2 Samples are stored in cold room storage, with a temperature of 2-8°C. No chemical preservation is required.

11.3 The recommended maximum holding time is six months.

12.0 Quality Control (QC)

12.1 The minimum QC for this method includes an initial demonstration of capability (IDOC) and MDL determination.

12.2 One laboratory reagent blank, one laboratory control sample, one MS, and one MSD control are required for every 20 samples.

12.3 IDOC

12.3.1 Prior to analyzing samples by this method, the technician must prepare four solids samples spiked with all metal standards at the same levels used for MS and control

samples. These samples are then digested in the same manner as normal samples. The results are statistically tabulated to obtain the average percent recovery (X) and the standard deviation (s) of the percent recoveries. If both s and X are acceptable, this method may be used to generate data. If s or X fails, the technician/analyst must take corrective action and repeat the IDOC. The technician/analyst must repeat the above steps until acceptable values for s and X are obtained.

13.0 Calibration and Standardization (Information obtained from DigiBLOC Operations Manual)

13.1 Temperature Controller (calibrate only with a National Institute of Standards and Technology (NIST) certified thermometer).

13.1.1 Place thermometer in sample vial and heat sample to temperature. Ensure that the thermometer is suspended in sample and not touching vial wall.

13.1.2 After the temperature is achieved, wait 10 minutes for thermal equilibrium.

13.1.3 Press ▼and ▲ together for 3 seconds to enter program mode.

13.1.4 Press ▼ to scroll to level option.

13.1.5 Holding ж, press ▲ to move to control level 3.

13.1.6 Press ▲ to scroll to zero adjustment.

13.1.7 Holding ж, use ▲ or ▼ to set the correct zero offset (°thermometer - °DigiBLOC = offset).

13.1.8 Press ▲ and ▼ together for 3 seconds to exit program mode.

13.2 DigiPROBE

13.2.1 Use same procedure as for temperature controller expect for Section 13.1.7 where the zero offset for the probe would be the following: (°thermometer - °DigiPROBE = offset).

14.0 Procedure

14.1 Turn on DigiBLOC and set temperature to 95°C. The DigiBLOC is operated in a fume hood.

14.2 Label each vial with the appropriate laboratory identification number.

14.3 Mix the dried sample thoroughly and weigh 1 g of sample, to 0.01g, into the corresponding digestion vial. Place the vial into the digestion rack. Record weight on digestion run sheet (attachment 22.1).

14.4 Add 2.5 mL of DI water to all samples. Add 2.5 mL of concentrated nitric acid to all samples. *Addition of acid should be conducted under a fume hood.*

14.5 Place reflux caps on all sample vials. Place digestion rack with samples into digestion block. Place the clean temperature probe into a homogeneous sample. Allow samples to heat for 15 minutes.

14.6 Remove the digestion rack with samples from the block digestor and cool 15 minutes under a fume hood. Add an additional 5 mL of concentrated nitric acid (in the fume hood) and place digestion rack with samples back into the digestion block. Heat at 95°C for 1.5 hours.

14.7 Remove the digestion rack with samples from the block digestor and cool 15 minutes under a fume hood. Begin adding 30% hydrogen peroxide in increments of 0.5 mL. *Note: Samples will effervesce and may foam, some reactions may be violent, add hydrogen peroxide slowly and under a fume hood.* When initial reaction subsides, add another 0.5 mL until a total of 3 mL H_2O_2 has been added to each sample. Continue heating until all reaction subsides.

14.8 Remove the digestion rack with samples from block digestor and allow to cool 15 minutes under a fume hood. Add 2.5 mL of concentrated hydrochloric acid* to each sample under a fume hood and return the digestion rack with samples to block digestor for 15 minutes. *** (For runs analyzed for Thallium only, do not add the HCl.)**

14.9 Remove the digestion rack with samples and cool completely under a fume hood. Dispose of reflux caps in trash receptacle. Dilute each sample with DI water to a final volume of 50 mL. Screw on caps and mix well.

14.10 Samples are allowed to settle before being analyzed.

15.0 Calculations

15.1 No calculations are tabulated during the digestion preparation.

15.2 Laboratory Information Management System (LIMS) - Data Entry

15.2.1 Upon completion of digestion preparation, the following information is to be inputted into the LIMS: date of digestion, digestion run number, and initials of technician.

16.0 Method Performance

16.1 Individualized for each instrument used for analysis.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Whenever feasible, staff should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

17.3 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Not applicable

19.0 Corrective Actions

19.1 Any sample not analyzed within 6 months of collection is coded "HT." See SOP 106.

19.2 If the quality control criteria are not met during analysis, the digestion may need to be repeated.

20.0 Waste Management

20.1 Liquid waste that is generated by the assays includes nitric acid waste and sample waste. The waste containers are labeled with the type of waste, the notation "hazardous waste" if hazardous, and the operator's initials. The hazardous waste containers are held until the monthly waste collection occurs and a licensed hazardous waste disposal company can properly dispose of them.

20.2 Broken/waste glass is collected at the bench in a plastic pail until transferred to a collection barrel for disposal.

20.3 Excess sample is returned to cold room storage. Sample receiving staff will dispose of the excess sample as trash if they do not contain hazardous material (i.e., samples from an industrial site, high lead, etc.). If the excess sample contains hazardous material it will be packaged and transported in a safe manner (SOP 100) to the hazardous waste room for proper disposal by a hazardous waste disposal contractor.

20.4 Small amounts of acid waste can be neutralized with soda ash prior to disposing down the drain with copious amounts of water. Any large amounts of acid waste

should be contained in a properly labeled waste container. Once the container is nearly full it is transported in a safe manner (SOP 100) to the basement and place in the hazardous water room for proper disposal by a hazardous waste disposal contractor.

21.0 References

21.1 Acid Digestion of Sediments, Sludges, and Soils, Method 3050B Revision 2, U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, December 1996, SW-846, On-line, Office of Solid Waste and Emergency Response, Washington, DC.

21.2 Inductively Coupled Plasma Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, U.S. Environmental Protection Agency, Method 200.7, Cincinnati, Ohio, 1982.

21.3 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Revision 5.4, Cincinnati, Ohio, 1994.

21.4 DigiBLOC Digestion System Operation Manual, SCP Science, Revision 1.3, Champlain, NY, 2000.

22.0 Attachments

22.1 Sample batch run sheet.

MDEQ SOP# 209 REVISION # 0

APPROVED BY _____ DATE 1/24/05
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 1/24/05
COMPLIANCE OFFICER

APPROVED BY _____ DATE 1/14/05
QA OFFICER

APPROVED BY Sandra K Gregg DATE 1-13-05
UNIT MANAGER

APPROVED BY Rebecca A. Brenin DATE 1/13/05
ANALYST

Sediment/Solid/Sludge
Hot Block Metal Digestion (EPA Method 3050B)

Attachment 22.1

Technician: _____ Digest date: _____ Run #: _____

Analyst: _____ Analysis date: _____ Final Vol.: _____

Rack: _____

Block Temp.: _____

CHEMICAL TRACKING NUMBERS		
HNO_3:	Mixed Met.:	Fe:
HCl:	Ag:	Al:
H_2O_2:	As/Se:	Ti:
		Tl:

	Sam num	AA#	Weight	Elements Requested:	Comments:
1	Blank 1				
2	Control 1				
3	MC -				
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23	MS1				
24	MSD1				
25	Blank 2				
26	Control 2				
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47	MS2				
48	MSD2				

DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 344 REVISION #_____

EFFECTIVE DATE 01/02

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MERCURY COLD VAPOR ATOMIC ABSORPTION

1.0 Applicable Analytical Methods

1.1 Determination of Mercury in Cold Vapor Atomic Absorption Spectrometry, U.S. Environmental Protection Agency, Method 245.1, Methods for Chemical Analysis of Water and Wastes, Revision 3.0, EMMC Version, 1994.

1.2 Mercury in Sediment (Manual Cold Vapor Technique), U.S. Environmental Protection Agency, Method 245.5, Methods for Chemical Analysis of Water and Wastes, 1983.

1.3 Mercury in Liquid Waste (Manual Cold Vapor Technique), U.S Environmental Protection Agency, Method 7470A, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

1.4 Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique), U.S. Environmental Protection Agency, Method 7471A, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

2.0 Matrix or Matrices

2.1 Drinking water, surface water, ground water, and saline water.

2.2 Domestic and industrial wastewaters.

2.3 Soils, sediments, bottom deposits, and sludge-type materials.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations, 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 The MDL was determined by analyzing seven replicate samples for each matrix. Seven deionized (DI) water samples were spiked with mercury standard to yield a theoretical concentration of 0.20 µg/L. Seven clean sand samples were spiked with mercury standard to yield a theoretical concentration of 0.05 mg/Kg. The replicates were analyzed identical to normal samples.

3.3 Analytical results for the seven replicates were tabulated statistically. The MDL was calculated using a formula that applies the student t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom. See Section 16.1 and the attached MDL study.

3.4 The MDL for this method is determined annually or whenever there is a significant change in the procedure including a change in the analyst.

3.5 Reporting limit (RL) – The RL for this method has been set at 0.2 µg/L for water and 0.5 mg/Kg for sediments with a % total solid of 50 to 100%. The RL for sediments will vary depending on the % total solids in the sample.

4.0 Scope and Application

4.1 This method applies to properly digested drinking water, surface water, ground water, saline water, and domestic and industrial wastewater. It also applies to digested soils, sediments, bottom deposits, and sludge-type materials.

4.2 The applicable range is 0.2 to 6.0 µg/L as mercury for waters and 0.05 to 0.6 mg/Kg as mercury for sediments. These ranges may be expanded by dilutions.

5.0 Method Summary

5.1 The samples must be prepared in the manner described in this method prior to analysis for mercury. Organo-mercury compounds are oxidized to inorganic mercury by heated digestion with concentrated acids, potassium permanganate, and potassium persulfate.

5.2 The cold vapor atomic absorption method is based on the absorption of radiation at the 253.7 nm wavelength by mercury vapor. The mercury is reduced to the elemental mercury state with stannous chloride in a sodium chloride-hydroxylamine hydrochloride solution. The elemental mercury is purged from the solution using a stream of argon into an absorption cell, which is placed in the light path of a hollow cathode lamp. Absorbance is measured as a function of mercury concentration.

6.0 Definitions

6.1 Analyte – Total mercury.

6.2 Calibration Blank (CB) – Prepared by adding reagents to blank water in the same concentration as the samples and standards. The CB is used to zero the instrument,

for all initial and continuing CB determinations, and to flush the system between samples and standards.

6.3 Initial Calibration Blank (ICB) – A CB analyzed at the beginning of the analysis run to demonstrate that the instrument is capable of acceptable performance.

6.4 Continuing Calibration Blank (CCB) – A CB analyzed in the course of the analysis run to demonstrate that the instrument is capable of continuous acceptable performance.

6.5 Calibration Standard (CAL) – A solution prepared from the primary standard solution or stock standard solutions. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

6.6 Calibration Curve – A plot of concentrations of known analyte standards versus the instrument response to the analyte. CALs are prepared by successively diluting a standard solution to produce working standards that cover the working range of the instrument. Standards should be prepared at the frequency specified in this SOP. The CALs should be prepared using the same type of reagents and at the same concentration as will result in the samples following sample preparation.

6.7 Initial Calibration Verification (ICV) – Second source standards to check the accuracy of the CALs.

6.8 Continuing Calibration Verification (CCV) – A control standard analyzed in the course of the analysis run to demonstrate that the initial calibration determined remains valid throughout the course of the analytical run.

6.9 Laboratory Control Sample (LCS) – An aliquot of reagent water or other blank matrix to which known quantities of the method analyte are added in the laboratory. The LCS is analyzed and prepared exactly like a sample. Its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements.

6.10 Linear Calibration Range (LCR) – The concentration range over which the instrument response is linear.

6.11 Laboratory Duplicates (LD1 and LD2) – Two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analyses of LD1 and LD2 indicate precision associated with laboratory procedures but not with sample collection, preservation, or storage procedures.

6.12 MDL – The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. See internal procedure SOP 103 for details.

6.13 Mixed Control (MC) – A composite sample of clean water samples for water analyses and reference samples from the National Institute for Standards and

Technology for sediment analyses. The MC is analyzed and prepared exactly like a sample. It is also a second source standard. The purpose of the MC is to determine whether the mythology is in control and whether the laboratory is capable of making accurate and precise measurements. It is also a check on the primary standards.

7.0 Interferences

7.1 Chloride has been found to interfere at levels above 100 mg/L by producing chlorine, which absorbs at 253.7 nm. The interference may be overcome by the addition of sodium chloride-hydroxylamine hydrochloride to the sample.

7.2 Certain volatile organic compounds that absorb at 253.7 nm may also cause interferences. To confirm suspect positive mercury results, a run without stannous chloride can determine if this type of interference is present.

7.3 Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from reagent water.

7.4 Mercury sample preparation, digestion, and analysis may be subject to environmental contamination if performed in areas with high ambient backgrounds where mercury was previously employed as an analytical reagent in analyses such as total Kjeldahl nitrogen (TKN) or chemical oxygen demand (COD).

8.0 Safety

8.1 Safety glasses and shoes that completely cover the feet are required in all designated laboratory areas.

8.2 It is recommended that the analyst wear gloves and a lab coat when performing this procedure.

8.3 Be familiar with the Laboratory Chemical Hygiene Plan.

8.4 Be familiar with the Laboratory Safety Policy (SOP 100).

8.5 Be familiar with any material safety data sheets (MSDSs) applicable to this method. Mercury compounds are highly toxic if swallowed, inhaled, or absorbed through the skin. Consult the MSDSs before proceeding with the analysis.

8.6 Be familiar with the location of safety equipment including showers, eye wash solutions, and spill kits.

8.7 The analyst should always thoroughly wash hands in warm soapy water when leaving the work area and before handling food or drink.

8.8 The analyst should assume that all samples have the potential to be hazardous and should always exercise caution when transporting, handling, and/or opening any samples.

8.9 The acidification of samples containing reactive materials may result in the release of toxic gases such as cyanides or sulfides. Acidification of samples should be done in a fume hood.

8.10 General good laboratory practices are required. The analyst should take all necessary precautions in order to minimize the potential of exposure to samples and reagents used in this method.

9.0 Equipment and Supplies

9.1 Varian SpectrAA 20 plus atomic absorption spectrophotometer or equivalent.

9.1.1 Mercury hollow cathode lamp.
9.1.2 Varian vapor generation accessory VGA-76 or equivalent.
9.1.3 Quartz absorption cell – With quartz windows, 10 cm long, with gas inlet and outlet ports attached approximately ½ inch from each end. The cell is strapped to a burner for support and aligned in the light beam to give the maximum transmittance.
9.1.4 Software – Varian Analytical.
9.1.5 Computer – Self-contained in instrument.
9.1.6 Printer – Citizen MSD-20, dot matrix.
9.1.7 Aeration tubing – Used for passage of mercury vapor from the sample bottle to the absorption cell.

9.2 Fleakers – 300 mL, glass.

9.3 Wire racks – BOD.

9.4 Beakers – 500 and 600 mL capacity.

9.5 Water bath – Set at 95°C.

9.6 Hot plate.

9.7 Stir plate and stir bars.

9.8 Powder funnel – Plastic.

9.9 Filter paper – Whatman #4.

9.10 Membrane filter paper – 0.45 µm.

9.11 DI water bottle – For rinsing.

9.12 Culture tubes – Disposable, borosilicate, glass, 16 x 125 mm.

9.13 Test tube racks – For 16 x 125 mm culture tubes.

9.14 Carboy – For DI water, five gallon capacity.

9.15 Volumetric flasks – 10 and 100 mL capacity.

9.16 Micro-pipettor - Digital, 1 to 5 mL and 200 to 1000 µL.

9.17 Repipettor – Capable of delivering 5, 15, and **15(??? correct number)** mL.

9.18 Oxford pipettor – Capable of delivering 2.5, 5, and 8 mL.

9.19 Pipette tips – 1 and 5 mL.

9.20 Vortex mixer – Daigger or equivalent.

9.21 Analytical balance – Capable of weighing 0.1 mg.

9.22 Calibration weights – For calibrating balance and verification.

9.23 pH strips.

9.24 Graduated cylinders – Various volumes.

9.25 Volumetric pipettes – Various volumes.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completed filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. Original certificates are kept by the Laboratory's Quality Assurance/Quality Control Officer.

10.6 All reagents are prepared with deionized water (DI). DI water is normal tap water that has been passed through a Millipore, Super Q™ water purification system and has an industry standard resistivity of 18MΩ.

10.7 Hydrochloric acid (HCl), concentrated (sp. gr. 1.18), assayed mercury level is not to exceed 1 µg/L.

10.8 Sulfuric acid (H_2SO_4), concentrated (sp. gr. 1.84), assayed mercury level is not to exceed 1 µg/L.

10.9 Nitric acid (HNO_3), concentrated (sp. gr. 1.41), assayed mercury level is not to exceed 1 µg/L.

10.10 Nitric acid, 10% - While swirling, cautiously add 20 mL of nitric acid to approximately 180 mL of DI water. In a graduated cylinder, dilute to 200 mL with DI water. Pour into a 1 L plastic bottle. Mix thoroughly. Repeat as necessary to complete the analytical batch.

10.11 Nitric acid, 20% - While swirling, cautiously add 80 mL of concentrated nitric acid to 320 mL of DI water in a 600 mL beaker. This is used to clean and store the gas liquid exchange vessel between runs. It should be changed at least once a month.

10.12 Agua Regia – Prepare immediately before use by carefully adding 3 volumes of conc. HCl to on**(???? should this be 1???)** volume of conc. HNO_3 (i.e., 300 mL HCl: 100 mL HNO_3). Add mixture to repipettor for dispensing.

10.13 Potassium persulfate ($K_2S_2O_8$), 5% solution, w/v – Dissolve 5 g of $K_2S_2O_8$ in 100 mL of DI water.

10.14 Stannous chloride solution, 25% in 20% HCl – Combine 62.5 g of stannous chloride crystals and 50 mL HCl in a 300 mL fleaker. Place on a hot plate. Heat until dissolved. Bring to 250 mL volume with DI water. Put this solution on a stir plate. Let stir. Using a Whatman #4 filter, filter the solution through a powder funnel into a 250 mL plastic bottle. This solution should be used the same day it is made. Do not store.

10.15 Sodium chloride hydroxylamine hydrochloride solution, 12% - Dissolve 60 g each of sodium chloride crystals and hydroxylamine hydrochloride crystals in 500 mL of DI water. This solution is made in a 1 L oxford dispenser that contains a stir bar. Place it on a stir plate until the crystals have dissolved.

10.16 Potassium Permanganate ($KMNO_4$), 5% solution, w/v – Add 125 g of $KMNO_4$ to 2500 mL of DI water. Place a stir bar into the mixture. Allow stirring on a stir plate until dissolved. Store in a closed glass bottle.

10.17 Mercury (Hg) stock standard – 1000 mg/L (ppm) standard is purchased.

10.18 Intermediate Hg standard, 10 mg/L – In a 100 mL volumetric flask, add 5 mL of HNO_3 and 1 mL of Hg stock standard (Section 10.17) to approximately 80 mL of DI water. Bring to volume with DI water. Mix thoroughly.

10.19 Working Hg standard, 100 µL – In a 100 mL volumetric flask, add 5 mL of HNO_3 and 1 mL of intermediate Hg standard (Section 10.18) to approximately 80 mL of DI water. Bring to volume with DI water. Mix thoroughly.

10.20 Detection verification Hg standard, 10 µL – In a 10 mL volumetric flask, add 1 mL of working Hg standard (Section 10.19) to approximately 8 mL of DI water. Bring to volume with DI water. Mix thoroughly.

10.21 Organic Hg Standard – In a 100 mL volumetric flask, add 5 mL of HNO_3, 0.1314 g of CH3HgCl, and 10 mL of methanol to approximately 80 mL of DI water. Bring to volume with DI water. Mix thoroughly.

10.22 Argon – Commercial grade with all necessary connections to connect to the Varian vapor generation accessory.

10.23 Soda ash – Used to neutralize acid solutions.

11.0 Sample Collection, Preservation, Shipment, and Storage

12.2.□ Water samples are collected in 500 mL high-density polyethylene screw cap bottles. The bottles should be completely filled. Sediments are collected in 250 mL glass jars with aluminum or Teflon lined screw caps.

11.2 Water samples for total mercury are acidified with 1+1 HNO_3 to a pH<2 at the time of collection. Sediment samples are stored at 4°C. No chemical preservation is necessary.

11.3 Water samples for dissolved mercury are filtered through a 0.45 µm and then acidified with 1+1HNO_3 to a pH<2.

11.4 The recommended maximum holding time for water samples is 28 days. However, analysis should be completed as soon as possible. Sediment samples may be kept for six months.

12.0 Quality Control (QC)

12.1 The minimum QC for this method includes an initial demonstration of capability (IDOC), MDL determination, LCR, routine analysis of reagent blanks, fortified blanks, and other laboratory solutions as continuing checks on performance.

12.2 IDOC

12.2.1 Prior to analyzing samples by this method, four DI water samples and four clean sand samples spiked with the appropriate mercury standard must be analyzed as described in Section 13 of this method. The results are statistically tabulated to obtain the average percent recovery (X) and the standard deviation (s) of the percent recoveries. Obtained values for s and X are compared to the criteria in Section 12.3. If both s and X are acceptable, this method may be used to generate data. If s or X fails, corrective action must be taken and the IDOC repeated. The steps above must be repeated until acceptable values for s and X are obtained.

12.3 System audits are checked at least once per analytical batch and are in control if the following criteria are met.

12.3.1 CB – Analyzed to establish the blank before running any samples. The CB is then used as part of the calibration curve and is run after approximately every tenth sample throughout the analytical run. It is used to assess the contamination level in the laboratory environment. CB values that exceed the MDL indicate laboratory or reagent contamination and should be investigated.

12.3.2 LCS – Used to assess laboratory performance against the required control limits of 85 - 115%. The laboratory determines new limits each year based on internal performance data.

12.3.3 Organic LCS – An aliquot of reagent water to which a known quantity of organic mercury standard is added. The organic LCS is used to determine if the analysis is recovering organic mercury. The limits for the organic mercury are set each year. They usually run between 90-110%. There are two organic LCSs analyzed per analytical batch.

12.3.4 LD1 and LD2 – Two aliquots of the same sample analyzed in the same analytical batch. These analyses indicate precision associated with laboratory procedures. The relative percent difference should be less than $\pm$10%. There are three sets of duplicates per analytical batch.

12.3.5 Matrix spike (MS) – Used to determine the accuracy of the analytical batch. It consists of spiking an aliquot of sample with a known concentration of mercury. A full batch consists of three MS samples. The limits for the MS samples are set at $\pm$10% of the theoretical value of the sample concentration plus the spike concentration.

12.3.6 Detection limit verification sample – Analyzed and evaluated once per analytical batch. It is used to evaluate the performance of the analysis at the reporting limit. The value should be within $\pm$10% of the true value (.2 µg/L).

12.3.7 ICV – Used to evaluate the standard curve. Each analytical batch contains one ICV. The recovery of the ICV should be $\pm$10% of the true value.

12.4 Analytical batches of samples with two or less QC audits outside the limit are acceptable. If there are three QC audits outside the limits, the batch is reviewed for possible problems and may have to be repeated. Analytical batches with more than three QC audits outside the acceptable limits are reviewed and repeated. Corrective action is initiated, and the reason for the unacceptable QC audits are reviewed, evaluated, and corrected. All problems with the instrument or technique are solved before the next samples are analyzed.

12.5 Proficiency audit samples are obtained from an independent source bi-annually. Two samples at different concentration levels are received for each evaluation. The samples are prepared and analyzed according to the instructions provided. The results are then submitted to the source for evaluation. Participation in these studies is used as a means to independently monitor this method's performance and to compare its performance against that of the other participants.

13.0 Calibration and Standardization

13.1 Calibration of the instrument is performed according to Varian SpectrAA 20 plus instrument protocol. Further instrument set up and calibration is provided in Section 14.

14.0 Procedure

14.1 Water sample preparation

14.1.1 Prepare the analytical batch sheet, including sample numbers, date of digestion, analyst, whether the hold time was met, initial and final volumes of sample, initial and final temperature of the water bath, and QC samples.

14.1.2 Clean all glassware with soap and water, DI rinse, 1+1 nitric acid, and DI rinse.

14.1.3 Label fleakers with sample numbers and concentration of calibration curve using a blue marker.

14.1.4 Add 100 mL of DI water to the blanks, calibration curve, and LCS.

- **14.1.4.1** Spike calibration curve with 0.5, 3, and 6 mL of the working Hg standard.
- **14.1.4.2** Spike LCS and MS QC samples with 4 mL of working Hg standard.
- **14.1.4.3** Spike organic LCS with 4 mL of the organic Hg standard.
- **14.1.4.4** Use 50 mL of matrix sample and 50 mL of DI water for matrix control.

14.1.5 Pre-rinse the graduated cylinder with 1+1 nitric acid, DI water, and sample between each sample measurement.

14.1.6 Shake each water sample prior to measuring 100 mL of sample in a pre-rinsed graduated cylinder.

14.1.7 Transfer 100 mL of the water sample into a pre-labeled 300 mL fleaker.

14.1.8 Add 5 mL of H_2SO_4 and 2.5 mL of HNO_3 to each fleaker.

14.1.9 Add 15 mL of $KMnO_4$ solution to each fleaker. Additional $KMnO_4$ may be required for sewage or industry wastewaters. Shake. If necessary, add additional portions of $KMnO_4$ solution, until the purple color persists for at least 15 minutes. Add 8 mL of

$K_2S_2O_8$ solution to each fleaker. Mix thoroughly. Heat at 95° C for two hours in a water bath.

14.1.10 Remove the sample containers from the water bath. Cool to room temperature. Cover each fleaker with saran wrap. Place in a wire rack. The samples are now ready for analysis.

14.2 Sediment Sample Preparation

14.2.1 Prepare the analytical batch sheet, including sample numbers, date of digestion, analyst, sample weight, initial and final temperature of the water bath, and QC samples.

14.2.2 Clean all glassware with soap and water, DI rinse, 1+1 nitric acid, and DI rinse.

14.2.3 Using a blue marker, label fleakers with sample numbers and concentration of calibration curve.

14.2.4 Weigh approximately 1.0 g of sample into an appropriately labeled 300 mL fleaker.

14.2.5 Add 5 mL of DI water to all of the fleakers including blanks, calibration curve, LCS, and MC.

14.2.5.1 Spike calibration curve with 0.5, 3, and 6 mL of working Hg standard (Section 10.19).

14.2.5.2 Spike LCS and MS QC samples with 4 mL of working Hg standard (Section 10.19).

14.2.5.3 Spike organic LCS with 4 mL of the organic Hg standard (Section 10.21).

14.2.5.4 MC – Use 0.5 g of mixed control sample.

14.2.6 Add 5 mL of aqua regia (Section 10.12) to all of the fleakers. Heat for five minutes at 95°C in a water bath.

14.2.7 Allow the samples to cool. Add 50 mL of DI water and 15 mL of KMnO4 solution (Section 10.16) to each fleaker. Swirl. Return to the water bath for 30 minutes.

14.2.8 Remove the sample containers from the water bath. Cool to room temperature. Cover each fleaker with saran wrap. Place in a wire rack. The samples are now ready for analysis.

14.3 Operate the Varian SpectrAA20 plus system according to basic operating procedures in the operating manual.

14.3.1 The instrument operating conditions are listed in Table 1. The wavelength settings, slit width selection, lamp selection, and gas flows are manually controlled. In all other aspects, the Varian SpectrAA 20 plus is controlled through the instrument's microprocessor. Refer to the instrument manual for more detailed instructions.

14.3.2 Insert the program floppy disc into the Varian SpectrAA 10 plus. Turn the instrument on. Open the valve for the argon tank ensuring that the pressure is approximately 46 psi. Turn the printer on.

14.3.3 Filter the freshly prepared stannous chloride solution into a 250 mL plastic container that has been premarked at 250 mL. Bring to volume with DI water.

14.3.4 Enter the necessary data into the instrument. If problems arise, any page can be accessed through the index page. Choose the index page key. Choose the new

page key. This should be the report format page. Enter the run number and date. Choose the print key. Choose the new page key again to get to sample labels. Enter the sample and standard names. Choose the print key again. Choose the optimization key. This will be the screen used to maximize the bar length on the optimization graph.

14.3.5 Install the gas-liquid separator on the VAG-76 according to pages 11 to 13 of the VGA-76 Vapor Generation Accessory Manual. Also refer to Figure 4 on page 6 of this manual. If sediment samples are being run, place the gas/liquid separator in a 10% mixture of silicone and DI water before using.

14.3.6 Set the slit width to 0.5 mm. Set the wavelength to 253.7 nm. Adjust the lamp screws to maximize the bar length. Lower the absorption quartz cell into alignment. Adjust the burner rotation lever and the horizontal and vertical burner adjustments to maximize the bar length. If the bar length is fully extended, choose the rescale key and continue the adjustments.

14.3.7 Put the three pump tubes on the roller bars. Switch the pump on. Adjust the flow rates using DI water. Place the tubing into the proper chemicals (DI water, stannous chloride, and 10% nitric acid). Allow the system to condition for at least 10 minutes. Refer to the VGA-76 Generation Accessory Manual for more details.

14.3.8 Obtain two 100 mL graduated cylinders. Fill one with 50 mL of DI water and 50 mL of concentrated nitric acid. The graduated cylinders will be used to bring samples and standards to a volume of 100 mL.

14.4 Sample preparation

14.4.1 Add 4 mL of sodium chloride-hydroxylamine hydrochloride for water and sediment samples. Bring to a final volume of 100 mL using one of the two graduated cylinders. Sediment samples should be allowed to settle slightly before analysis to avoid solid particulate uptake into the tubing. Rinse the graduated cylinder with DI water after bringing the sample up to volume. Transfer the acid solution from the second graduated cylinder. Rinse this cylinder with DI water. Use for the next sample.

14.4.2 Bring the digested samples to a volume of 50 mL with DI water for oil and organic samples. Graduated cylinders should be cleaned as in Section 14.4.1.

14.5 Establish the blank

14.5.1 Go to the optimization page. Record the photomultiplier volts.

14.5.2 Go to the standards page. Check to ensure that the correct standards are listed.

14.5.3 Go to the calibration page. Remove the sample uptake tube from the nitric acid solution. Place it in the blank. Wait approximately 20 seconds. Depress the "instrument zero" key three times allowing it to read between each depression of the key.

14.5.4 Depress the "read" key with the cursor at the blank. The blank should be within the absorbance listed in Table II. If the blank falls outside range, return to the blank position. Depress the "instrument zero" key three times. Reread the blank. After reading the sample, put the uptake tube back into the nitric acid solution to rinse out the uptake tube.

14.6 Calibration

14.6.1 After establishing the blank, place the uptake tube into the first standard. Allow the standard to pass through the uptake tube. Depress the "read" key. The absorbance should be within the range listed in Table II. Replace the uptake tube into the 10% nitric acid rinse after reading the sample.

14.6.2 Repeat this process with the rest of the standards. Check to make sure the absorbances are within the ranges listed in Table II. The instrument will print the calibration curve after the last standard is run.

14.7 Analysis

14.7.1 After the calibration curve has printed and is acceptable, depress the "sample analysis" key. Make sure to be on a blank. The blank and a low level standard are the first two samples on every analytical batch. The blank should read between $\pm$.020 for water and $\pm$.0020 for sediments. If the blank reading is outside of the accepted value, go back to the calibration page and re-zero the instrument. After re-zeroing the instrument, depress the "sample analysis" key. Depress the "previous sample" key to get back to the blank. Run the first standard. The value for the first standard should vary no more than 10% of its true value. A blank and a check standard, a low and mid-level standard alternately, are read after every 10 samples. If the value for the check standard falls outside of the 10% range of the true value, the curve has to be recalibrated.

14.7.2 To read the samples, remove the uptake tube from the 10% nitric acid rinse. Place it in the sample. Allow the sample to pass all the way through the sample uptake tube. Depress the "read" key. There will be a program delay. The instrument will then read the sample, display the result, and print the result.

14.7.3 After the first half of the analytical batch has been analyzed, depress the "index" key. Go to the sample labels page. Enter the information for the second half of the analytical batch. Return to the index. Enter "16" for the option number. Depress the "new page" key. Use the "previous sample" key to back to number 1. Once this has been completed, analyze the second half of the analytical batch.

14.7.4 After all samples have been analyzed, analyze the blank and each of the CALs.

14.8 Shut down procedure

14.8.1 Return the uptake tube to the10% nitric acid . Rinse. Allow the system to rinse for a few minutes.

14.8.2 While the system is rinsing, return the cart and samples to the digestion room.

14.8.3 Take the uptake tube out of the 10% nitric acid rinse. Put all three tubes into DI water to rinse out all reagents.

14.8.4 While the system is being rinsed w/with DI water, empty and rinse the three reagent bottles with DI water. Store for the next analytical batch.

14.8.5 Remove the tubes from the DI water. Leave the pump running until the DI water has been cleared from the tubing and mixing coil. Empty the DI water beaker. Store until the next analytical batch. Turn the VGA pump off.

14.8.6 Remove the gas/liquid exchanger. Rinse with DI water. Store the gas/liquid exchanger in a 20% nitric acid solution.

14.8.7 Depress the "on-line" key on the printer. This will cause the printer light to go out, and the printer will be off-line. Depress the line feed, "LF/FF" key until the data can be removed. Tear off the data. Depress the "park/load" key. When the printer stops, depress the "park/load" key again to reset the paper in the printer. Depress the "on-line" key to enable the printer.

14.8.8 Turn the power to the instrument off. Turn the printer off. Close the argon tank.

15.0 Calculations

15.1 The standards for mercury water analysis are read as 0.2, 0.5, 3.0, and 6.0 µg/L. Sample results are read as µg/L and require no calculations unless there is a dilution. The results would then be multiplied by the dilution factor.

15.2 Leachate samples are calculated using the following equation and are reported as mg/Kg:

$$\text{mg/Kg} = \frac{(\text{concentration in µg/L})(.100\ \text{L}/25\ \text{g})(1\ \text{mg}/1000\ \text{µg})(1000\ \text{g/Kg})}{\%\ \text{total solids as .XX}}$$

15.3 Sediment standards are 0.05, 0.3, and 0.6 µg/100 mL. The following formula is used for sample results in mg/Kg:

$$\text{mg/Kg} = (\text{ug}/100\ \text{mL})(\text{dilution})\frac{(100\ \text{mL})}{(\text{g of samples})(\%\text{TS})}(1\ \text{mg}/1000\ \text{µg})(1000\text{g}/1\ \text{Kg})$$

15.4 Oil and organic standards are read as µg/100 mL. The following formula is used for sample results in mg/Kg:

$$\text{mg/Kg} = (\text{µg}/100\ \text{mL})(\text{dilution})(100\ \text{mL/g of sample})(1\ \text{mg}/1000\ \text{µg})(1000\ \text{g}/1\ \text{Kg})$$

15.5 Calculation of the % recovery for accuracy control (AC) audits is as follows:

$$\%\ \text{recovery AC} = (M/T)100$$

M = measured spike sample concentration.
T = theoretical spike sample concentration where T = (X + C).
C = concentration of spiking standard.
X = average concentration of the two duplicates for precision.

16.0 Method Performance

16.1 MDL for water – An initial MDL was determined using 10 replicate analyses of a low level spiked blank with a mean concentration .9226 µg/L resulting in a standard deviation of 0.0104 µg/L mercury and an MDL of 0.0295 µg/L at 99% confidence.

16.2 RL for water – After examining several factors such as normal precision of water samples near the RL, normal blank levels, and the MDL, the RL has been set at 0.2 µg/L mercury.

16.3 MDL for sediments – An initial MDL was determined using 11 replicate analyses of a low level sample with a mean concentration of 0.0630 mg/Kg resulting in a standard deviation of 0.0066 mg/Kg and an MDL of 0.0182 mg/Kg at 99% confidence.

16.4 RL for sediments – After examining several factors such as normal precision of sediment samples near the RL, normal blank levels, and the MDL, the RL has been set at 0.05 mg/Kg mercury.

16.5 MDL studies are determined annually for this method using the Code of Federal Regulations 40 CFR, Part 136, Appendix B and internal SOP 103.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Whenever feasible, staff should use the pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

17.3 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Analytical data reported must be within the linear range of the assay (>0.2 µg/L and <6.0 µg/L for water and >0.05 mg/Kg and <0.6 mg/Kg for sediments).

18.2 Data is reported to a maximum of two significant figures as follows: water – 0.X, X.X, XX, or XX0 and sediments - .XX, X.X, XX, or XX0.

18.3 Dilutions should be greater than 10% of full scale to be reported (i.e., the diluted sample results should be >0.6 µg/L for water and >0.06 mg/Kg for sediments).

18.4 Dilutions increase the RL (i.e., RL of 0.2 µg/L or 0.05 mg/Kg multiplied by the dilution factor).

18.5 Appropriate laboratory reporting codes for dilutions, interferences, holding times, improper preservation, etc., will be appended to the test result according to laboratory policy (SOP 106).

18.6 All QA/QC for the analytical batch will be within the acceptance criteria stated in Section 12 of this method before the data can be reported.

18.7 Out of range values must be diluted, rerun, and acceptable before they can be reported.

18.8 If samples are suspected of having carryover contamination, they must be rerun for verification before they are reported.

18.9 The lead worker and Unit Manager review all data before the final reporting out of results.

19.0 Corrective Actions

19.1 Preventative maintenance is done on a routine basis. A maintenance logbook is kept with the instrument.

19.2 The sample uptake tube is changed after every two or three analytical batches. The uptake tubes for the stannous chloride and DI water are changed approximately every six months.

19.3 The quartz cell and gas/liquid exchanger are cleaned as needed using acetone followed by a DI water rinse. The quartz cell is then put in an oven to dry and the gas/liquid exchanger is stored in a 20% hydrochloric acid solution.

19.4 If the photomultiplier reading drops or the sensitivity drops, a new lamp may be required.

19.5 The DI water reservoir in the VGA needs to have DI water added every week or two. Remove the burner. Pour DI water into the reservoir. Replace the burner.

20.0 Waste Management

20.1 The waste container is emptied as needed by neutralizing the waste with soda ash and rinsing it down the drain with copious amounts of water.

20.2 Broken/waste glass is collected at the bench in a plastic pail until transferred to a collection barrel for disposal.

20.3 Excess samples and dilutions can be disposed of down the drain with copious amounts of water if they do not carry some other hazardous material (i.e., samples from an industrial site, etc.) that requires them to be handled as a hazardous waste.

21.0 References

21.1 Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry, U.S. Environmental Protection Agency, Method 245.1, Methods for Chemical Analysis of Water and Wastes, Revision 3.0, EMMC Version, 1994.

21.2 Mercury in Sediment (Manual Cold Vapor Technique), U.S. Environmental Protection Agency, Method 245.5, Methods for Chemical Analysis of Water and Wastes, 1983.

21.3 Mercury in Liquid Waste (Manual Cold Vapor Technique), U.S. Environmental Protection Agency, Method 7970A, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

21.4 Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique), U.S. Environmental Protection Agency, Method 7471A, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

21.5 SpectraAA 10/20 and 20 Plus Operation Manual, Varian Techtron Pty., Limited.

21.6 VGA-76 Vapor Generation Accessory Operation Manual, Varian Techtron Pty., Limited.

21.7 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Part 136, Appendix A and B.

22.0 Attachments

22.1 Sample batch sheet for mercury.

22.2 2001 MDL study.

APPROVED BY _____ DATE 1/10/02
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 1/10/02
COMPLIANCE OFFICER

APPROVED BY _____ DATE 1/11/02
QA OFFICER

APPROVED BY Sandra K Gregg DATE 1/10/02
UNIT MANAGER

APPROVED BY Ted Donnenberg DATE 1/10/02
ANALYST

Attachment 22.1

Table I
Instrument Operating Conditions

Wavelength	253.7 nm
Slit Width	0.5 nm
Lamp Current	4 MA
Delay Time	60 sec
Measurement Time	4.0 sec
Replicates	3
Background Correction	off

Table II
Calibration Standard Acceptable Absorbance

Hg Water Standard ug/L	Blank	0.2	0.5	3.0	6.0
Absorbance Units	± .000	.004 - .006	.011 - .013	.072 - .077	.144 - .152
Hg Sediment Standard ug/100 mL	Blank		0.05	0.30	0.60
Absorbance Units	± .000		.011 - .013	.068 - .072	.135 - .143

The range listed for each standard is the mean plus and minus one standard deviation of all the curves analyzed between 6-5-01 and 12-27-01.

Table III
Quality Control Limits

	Control (±10%)	Organic (±10%)	DLV Cont.	MC (±10%)	AC (±10%)
Hg water (ug/L)	3.6 to 4.4	3.6 to 4.4	.165 to .241	1.18 to 1.44	3.6 to 4.4
Actual Value	4	4	0.2	1.31	4
	Control (±10%)	Organic (±10%)	DLV Cont.	MC (±15%)	AC (±15%)
Hg Sed. (ug/100ml)	.36 to .44	.36 to .44	.050 to .063	1.23 to 1.67	.34 to .46
Actual Value	0.4	0.4	0.05	1.45	0.4

The quality control is analyzed and calculated on an annual basis.

Attachment 22.2

Hg-Water

Tech _____ Digest date _____ Run # _____

Analyst _____ Analysis date _____ Temp. In. _____ Final _____

Time In _____ Out _____

	Sample #	HT OK	AA in ug/L	DIL	Remarks	Report ug/l	Check STD	
1	BLK							
2	0.2							
3	0.5							
4	3.0							
5	6.0							
6								
7								
8								
9								
10								
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39								
40								

Control (4,+/-10%)		result	% rec.	PC	result	% rec.	diff.
Organic (4,+/-10%)				AC (+/-10%)			
MC (1.26,+/-10%)				DL Cont (.2,+/-15%)			

HNO_3_____ $K_2S_2O_8$_____ Hg_____ Org._____

H_2SO_4_____ $KMnO_4$_____ 0.02 Hg_____

Stannous Chloride/HCl_____ Hydroxylamine Hydrochloride/Sodium Chloride_____

Attachment 22.3

Hg-Sediment

Tech _____ Digest date _____ Run # _____

Analyst _____ Analysis date _____ Temp. In. _____ Final _____

Time In _____ Out _____

	Sample #	HT OK	AA reading	DIL	Remarks	Weight	Report mg/kg	Check std	
1	BLK								
2	0.05								
3	0.30								
4	0.60								
5									
6									
7									
8									
9									
10									
11									
12									
13									
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40									

Control (.4,+/-10%)	result	% rec	PC		result	% rec.	diff.
Organic (.4,+/-10%)			AC (+/-15%)				
MC (1.45,+/-10%) SJ			DLV STD (0.05)				

Aqua reagia_____ _____ _____ $KMnO_4$_____ Hg_____ _____ Org._____

Stannous Chloride/HCl_____ Hydroxylamine Hydrochloride/Sodium Chloride_____

Attachment 22.4

Michigan Department of Environmental Quality

Date: 1/24/01 Water/ 1/31/01 Sed.
Instrument:Varian Hydride AA
Analyst: Ted Sonnenberg

METHOD DETECTION LIMITS

Analyte	EPA Method	Spike Value ug/L or mg/Kg	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Rep. 5	Rep. 6	Rep. 7	t Value	Standard Deviation	Mean	%RSD	MDL ug/L or mg/Kg
Mercury Water	245.1/7470	0.200	0.201	0.194	0.185	0.190	0.189	0.189	0.197	3.143	0.005	0.192	2.857	0.017
Mercury Sediment	245.5/7471	0.050	0.056	0.054	0.056	0.056	0.056	0.057	0.056	3.143	0.001	0.056	1.551	0.003

George L. Krisztian
Laboratory Compliance Officer

DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 349 REVISION # 2

EFFECTIVE DATE 01/05

 COPY_____

METALS ANALYSIS USING INDUCTIVELY COUPLED PLASMA/MASS SPECTROMETRY (ICP/MS)

ICP MS

Table of Contents

1.0 Applicable Analytical Methods....2
2.0 Matrix or Matrices....2
3.0 Method Detection Limits (MDLs)....2
4.0 Scope and Application....3
5.0 Method Summary....4
6.0 Definitions....5
7.0 Interferences....7
8.0 Safety....8
9.0 Equipment and Supplies....9
10.0 Reagents and Standards....10
11.0 Sample Collection, Preservation, Shipment, and Storage....13
12.0 Quality Control (QC)....14
13.0 Instrument Startup and Precalibration....18
14.0 Sample Analysis Procedure....20
15.0 Calculations....21
16.0 Method Performance....23
17.0 Pollution Prevention....23
18.0 Data Assessment....24
19.0 Corrective Actions....24
20.0 Waste Management....25
21.0 References....25
22.0 Attachments....26
Approved By....27
Table 1: Typical Instrument Operating Conditions....i
Table 2: Maintenance Log....ii
Table 3: MDL Studies....iv
Table 4: Initial Precision and Recovery Studies....viii
Table 5: Linear Dynamic Range Studies....x
Table 6: ICP/MS Quality Control Summary....xi
Table 7: Digestion Batch Run Log Summary....xii
Table 8: Sample Table Summary....xiii
Table 9: Analysis Run Log Summary....xiv
Table 10: Data Upload Summary....xv

1.0 Applicable Analytical Methods

1.1 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Methods for Chemical Analysis of Water and Wastes, Revision 5.4, EMMC Version.

1.2 Inductively Coupled Plasma – Mass Spectrometry, U.S. Environmental Protection Agency, Method 6020, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

1.3 EPA Method 200.8 Turnkey Method for the ELAN 6000/6100 ICP-MS, Perkin Elmer Method Manual, 1996.

2.0 Matrix or Matrices

2.1 Drinking water, surface water, and ground waters.

2.2 Wastewaters, sediment, solids, high volume filters, and PM_{10} filters.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 Every analyte to be quantitated by this method must have an MDL study performed for it. The MDLs were determined by analyzing seven replicate samples. Seven samples of each matrix were spiked with various amounts of metal standards to yield a theoretical concentration one to five times the MDL value. The replicates were analyzed identical to normal samples.

3.3 Analytical results for the seven replicates were tabulated statistically. The MDL was calculated using a formula that applies the student t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom.

3.4 The MDL for this method is determined annually or whenever there is a significant change in the procedure including a change in the analyst.

3.5 Reporting limits (RL) for this method are shown in the following table.

Element	Recommended Analytical Mass	Water Reporting Limits		Filter Reporting Limits	
Aluminum	27	50	ug/L	na	
Antimony	123	1	ug/L	na	
Arsenic	75	1	ug/L	0.25	ng/m^3
Barium	137	5	ug/L	0.25	ng/m^3
Beryllium	9	1	ug/L	0.25	ng/m^3
Cadmium	111	0.2	ug/L	0.25	ng/m^3
Chromium	52	1	ug/L	0.25	ng/m^3
Cobalt	59	15	ug/L	0.25	ng/m^3
Copper	63, 65	1	ug/L	0.25	ng/m^3
Lead	206, 207, 208	1	ug/L	0.25	ng/m^3
Manganese	55	5	ug/L	0.25	ng/m^3
Molybdenum	98	25	ug/L	0.25	ng/m^3
Nickel	60	2	ug/L	0.25	ng/m^3
Selenium	78, 82	1	ug/L	na	
Silver	107	0.5	ug/L	na	
Strontium	88	5	ug/L	na	
Thallium	205	2	ug/L	na	
Titanium	47	10	ug/L	na	
Vanadium	51	2	ug/L	0.25	ng/m^3
Zinc	66	10	ug/L	0.25	ng/m^3

4.0 Scope and Application

4.1 This method provides procedures for determination of dissolved and total recoverable element concentrations in ground water, surface water, and drinking water. It also provides procedures for determination of total recoverable element concentrations in wastewater, filter, and sediment samples.

4.2 This method is applicable to the following elements:

Analyte	Symbol	Chemical Services Number (CASRN)
Aluminum	Al	7429-90-5
Antimony	Sb	7440-36-0
Arsenic	As	7440-38-2
Barium	Ba	7440-39-3
Beryllium	Be	7440-41-7
Cadmium	Cd	7440-43-9
Chromium	Cr	7440-47-3
Cobalt	Co	7440-48-4
Copper	Cu	7440-50-8
Lead	Pb	7439-92-1
Manganese	Mn	7439-96-5
Molybdenum	Mo	7439-98-7
Nickel	Ni	7440-02-0
Selenium	Se	7446-08-4
Silver	Ag	7440-22-4
Strontium	Sr	7440-24-6
Thallium	Tl	7440-28-0
Titanium	Ti	7732-18-5
Vanadium	V	7440-62-2
Zinc	Z	7440-66-6

4.3 For determination of both dissolved and total recoverable analytes for the method matrices, a digestion/extraction is required prior to analysis.

5.0 Method Summary

5.1 Prior to analysis, the samples are solubilized by digestion/extraction using an appropriate sample preparation method.

5.2 The method describes the multi-element determination of analytes by ICP/MS. Sample digests/extracts are nebulized into a spray chamber where a stream of argon gas carries the sample aerosol through a quartz torch and injects it into a radio-frequency/argon plasma. The sample is then decomposed and desolvated to its basic ion state. The ions produced are entrained in the plasma gas and, by means of a water cooled, differentially pumped interface, introduced into a high vacuum chamber that houses a quadrupole mass spectrometer. The ions are sorted according to their mass-to-charge ratio and measured with a detector.

6.0 Definitions

6.1 Method Detection Limit (MDL) - The minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the value is greater than zero.

6.2 Reporting Limit (RL or RDL) – The minimum concentration of a substance that is reported as a positive result.

6.3 Calibration Curve - A graphical plot of multiple concentrations of known analyte versus the measured instrument response to the analyte at those concentrations.

6.4 Linear Calibration Range (LCR) - The concentration range over which the instrument has been calibrated to be linear.

6.5 Linear Dynamic Range (LDR) – The concentration range over which the instrument response to an analyte is linear. This range may extend beyond the Linear Calibration Range.

6.6 Water or aqueous sample – For the purpose of this method, a sample taken from one of the following sources: drinking water, surface water, ground water, storm runoff, industrial wastewater, or domestic wastewater.

6.7 Filter sample – For the purpose of this method, a filter used for the collection of ambient particulate matter from a volume of air.

6.8 Solid sample – For the purpose of this method, a sample that is classified as soil, sediment, or sludge.

6.9 Dissolved analyte – An analyte in an aqueous sample that will pass through a 0.45 μm membrane filter assembly prior to sample acidification.

6.10 Total recoverable analyte – The concentration of analyte determined by analysis of a sample following digestion by refluxing with hot dilute mineral acid(s) as specified in this method.

6.11 Tuning solution – A solution which is used to tune and verify acceptable instrument performance prior to calibration and sample analyses.

6.12 Calibration Blank (CB) – A blank solution of reagent water containing all analytical reagents, used to establish the analytical calibration curve and for all initial and continuing calibration blank determinations.

6.13 Stock Standard Solution (SSS) – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

6.14 Calibration Standard (CS) – A solution prepared from the dilution of stock standard solutions. The CS solutions are used to calibrate the instrument response with respect to analyte concentration.

6.15 Initial Calibration Verification (ICV) – A second source standard, independent of the calibration standard, used to verify the accuracy of the calibration curve.

6.16 Detection Limit Verification (DLV) – A solution prepared at or near the reporting limit for each analyte, used to verify the accuracy of low level determinations.

6.17 Continuing Calibration Verification (CCV) - A standard prepared at a mid point level of the calibration curve, different from any calibration standard concentration, analyzed during the course of an analysis, to demonstrate instrument performance on a continuing basis.

6.18 Linear Range Verification (LRV) – A standard prepared above the linear calibration range used to demonstrate linearity above the calibration range.

6.19 Continuing Calibration Blank (CCB) - A calibration blank analyzed during the course of an analysis to demonstrate instrument performance on a continuing basis.

6.20 Internal Standard (IS) – A standard of analyte(s) added to a sample or standard solution in known amount(s) and used to measure the relative responses of other method analytes that are components of the same sample or solution. The IS must be an analyte that is not a sample component and should be grouped with analytes that are no more than 50 atomic mass units away from its atomic mass unit.

6.21 Rinse Blank (RB) – A blank solution of reagent water containing 2% nitric acid used to flush the entire sample introduction system between each sample analysis.

6.22 Laboratory Reagent Blank (LRB, BLANK1, BLANK2, QC Blank) – An aliquot of reagent water containing all reagents used during sample preparation. The LRB should be prepared in the same way that samples are prepared and is used to determine if any contamination occurs during the sample preparation process.

6.23 Laboratory Fortified Blank (LFB, CONTROL1, CONTROL2, QC Spike) - An aliquot of reagent water containing all reagents and fortified with a known amount of method analyte(s) used during sample preparation. The LFB should be prepared in the same way that samples are prepared and is used to verify the accuracy and efficiency of the sample preparation process.

6.24 Laboratory Fortified Matrix (LFM, MSD1, MSD2, QC Spike) - An aliquot of sample fortified with a known amount of analyte(s), prepared and analyzed using the same procedure as the original sample. The LFM is used to indicate whether or not sample matrix has an effect on the quantification of analyte(s).

6.25 Laboratory Duplicate (LD, MS1, MS2, QC Duplicate) – A second laboratory fortified matrix sample. The LD is used to indicate precision of sample preparation and analysis.

7.0 Interferences

7.1 Isobaric interferences occur when an isotope of one element is at the same nominal mass as an isotope of another element (e.g. Mo^{98} and Ru^{98}). Corrections for isobaric interferences may be made by measuring the intensity due to the interfering element at another isotope and using its natural abundance ratios to correct for its presence at the analytical mass of interest. Most commonly used corrections for isobaric interferences are already present as default interference equations in the ELAN NT software.

7.1.1 Care should be taken to ensure that the isotope measured for correction purposes does not suffer from overlap with other isotopes that may be present in the sample.

7.2 Abundance sensitivity is a property defining the degree to which the wings of a mass peak contribute to adjacent masses. The abundance sensitivity is affected by ion energy and quadrupole operating pressure. Wing overlap interferences may result when a small ion peak is being measured adjacent to a large one. The potential for these interferences should be recognized and the spectrometer resolution adjusted to minimize them as is the case with the ELAN NT software.

7.3 Isobaric polyatomic ion interferences are caused by ions consisting of more than one atom that have the same nominal mass-to-charge ratio as the isotope of interest and that cannot be resolved by the mass spectrometer in use. These ions are commonly formed in the plasma or interface system from support gases or sample components. These interferences must be recognized, and, when they cannot be avoided by the selection of alternative analytical isotopes, appropriate corrections must be made to the data. Equations for the correction of the data are supplied with the ELAN NT software. Argon gas contains the common ^{82}Kr interferent that affects the determination of both arsenic and selenium. This can be reduced with the use of high purity krypton free argon.

7.4 Physical interferences are associated with the physical processes that govern the transport of sample into the plasma, sample conversion processes in the plasma, and the transmission of ions through the plasma-mass spectrometer interface. These interferences may result in differences between instrument responses of the samples and the calibration standards. These interferences may occur in the transfer of sample to the nebulizer (e.g., viscosity effects), at the point of aerosol formation and transport to the plasma (e.g., surface tension), or during excitation and ionization processes within the plasma. Dissolved solids greater than 0.2% (w/v) in the sample may contribute deposits of material on the sampler and/or skimmer cones reducing the effective diameter of the orifices and ion transmission. Internal

standards may be used to compensate for many physical interference effects provided they have similar analytical behaviors as the elements analyzed.

7.5 Memory interferences result when isotopes of elements in a previous sample contribute to the signals measured in a new sample. They can result from sample deposition on the sampler and skimmer cones and from the buildup of sample material in the plasma torch and spray chamber. Flushing the system with a rinse blank between samples can minimize memory effects. Each ELAN is set to run a rinse blank between samples for a minimum of 30 seconds. Memory interferences are also checked by using a minimum of three replicate integrations for data acquisition. If the relative standard deviation is greater than 10%, the analysis is repeated.

8.0 Safety

8.1 Safety glasses and shoes that cover the feet are required in all designated laboratory areas.

8.2 It is recommended that the analyst wear gloves and a lab coat when performing this procedure.

8.3 Be familiar with the Laboratory Chemical Hygiene Plan.

8.4 Be familiar with the Laboratory Safety Policy (SOP 100).

8.5 The analyst must be familiar with any material safety data sheets applicable to this method.

8.6 The analyst must be familiar with the location of safety equipment including showers, eye wash stations, spill kits, and fire extinguishers.

8.7 The analyst should always thoroughly wash hands in warm soapy water when leaving the work area and before handling food or drink.

8.8 The analyst should assume that all samples have the potential to be hazardous and should always exercise caution when transporting, handling, and/or opening samples.

8.9 General good laboratory practices are required. The analyst should take all necessary precautions in order to minimize the potential of exposure to samples and reagents used in this method.

8.10 The ELAN is fully interlocked to protect the user from dangers such as high voltages, RF radiation and intense UV radiation. At no time should the user attempt to disable these interlocks or operate the instrument if any safety interlock is disabled or malfunctioning. The ICP should only be viewed with proper eye protection from UV emissions.

8.11 Liquid argon represents a potential cryogenic hazard, and safe handling procedures should be used at all times when handling liquid argon tanks.

9.0 Equipment and Supplies

9.1 ICP/MS system

9.1.1 Perkin-Elmer ELAN 6100 - includes instrument, computer system (Dell Optiplex GX1), ELAN NT software Version 2.2, printer, and AS-90/AS-91 auto-sampler.

9.1.2 Perkin-Elmer ELAN 9000 - includes instrument, computer system (Dell Optiplex GX150), ELAN NT software Version 2.4, printer, and AS-93plus auto-sampler.

9.1.2.1 Computer system to include Excel™ and LabWorks™ LIMS system.

9.2 Peristaltic pump tubing

9.2.1 Black/black – 0.75 mm inter diameter ID, for sample introduction. Fisher # 14190108.

9.2.2 Yellow/orange – 0.51 mm ID, for internal standard introduction. Fisher # 14190104.

9.2.3 Red/red – 1.14 mm ID, for rinse. Fisher # 14190109.

9.2.4 Black/white – 0.125 in ID, for waste removal. Fisher # 1160532200.

9.2.5 Purple/white – 2.79 mm ID, for AS 93plus rinse station. Perkin Elmer # 070540-18.

9.3 T connector – Polypropylene, 1/16" ID, PE PIN BO19-8201, Cole Parmer Part # H-06365-77, for hooking up online addition of internal standards.

9.4 Calibrated mechanical pipettes: 10-100 µL, 100-1000 µL, 1000-5000 µL.

9.5 Pipette tips - Metal-free, plastic, for each of the above pipettes.

9.5.1 0-300 uL – Stock # 3P03

9.5.2 101-1000 uL – Stock # 3P01

9.5.3 1-5 mL – Stock # 3P05

9.6 Autosampler tubes - 50 mL, plastic, PE PIN BO #19-3234 or equivalent.

9.7 Sample tubes - 17 x 100 mL, disposable, polypropylene, VWR # 60818-618, Stock # - 2T71 or equivalent.

9.8 Centrifuge tubes - 15 mL, capped, VWR # 21008-220, Stock # - 2C43 or equivalent.

9.9 Volumetric flasks as necessary.

9.10 Analytical balance - Capable of weighing 0.1 mg as necessary.

9.11 Calibration weights - For calibrating balance and verification.

9.12 pH strips, 0-14 range as necessary, Stock # - 2P35.

9.13 Liquid Argon – AirGas # AR 160LT230

10.0 Reagents and Standards

***NOTE**: All reagents may contain impurities that may affect the integrity of the analytical results. All reagents and standards must be traceable to the manufacturer. All reagents and standards must be labeled with: date received, date opened, expiration date, tracking number, and user's initials. All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and contents. All standard logbooks must be completely filled out. All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. Original certificates are kept in a three ring binder by the ICP/MS. All reagents are prepared with deionized (DI) reagent water. DI water is normal tap water that has been passed through a Millipore, Super Q™ water purification system and has an industry standard resistivity of 18 MΩ.*

10.1 Nitric acid – Concentrated, trace metal grade, Mallinckrodt # 6623-46.

10.2 Hydrochloric acid – Concentrated, Mallinckrodt 5587.

10.3 Blank solutions – Reagent blank, Calibration blank, Rinse blank

10.3.1 Reagent blank – Prepare by adding 1 mL of concentrated nitric acid and 0.1 mL of hydrochloric acid to 45 mL of DI reagent water. Bring to 50 mL final volume. This solution is used throughout the entire sample preparation and analytical process.

10.3.2 Calibration blank - Prepare by adding 1 mL of concentrated nitric acid and 0.1 mL of hydrochloric acid to 45 mL of DI reagent water. Bring to 50 mL final volume. This solution is used for instrument calibration and subsequent calibration verification analyses.

10.3.3 Rinse blank – Prepare by adding 60 mL of concentrated nitric acid to approximately 2500 mL of reagent water. Bring to a 3 L final volume. This solution is a 2% nitric acid solution and is used for rinsing the sample introduction system between each sample analysis.

10.4 Single element Stock Standard Solutions

10.4.1 Germanium – 1000 mg/L, Spex PLGE9-2Y or equivalent.
10.4.2 Indium – 1000 mg/L, EM Science ICP242-1 or equivalent.
10.4.3 Bismuth – 1000 mg/L, EM Science ICP205-1 or equivalent.
10.4.4 Tellurium – 1000 mg/L, EM Science ICP260H-1 or equivalent.
10.4.5 Molybdenum – 1000 mg/L, VWR VW4218-1 or equivalent.
10.4.6 Antimony – 1000 mg/L, VWR VW4201-1 or equivalent.
10.4.7 Titanium – 1000 mg/L Spex CLT19-2Y or equivalent.

NOTE: *Bismuth and tellurium are not used on a regular basis and are provided as alternate internal standards where matrix interferences are suspected on internal standards normally used.*

10.5 Multi Element Stock Standard Solutions

10.5.1 Calibration Stock 1, Multi Element Solution 2A – 10 ug/mL of Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, K, Li, Mn, Mg, Na, Ni, Pb, Rb, Se, Sr, Tl, U, V, and Zn, Spex CLMS-2A.

10.5.2 Calibration Stock 2 – 10 mg/L of Mo, Sb, and Ti.

10.5.2.1 Prepare by filling a 100 mL volumetric flask with DI reagent water. Add 1 mL each of Molybdenum, Antimony, and Titanium single element stock standard solutions from above and 2 mL of concentrated nitric acid. Bring to volume.

10.5.3 QC standard 7A – 1000 mg/L of K, 500 mg/L of Si, 100 mg/L of Al, B, Ba, N and 50 mg/L of Ag, Spex QC-7A.

10.5.4 QC standard 21 – 100 mg/L of As, Be, Ca, Cd, Co, Cr, Cu, Fe, Li, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sr, Ti, Tl, V, and Zn, Spex QC-21.

10.5.5 Internal Standard Stock solution – 10 mg/L of Bi, Ho, In, Li6 (95% enriched), Sc, Tb, and Y, Spex CLISS-1.

10.6 Multi Element Working Standard Solutions.

NOTE: *Working standard solutions should be prepared fresh on a weekly basis or as necessary whichever is sooner.*

10.6.1 Calibration Standard 1 - 10 ug/L

10.6.1.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 50 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.2 Calibration Standard 2 - 20 ug/L

10.6.2.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 100 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.3 Calibration Standard 3 - 100 ug/L

10.6.3.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 500 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.4 Quality Control Standard (QCS) - 50 ug/L

10.6.4.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 250 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.5 Initial Calibration Verification standard (ICV) - 25, 50 ug/L. This is an independent source standard used to verify the calibration. Ag will be at 25 ug/L. All other elements will be at 50 ug/L.

10.6.5.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of reagent water. Add 25 uL of QC standard 7A (Section 10.5.3) and QC standard 21 (Section 10.5.4). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.6 Detection Limit Verification standard (DLV) - 1.0 ug/L

10.6.6.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 500 uL of the 100 ug/L Calibration Standard 3 (Section 10.6.3). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.7 Continuing Calibration Verification standard (CCV) - 50 ug/L

10.6.7.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of DI reagent water. Add 250 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid and 0.1 mL of concentrated hydrochloric acid. Bring to volume.

10.6.8 Linear Range Verification standard (LRV) - 500, 1000 ug/L

10.6.8.1 Prepare each by adding 50 uL and 100 uL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2) to two 10 mL centrifuge tubes (Section 9.8). Bring each to a 10 mL final volume using reagent blank (Section 10.3.1).

NOTE: *Typical internal standard responses should yield approximately 200,000 to 500,000 cps for the elements in this solution. Because the sensitivity of both the Elan6100 and the Elan9000 may be different, the prepared concentrations of internal standard solutions may be different for each and may change over time as the sensitivity of the instruments may change. The following preparation is just one example that may be used.*

10.6.9 Internal Standard Working solution (IS) - 30 ug/L – Bi, Ho, In, Li6, Sc, Tb, Y. 300 ug/L Ge.

10.6.9.1 Prepare by partially filling a 2 L flask with DI reagent water. Add 6 mL of Internal Standard Stock solution (Section 10.5.5) and 600 uL of Germanium Stock Standard solution (Section 10.4.1). Add 20 mL of concentrated nitric acid. Bring to volume.

10.7 Instrument Optimization solutions

10.7.1 Tuning, Performance evaluation and Pulse stage detector calibration solution – 10 ug/L of Ba, Cd, Ce, Cu, In, Pb, Mg, Rh, and U, Perkin Elmer N812-5030.

10.7.2 Lens calibration solution – 10 ug/L of Be, Co, In, and U, Perkin Elmer N812-5031.

10.7.3 Analog stage detector calibration solution – 200 ug/L of Be, Cd, Cu, Pb, Mg, and Rh, Perkin Elmer N812-5032

10.7.4 Dual Detector Calibration solution – 200 ug/L all method analytes.

10.7.4.1 Prepare by filling a 50 mL centrifuge tube with approximately 40 mL of reagent water. Add 1 mL each of calibration stock 1 (Section 10.5.1) and calibration stock 2 (Section 10.5.2). Add 1 mL of concentrated nitric acid. Bring to volume.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Water Samples

11.1.1 Water samples are collected in 500 mL high-density polyethylene screw cap bottles. The bottles should be filled completely.

11.1.2 Water samples are preserved with 1:1 nitric acid to a pH less than 2 at the time of collection or as soon thereafter as practically possible (within 24 hours). Dissolved water samples are filtered through a 0.45 μm pore diameter membrane filter at the time of collection or as soon thereafter as practically possible (within 24 hours) prior to preserving with 1:1 nitric acid to a pH less than 2. Following acidification to a pH less than 2, the sample is mixed, held for a minimum of 16 hours, and the pH verified to be less than 2. If the pH is not less than 2, more acid is added, and the sample is held for 16 hours until verified to be pH less than 2.

11.1.3 Water samples are stored at room temperature. The recommended maximum holding time for water samples is six months from the time of collection, providing they have been properly preserved.

11.2 Filter Samples

11.2.1 Filters are sent to the laboratory folded in half with the exposed surface to the inside in a folder that is inserted into a labeled envelope. The information on the envelope should include: (1) county, (2) location, (3) site number, (4) sampling date, (5) filter number, (6) initial time, (7) final time, (8) initial flow, (9) final flow, (10) flow units, (11) installation date, (12) removal date, (13) field operator, (14) sample information, and (15) noticeable activity near sampler information.

11.2.2 Filters are stored in a temperature and humidity controlled room where they are weighed, if needed, prior to analysis. The recommended maximum holding time for filter samples is six months from the time of collection, providing they have been properly preserved.

11.3 Solid Samples

11.3.1 Solid samples are stored at 4°C. The recommended maximum holding time for solid samples is six months from the time of collection, providing they have been properly preserved.

12.0 Quality Control (QC)

12.1 Laboratory performance quality assurance procedures.

12.1.1 Initial demonstration of capability (IDOC) - The following items must be completed before the analysis of any sample is performed by each laboratory using this method.

12.1.2 Linear Dynamic Range (LDR) – The LDR is established for each analyte by running a series of increasing concentration standards close to the upper linear range of the instrument. It is suggested that multi-element standards be used for this procedure whenever possible. Care should be taken to avoid potential damage to the detector during this process. The LDR that may be used for the analysis of samples should be judged by the analyst from the resulting data. The upper LDR is defined as the concentration where the measured value is within 10% of the actual prepared value of the standard. Determined sample analyte concentrations that are greater then 90% of the determined upper LDR limit must be diluted and reanalyzed. The upper LDR may be determined whenever one of the following occurs: (1) a new detector is installed, (2) a different sample introduction system (change in nebulizer or spray chamber type) is installed, or (3) a new analyst is using the system.

12.1.3 MDL determination - Fortify a reagent blank with a concentration of each analyte that is two to five times the estimated detection limit. This solution is called the MDL solution. Take seven replicate aliquots of this solution and process through the entire method (including any sample preparation steps). Calculate the standard deviation of the measured concentrations for the seven aliquots. Multiply the standard deviation by 3.14 (student's t value for 99% confidence level and n=7) to obtain the MDL (in concentration units). The MDL must be sufficient to detect analytes at the required levels according to compliance monitoring regulations. The MDL should be redetermined annually, when a new analyst runs the instrument, when any change to the sample preparation procedure occurs, and/or when any significant change to the instrument occurs (new detector, different sample introduction system is used, or new analyst is using the system).

12.1.4 Initial precision and recovery (IPR) – To establish the ability to generate acceptable precision and recovery, the following operations are performed: (1) four replicates of an IPR solution (QCS solution from Section 10.6.4 may be used) are analyzed according to the procedure beginning in Section 13, (2) using the results of the set of four analyses, compute the average percent recovery (X), and standard deviation of the percent recoveries (s).

12.2 Sample preparation quality assurance procedures.

12.2.1 Laboratory Reagent Blank (LRB) - A minimum of one LRB must be prepared for every batch of 20 samples prepared of the same matrix. For routine analyses, LRBs may be called "BLANK1," "BLANK2," or "QC Blank."

12.2.1.1 When LRB values constitute 10% or more of the analyte level or are 2.2 times the analyte MDL (whichever is greater), fresh aliquots of the samples should be prepared and analyzed again for the affected analytes after the source of contamination has been identified and corrected.

12.2.2 Laboratory Fortified Blank (LFB) - A minimum of one LFB must be prepared for every batch of 20 samples prepared of the same matrix. For routine analyses, LFBs may be called "CONTROL1," "CONTROL2," or "QC Spike" and should be spiked at a concentration of 50 ug/L.

12.2.2.1 The percent recovery is calculated according to the following formula:

LFBR % = (LFB – LRB) / S * 100
where
LFBR % = percent recovery for the LFB.
LFB = measured concentration of the LFB
LRB = background concentration of the LRB
S = amount of spike added to the LFB

12.2.2.2 The percent recovery for the LFB must be within the required control limits of 85-115%. If the recovery is not in control, the source of the problem should be identified and resolved before analysis is continued.

12.2.2.3 When sufficient internal performance data becomes available (usually a minimum of 20 to 30 analyses), control limits for the LFB may be determined from the mean percent recovery. Upper and lower control limits should be as follows:

Upper control limits = x + 3S
where
S = standard deviation of last 20 measurements
x = mean value

Lower control limit = x - 3S
where
S = standard deviation of last 20 measurements
x = mean value

12.2.2.4 The optional control limits must be equal to or better than the required control limits of 85% to 115%. All such data should be kept on file and available for review.

12.2.3 Laboratory Fortified Matrix (LFM) - A minimum of one LFM must be prepared for every batch of 20 samples prepared of the same matrix. For routine analyses, LFMs may be called "MSD1," "MSD2," or "QC Spike" and should be spiked at a concentration of 50 ug/L.

12.2.3.1 The method uses LFM samples to determine if there are any potential matrix effects from samples that may interfere with the analyte concentration determinations.

12.2.3.2 The aliquot used for the LFM must be a duplicate of an aliquot used for sample analysis.

12.2.3.3 Calculate the percent recovery for the LFM as follows:

LFMR % = (LFM – LM) / S * 100
where
LFMR % = percent recovery for the LFM
LFM = measured concentration of the LFM
LM = measured concentration of the sample
S = amount of spike added to the LFM

12.2.3.4 The recovery of the LFM must be within the required acceptance range of 70% to 130%. For this SOP the recovery of the LFM should be within the acceptance range of 80% to 120%. If the recovery is not consistently within this range and the LFB recovery is acceptable, provisions must be made to determine matrix interference effects for client samples and to make appropriate qualifications to reported results.

12.2.3.5 Recovery calculations are not required if the concentration of the analyte added is less than 30% of that present in the sample.

12.2.4 Laboratory Duplicate (LD) - A minimum of one LD must be run for every batch of 20 samples of the same matrix. For routine analyses, LDs may be called "MS1," "MS2," or "QC Duplicate."

12.2.4.1 The aliquot used for the LD must be a duplicate of the aliquot used for the original sample analysis and LFM analysis. The LD is prepared as a duplicate of the LFM.

12.2.4.2 Calculate the Relative Percent difference for the LD as follows.

LDP % = abs(LFM – LD) / (LFM + LD) / 2 * 100
where
LDP % = relative percent difference for the LD
abs = the absolute value
LFM = measured concentration of the LFM
LD = measured concentration of the LD

12.2.4.3 The relative percent difference between the LD result and the LFM result should not exceed 20%. If the relative percent difference is above this limit, the sample and LD should be reanalyzed and a new relative percent difference calculated.

12.3 Instrument performance quality assurance procedures.

12.3.1 Calibration

12.3.1.1 The calibration must use a minimum of a calibration blank and 2 standards. It must be run at the beginning of an analysis prior to sample analyses.

12.3.1.2 The calibration linearity must yield a correlation coefficient of at least 0.995 or better.

12.3.1.3 Any sample analyte concentration greater than the highest calibration standard should be diluted to within the calibration range and reanalyzed.

12.3.2 Instrument Calibration Verification (ICV)

12.3.2.1 The ICV must be analyzed immediately following the calibration and prior to any sample analyses.

12.3.2.2 The ICV must yield a recovery that does not deviate by more than10% of the actual analyte concentration. If the recovery falls outside of this range, the analysis must be stopped, the problem corrected, system recalibrated, and the analysis restarted.

12.3.3 Detection Limit Verification (DLV)

12.3.3.1 The DLV is routinely analyzed following the ICV prior to any sample analyses.

12.3.3.2 The DLV should yield a recovery that does not deviate by more than 10% of the actual analyte concentration. If the recovery falls outside of this range, care should be taken in assessing the quality of data at this level.

12.3.4 Continuing Calibration Verification (CCV)

12.3.4.1 The CCV must be analyzed prior to the first sample analysis, after every 10 samples, and after the last sample analysis.

12.3.4.2 The CCV must yield a recovery that does not deviate by more than 10% of the actual analyte concentration. If the recovery falls outside of this range, the CCV maybe reanalyzed or the analysis must be stopped, the problem corrected, system recalibrated and the analysis restarted from the point at which the last CCV yielded acceptable recovery.

12.3.5 Continuing Calibration Blank (CCB)

12.3.5.1 The CCB must be analyzed prior to the first sample analysis, after every 10 samples, and after the last sample analysis. For this procedure the CCB will immediately follow the CCV analysis.

12.3.5.2 The CCB must yield results that are within 10% of calibration. If the recovery falls outside of this range, the CCB maybe reanalyzed or the analysis must be stopped, the problem corrected, system recalibrated and the analysis restarted from the point at which the last CCB yielded acceptable recovery.

12.3.6 Internal Standards (IS)

12.3.6.1 The internal standard must be added to every sample including the calibration. This is achieved by online addition, where the internal standard mixes with sample prior to introduction into the instrument nebulizer.

12.3.6.2 The absolute response of all ISs in all samples, must be within 60-125% of the original response in the calibration blank. If the recovery of any IS falls outside of this range, the sample must be reanalyzed for those analytes affected. If another IS used yields acceptable results, then the data for those analytes affected by the IS that failed, may be reprocessed using the IS that yielded acceptable results. The IS used to reprocess the data should not be more than 50 atomic mass units from the analytes of interest. If the IS fails in either the CCV or CCB, follow the appropriate corrective action procedures described for CCV or CCB failures (Section 12.3.4.2 or 12.3.5.2).

NOTE: *A thorough understanding of the Elan6100 & Elan9000 hardware and software guides as well as the Windows™ operating system is recommended to continue and understand this SOP. Moving around within the windows of the software is described within the guides. The following procedures assume that software methods and files have been developed and will be used for routine analyses. Any procedures for creating, modifying, or editing methods and/or files can be found in the software guides. The following will describe in general how to perform the procedures and will use examples based on typical operating conditions that apply to both the Elan6100 and the Elan9000. The software makes use of workspaces, which allows all files necessary for an analysis to be grouped together and opened simultaneously. References to workspaces will be used in this SOP and shall imply that the files needed for routine analyses have been grouped accordingly.*

13.0 Instrument Startup and Precalibration

13.1 Powering up the system and software for both Elan6100 & Elan9000.

NOTE: *The instrument software is initialized and the instrument is allowed to warm up for a minimum of 30 minutes with the plasma on prior to running any sample analyses.*

13.1.1 Turn on the computer. At the desktop, double click the ELAN icon to load the Elan software.

Error! Objects cannot be created from editing field codes.

13.1.2 Choose "instrument" on the Elan toolbar to bring up the instrument window.

13.1.3 Verify there is an adequate argon supply. Verify that the system status indicator in the instrument window shows a green ready. Choose "start" in the instrument window just below the word "plasma" or press the green "Start" button on the front of the instrument. The ignition sequence has now begun. The plasma will light when the task bar completes moving from left to right. If ignition fails, choose "start" again. If ignition fails a second time, refer to the ELAN hardware guide to troubleshoot.

13.2 Pump Tubing installation

13.2.1 Install the pump tubing on the peristaltic pumps as follows: Elan6100 from the bottom, (1) black/white connected to the waste lines from the spray chamber and to the drain vessel, (2) red/red connected to the rinse lines from the rinse bottle and to the rinse station on the auto sampler, (3) orange/yellow connected to the IS supply and to one side of the "T" fitting to the sample loop, (4) black/black connected to the sample probe line and to the other side of the "T" fitting to the sample loop. Elan9000 from the left, (1) black/white connected to the waste lines from the spray chamber and to the drain vessel, (2) orange/yellow connected to the IS supply and to one side of the "T" fitting to the sample loop, (3) black/black connected to the sample probe line and to the other side of the "T" fitting to the sample loop.

13.2.2 Start a rinse to prime the pump tubing by initiating the sample probe and peristaltic pump. Choose "method" on the Elan toolbar. Choose the "sampling" tab. Choose "probe." Choose "go to rinse." The probe moves to the rinse station. Choose "devices" on the Elan toolbar. On the peristaltic pump window, choose "connect." Choose the right directional arrow to initiate the pump. The speed should already be set at -24 rpm. The pump should be pulling rinse water up the probe or pulling waste water from the spray chamber. If it is not, stop it or reverse the direction immediately to avoid solution back up into the spray chamber. Verify that the waste container is not full. Empty as necessary.

***NOTE**: The following procedures for performing Tuning, Mass Calibration, Performance Evaluation, and routine analyses are described in detail in the Elan's software guide. The procedures in this SOP will only generally describe what procedures to perform and acceptable performance criteria associated with those procedures. The Elan's tuning file is used to manage the quadrupole mass filtering performance. The following steps describe the use of the Elan's AutoTune function to permit automated parameter setting for mass calibration and resolution. Tuning is performed on a daily basis or every 24 hours of continuous operation. Alternate isotopes may be used to perform the Tune and Mass calibration, however, the tuning method file will have to be modified and a new solution may need to be prepared to accommodate the alternate isotopes. Refer to the Elan User's Guide. This SOP does not describe procedures for performing alternate tuning. For all optimization procedures including tuning, mass calibration and performance evaluation, disconnect the sample line from the tee fitting, connect it directly to the nebulizer line, and disengage the tension arm of the peristaltic pump from the internal standard line. For all sample analyses, reconnect the sample line to the tee fitting and reengage the tension arm to the internal standard line.*

13.3 Instrument Tuning, Mass Calibration and Performance Evaluation.

13.3.1 Open the tuning workspace and perform an instrument tune and mass calibration using the tuning solution. (Section 10.7.1)

13.3.2 Verify that the resolution for each elemental isotope is 0.7 ± 0.1 atomic mass units. Verify that the measured mass for each elemental isotope does not deviate by more than ± 0.1 atomic mass units from the actual isotopic mass. If either of the two above verifications fails for any isotope, repeat the tuning procedure until all isotopes

verify to be with in the acceptable limits. Print copies of the raw data and isotopic graphical scans. Hardware settings from the tune and mass calibration just performed should be saved when prompted while opening the analysis workspace. If repeated attempts fail to provide adequate mass calibration or resolution, see the daily optimization procedures section of the software guide for troubleshooting.

***NOTE**: Instrument stability and performance are demonstrated by running the tuning solution a minimum of five times. The resultant relative standard deviations of the absolute signals for all analytes must be less than 5%. The responses in Ion counts per second should be at or above target levels determined by the instrument manufacturer.*

13.3.3 Open the performance workspace and run an instrument performance evaluation using the same tuning solution from the tuning procedure (Section 10.7.1).

13.3.4 Verify that the following parameters are performed. The following criteria should be typically achieved for each instrument.

Parameter	**Elan6100**	**Elan9000**
Background	< 30cps @ Mass 220	< 30cps @ Mass 220
Rh Sensitivity	>150,000 cps	>300,000 cps
In Sensitivity	Not applicable	>300,000 cps
Mg Sensitivity	>20,000 cps	>40,000 cps
Pb Sensitivity	>100,000 cps	>100,000 cps
CeO/Ce (oxides)	≤0.03 (or 3%)	≤0.03 (or 3%)
Ba++/Ba+(doubly charged)	≤0.03 (or 3%)	≤0.03 (or 3%)

13.3.5 If the performance check is satisfactory, print the report, flush the sample introduction system with rinse blank, and begin calibration and analysis of samples. The daily performance file does not need to be saved since hardware settings are not changed. If the daily performance check is not satisfactory, refer to the optimization procedures and flow chart in the Elan's software guide for optimization procedures.

13.3.6 Complete the entries for the Daily Maintenance log.

14.0 Sample Analysis Procedure

14.1 Prepare calibration standards, QC standards (Section 10.0), and samples.

14.2 Open the routine analysis workspace.

***Note**: The following procedures involving sample, method, and report files are associated with automated procedures performed in Excel™. The use of these Automated procedures depends on the selection of the correctly formatted method, report, and sample files. Alternate files may not work with this automated process. Sample analyses are initially performed on uniquely identified batches of predigested samples. For aqueous samples, these unique batch identifiers are labeled as "M_DIG-###" where ### is a sequentially given number from 001-999. For Solid*

samples, these unique batch identifiers are labeled as "S_DIG-###" where ### is a sequentially given number from 001-999. For filter samples, these unique batch identifiers are labeled as "F_MMMYYYY" where MMM is the first three letters of the month and YYYY is the year.

14.3 Choose "sample" on the Elan toolbar. Fill the sample table for batch analysis by manually typing in the appropriate information, or import the sample digestion batch into the table from Excel™ by opening Excel™ and clicking on the "Import Sample Table File" button on the toolbar.

At the prompt, enter the batch ID of the analysis to be performed, "M_DIG-###." A sample file will be created and saved as "M_DIG-###.sam." If manual entry was done, save the file manually as "M_DIG-###.sam." Verify that this sample file is loaded in the workspace.

14.4 Choose "method" on the Elan toolbar. Load the method used for routine analysis from the "file" menu. Choose the "report" tab. Under "report to file," "report file name," change the report file name to the sample digestion batch number that is going to be analyzed (from 14.3 above) with a ".csv" attached as file type to save as a comma separated variable type file. If this is a re-analysis of the digestion batch, add a "-#R" to the file name, where "#" is the nth re-analysis of the digestion batch. This will be the data file imported into an Excel™ spreadsheet. Be sure the box for "Send to File" is checked (this enables report output). Any other adjustments to the method should only include the removal of analytes from the analysis list. Do not adjust isotopes within the list including analytes of interest, internal standards, or groupings. Save the method as the sample digestion batch ID ("M_DIG-###.mth"). The method file does not need to be loaded into the workspace. The sample file will point to the correct method file upon start of the analysis.

14.4.1 Load the samples into the autosampler positions as specified in the sample file.

14.4.2 Choose the samples to be analyzed by highlighting all sample row numbers in the sample file with the mouse.

14.4.3 Choose "Analyze Batch" at the top of the sample table.

14.4.4 Upon completion of the analysis, shut down the instrument by clicking on "Stop" below "Plasma" on the instrument window or by pressing the yellow "Stop" button on the front of the instrument.

14.4.5 Loosen or unclamp all sample tubing from the peristaltic pump(s). This will help extend the life of the tubing and allow it to be used again. The Elan9000 has a built in tube saver option that keeps its peristaltic pump rotating at a minute rpm.

15.0 Calculations

15.1 The Elan software performs all calculations necessary to convert raw data (ion counts/second) into reportable data (ug/L). Report option files contain the necessary information to display, print, and export data. Report option files for routine analyses have been developed for print and export and should not be modified. These files can be customized and saved under another name for the user's needs.

15.2 Data correction equations are pre built into the Elan software for isobaric elemental interferences. Correction equations for polyatomic or molecular interferences must be entered manually.

15.3 If multiple isotopes are monitored for an analyte, careful examination of the concentrations for both isotopes can provide useful information in detecting possible interferences. Consideration should be given to all isotopes before reporting data.

15.4 Data Collection and Validation

15.4.1 Data Export

15.4.1.1 Analysis data is printed and automatically exported to a file stored on the computer's hard drive. This file is defined in the Elan method file (Section 14.4). As each sample analysis is completed at run time, the data is printed and exported to this output file. The output file is complete when all samples have been analyzed. This is an automatic event and requires no user intervention as long as these files have been defined in the Elan method and report outputting is enabled. The report output file should be stored in the following directory of the computer: **C:\elandata\ReportOutput**.

***NOTE**: The following section is an optional alternative to manual data validation and describes in general detail the use of an automated spreadsheet generator in Excel™. A spreadsheet template in conjunction with a report output file from Elan is used to create an organized summary of a sample batch analysis. Runlog, Data Summary, Batch QC Summary, Re-Analyses, Data Failures, and Uploadable reporting template pages are created. This process takes a sample preparation batch from initial analysis to completion, which may include 1 or more analytical runs depending on re-analyses. Multiple files and folders have been and will be created using this automated process. An understanding of Excel™ and the LabWorks™ LIMS system is necessary to fully utilize this data handling procedure. If manual validation is performed, follow the quality control criteria outlined in section 12.*

15.4.2 Data Validation (Automated RunLog, Data Summary, Batch QC, Re-Analysis)

15.4.2.1 Open Excel™.
15.4.2.2 Open LabWorks™.
15.4.2.3 Export a Backlog report of requested metals analyses and sample IDs in LabWorks™, to a "worklist" file in Excel™. Refer to the LabWorks™ User Manual for complete instructions on this step.
15.4.2.4 In Excel™, click the "Auto Runlog Creator" button on the tool bar.

Follow any prompts from the procedure as the spreadsheet is built. During completion of the validation process a folder will be created for the digestion batch and will contain the report output file(s) from the analyses as well as the newly created Runlog spreadsheet file(s) and any subsequent re-analyses. These files and folder should be stored in the following directory of the computer: **C:\Documents and Settings\My Documents\Elan9000 RunLogs**.

15.4.2.5 Print a copy of the Runlog worksheet and the Re-analysis worksheet if any samples are to be reanalyzed. Print a copy of the Standards worksheet on the back of the Runlog worksheet and store this with the printed raw data from the analysis.

15.4.2.6 Reanalyze samples as necessary and repeat step 15.4.2.4 for all subsequent Re-analyses of the same sample preparation batch. When all sample preparation batch data is validated and reportable (this may take 1 or more re-analyses), a file will be automatically created that includes all of the data to be imported into LabWorks™. A prompt will be generated asking the user to create a name for this file. This file should be named the same as the digestion batch (Section 14.3). This file should be stored in the following directory of the computer: **C:\User\Temp**.

15.4.2.7 In LabWorks™, import the data file created from 15.4.2.6. Refer to the LabWorks™ User Manual for complete instructions on this step.

16.0 Method Performance

16.1 MDL – An initial MDL was determined for each analyte in water and filter matrices. MDL studies are determined annually for this method using the Code of Federal Regulations 40 CFR, Part 136, Appendix B, and internal procedure SOP 103.

16.2 Precision and accuracy summaries are generated annually.

16.3 Reporting Limit – After examining several factors such as normal precision of samples near the RL, normal blank levels, and the MDL, the RL or quantification limits are set for each analyte.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Whenever feasible, staff should use pollution prevention techniques to address waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

17.3 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Analytical data reported must be within the linear dynamic range of the each analyte.

18.2 All reportable data shall be generated to 2 significant figures within the LIMS. All reportable data below the Reporting Limit shall be reported as "ND" or Not Detected.

18.3 Data maybe reported above the Reporting Limit as "ND" due to matrix interferences or dilutions. The appropriate qualification code and raised Reporting Limit must be reported with the data.

18.4 Appropriate laboratory reporting codes for dilutions, interferences, holding times, improper preservation, etc., will be reported with the data according to laboratory policy. See internal procedure SOP 106.

18.5 All quality control data including precision, accuracy, standards, and controls for an analytical batch must be within the acceptance criteria stated in section 12 of this method before the data can be reported or must be qualified with the appropriate qualification code.

18.6 Out-of-range values must be diluted, rerun, and acceptable before they can be reported.

18.7 Suspected samples with carryover or memory effects should be rerun for verification before they can be reported.

18.8 The Unit Manager reviews all data before any is reported into the LIMS.

19.0 Corrective Actions

19.1 Preventative maintenance is performed on a routine basis. A maintenance logbook is kept with the instrument and must be completed on a daily basis. Most maintenance procedures will be done on the sample introduction system, and specific procedures may be found in the Elan 6100, 9000 hardware guide.

19.2 Poor recovery on selected QC analytes - If poor recoveries are obtained on only particular analytes in a QC standard and it has been verified that the sample has been properly prepared, the problem could be related to the internal standards (IS) used. The entire list of elements grouped with an IS should be reviewed. If the results for all elements in a group are not satisfactory but the results for elements not

grouped with that IS are acceptable, the problem could be related to the IS used for that grouping.

19.2.1 Try using a different IS and reprocessing the data.

19.2.2 The monitored intensities of the ISs should be reviewed. If the IS used for the elements with unacceptable results is not within the allowable range or the percent recovery for this IS is significantly different than the others, a different IS should be used and the data reprocessed.

19.3 Poor relative standard deviation (precision) on standards and samples.

19.3.1 Check to make sure that the interface cones are in good condition and that the orifices of both cones are round and of the proper size. Refer to the Elan 6100, 9000 hardware guide.

19.3.2 Check to make sure that the nebulizer is operating properly by checking the aerosol (plasma off and spray chamber removed). Refer to the Elan 6100, 9000 hardware guide.

19.3.3 Check to make sure that the peristaltic pump tubing is in good condition and not worn. When the auto-sampler probe is removed and reinserted in the wash solution, an air bubble will be visible in the tubing. Watch the progress of this bubble. Adjust the tension on the pump tubing so the flow is smooth and with minimal pulsation.

19.4 Sequence occurs improperly on startup of a batch analysis.

19.4.1 The sample file has either not been saved or re-opened properly. Save the sample file. Re-open the same file. The full path name of the method should appear in the method field of the sample list.

19.5 Use of the Elan 6100, 9000 Software and Hardware Guides may provide additional information on troubleshooting and corrective action procedures.

20.0 Waste Management

20.1 Liquid waste that is generated by the analysis includes nitric/hydrochloric acid waste and sample waste. The waste container is labeled as "waste." When the waste container is full, the contents are neutralized with soda ash and flushed down the drain with copious amounts of water.

20.2 Broken/waste glass is collected at the bench in a plastic pail until transferred to a collection barrel for disposal.

20.3 Excess samples and dilutions can be disposed of down the drain with copious amounts of water if they do not carry some other hazardous material (i.e., samples from industrial site, etc.) that requires them to be handled as a hazardous waste.

21.0 References

21.1 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry, U.S. Environmental Protection Agency, Method 200.8, Methods for Chemical Analysis of Water and Wastes, Revision 5.4, EMMC Version.

21.2 Inductively Coupled Plasma – Mass Spectrometry, U.S. Environmental Protection Agency, Method 6020, Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996.

21.3 EPA Method 200.8 Turnkey Method for the ELAN 6000/6100 ICP-MS, Perkin Elmer Method Manual, 1996.

21.4 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Appendix A & B.

21.5 Elan 6000 Incuctively Coupled Plasma Mass Spectrometer Software Guide Version 2.2, Perkin Elmer Sciex Software Manual, July 1998.

21.6 Elan Version 2.4 Software Guide, Perkin Elmer Sciex Software Manual, 1999-2001.

21.7 Elan 6100 Hardware Guide, Perkin Elmer Sciex, December 1998.

21.8 Elan 9000 Hardware Guide, Perkin Elmer Sciex, 2001.

22.0 Attachments

Table 1 - Instrument Operating Conditions

Table 2 - Maintenance Log

Table 3 - Method Detection Limit Studies

Table 4 - Initial Precision and Recovery Studies

Table 5 - Linear Dynamic Range Study

Table 6 - ICPMS Quality Control Summary

Table 7 - Digestion Batch Run Log Summary

Table 8 - Sample Table Summary

Table 9 - Analysis Run Log Summary

Table 10 - Data Upload Summary

APPROVED BY _____ DATE 1/26/05
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 1/24/05
COMPLIANCE OFFICER

APPROVED BY _____ DATE 1/12/05
QA OFFICER

APPROVED BY Sandra K. Gregg DATE 1-10-2005
UNIT MANAGER

APPROVED BY _____ DATE 1/10/05
ANALYST

Table 1: Typical Instrument Operating Conditions

Hardware		
Instrument	Perkin Elmer Elan6100	Perkin Elmer Elan9000
Pump Speed	-24rpm	-24rpm
ICP RF Power	1175 watts	1050 watts
Nebulizer Flow	0.85 L/min	0.85 L/min
Lens Voltage	AutoLens	AutoLens
Data Acquisition		
Detector Mode	Dual Detector	Dual Detector
Replicate Integrations	3	3
MCA Channels	1	1
Dwell Time	100 ms	100 ms
Mass Range	8-240 amu	8-240 amu
Scan Sweeps/Integration	10	10
Measurement Unit	Counts per Second	Counts per Second

* The above hardware operating conditions are based on typical performance and may be modified or optimized to provide optimal performance.

Table 2: Maintenance Log

Perkin-Elmer ELAN 9000, Serial# P0380203: Daily Maintenance/Performance Checklist Log for October 2004

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Miscellaneous Hardware															
Inspect waste and rinse water container fluid levels															
Inspect roughing pump and backing pump oil level and color															
Inspect penstaltic pump rollers for cleanliness Listen for bearing wear.															
Inspect or replace filters Rear air and argon, Torch, Electronics, Chiller, Fans															
Check Adequate Argon Supply															
Instrument Running Conditions															
Argon Pressure Coming in from the Elan regulator back of instrument (51-53 psi)															
Running vacuum pressure argon on Approx 1-2 e-5															
Chiller pressure Approx 50-55 psi															
Sample Introduction System															
Remove and wipe down interface cones (use 0.2%HN03 & kimwipes)															
Inspect Torch, Injector and Support Adapter for cleanliness and alignment															
Inspect Nebulizer and Spray chamber for cleanliness															
Inspect or replace Penstaltic Pump Tubing every 8 hours of pump operation															
Inspect condition of sample probe, sample, drain and rinse station tubing, replace as needed															
Notes															
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															

Table 2: Maintenance Log (continued)

Perkin-Elmer ELAN 9000, Serial# P0380203: Daily Maintenance/Performance Checklist Log for October 2004

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Optimizations Performed															
Tuning Mass Calibration and Resolution															
Instrument Performance															
X-Y Adjustment															
Nebulizer Gas flow L/min															
Lens Voltage															
Pulse Stage Detector Voltage															
Analog Stage Detector Voltage															
Dead Time Correction															
Dual Detector Calibration															
Auto Lens Calibration															
Oxides															
Notes															
1															
2															
3															
4															
5															
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13															
14															
15															

Table 3: MDL Studies

Michigan Department of Environmental Quality
Laboratory Section
Environmental Science & Services Division
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 4/2/2004
ANALYST: KS
METHOD: 200.8
MATRIX: AQUEOUS
INSTRUMENT: ELAN-6100
SUPERVISOR APPROVAL:

ICPMS Method Detection Limit Study

Analyte	RDL ug/L	Spike Value ug/L	REP #1 ug/L	REP #2 ug/L	REP #3 ug/L	REP #4 ug/L	REP #5 ug/L	REP #6 ug/L	REP #7 ug/L	STANDARD DEVIATION	MEAN ug/L	%RSD	MDL ug/L
Beryllium 9	1.0	0.1	0.113	0.084	0.094	0.103	0.096	0.084	0.095	0.01	0.10	10.72	**0.03**
Aluminum 27	50	0.5	0.374	0.080	0.198	0.189	0.112	0.181	0.140	0.10	0.18	52.24	**0.30**
Titanium 47	10	1.0	1.281	1.137	1.280	1.534	1.161	1.232	1.160	0.14	1.26	10.86	**0.43**
Vanadium 51	2.0	0.5	0.543	0.546	0.438	0.606	0.729	0.655	0.714	0.10	0.60	17.22	**0.33**
Chromium 52	1.0	0.5	0.671	0.641	0.653	0.641	0.618	0.622	0.670	0.02	0.65	**3.26**	**0.07**
Manganese 55	5.0	1.0	0.972	0.972	1.095	1.136	1.054	1.031	0.937	0.07	1.03	**7.04**	**0.23**
Cobalt 59	15	0.5	0.534	0.494	0.496	0.513	0.499	0.591	0.542	0.03	0.52	**6.67**	**0.11**
Nickel 60	2.0	1.0	1.173	1.246	1.929	1.858	1.657	1.511	1.209	0.31	1.51	20.78	**0.99**
Copper 63	1.0	0.5	0.552	0.714	0.573	0.541	0.571	0.647	0.641	0.06	0.61	10.45	**0.20**
Copper 65	1.0	0.5	0.534	0.694	0.550	0.542	0.545	0.648	0.632	0.06	0.59	10.90	**0.20**
Zinc 66	10	0.5	0.569	0.552	0.586	0.566	0.548	0.642	0.751	0.07	0.60	12.10	**0.23**
Arsenic 75	1.0	0.5	0.335	0.368	0.349	0.430	0.332	0.290	0.364	0.04	0.35	12.16	**0.13**
Selenium 78	1.0	1.0	1.431	1.501	1.506	1.081	1.534	1.375	1.392	0.15	1.40	10.99	**0.48**
Selenium 82	1.0	0.5	0.238	0.273	0.322	0.308	0.200	0.309	0.339	0.05	0.28	17.57	**0.16**
Strontium 88	5.0	0.1	0.084	0.085	0.080	0.081	0.086	0.084	0.075	0.00	0.08	**4.63**	**0.01**
Molybdenum 98	25	0.1	0.137	0.111	0.112	0.105	0.101	0.099	0.092	0.01	0.11	13.40	**0.05**
Silver 107	0.5	0.1	0.145	0.143	0.143	0.141	0.129	0.139	0.139	0.01	0.14	**3.77**	**0.02**
Cadmium 114	0.2	0.1	0.094	0.109	0.097	0.089	0.092	0.098	0.099	0.01	0.10	**6.62**	**0.02**
Antimony 121	1.0	0.5	0.496	0.500	0.485	0.684	0.576	0.542	0.509	0.07	0.54	12.95	**0.22**
Barium 137	5.0	0.1	0.077	0.073	0.077	0.083	0.087	0.080	0.103	0.01	0.08	12.04	**0.03**
Thallium 205	2.0	0.1	0.062	0.063	0.059	0.060	0.057	0.056	0.055	0.00	0.06	**5.14**	**0.01**
Lead 208	1.0	0.5	0.554	0.512	0.474	0.534	0.507	0.839	0.772	0.14	0.60	24.14	**0.45**

Table 3: MDL Studies (continued)

Laboratory Section
Environmental Science & Services Division
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

ANALYST: KS
METHOD: 200.8
MATRIX: AQUEOUS
INSTRUMENT: ELAN-9000
SUPERVISOR APPROVAL:

ICPMS Method Detection Limit Study

Analyte	RDL ug/L	Spike Value ug/L	REP #1 ug/L	REP #2 ug/L	REP #3 ug/L	REP #4 ug/L	REP #5 ug/L	REP #6 ug/L	REP #7 ug/L	STANDARD DEVIATION	MEAN ug/L	%RSD	MDL ug/L
Beryllium 9	1.0	0.1	0.067	0.047	0.054	0.054	0.078	0.058	0.050	0.01	0.06	18.50	**0.03**
Aluminum 27	50	0.5	0.929	0.529	0.606	0.688	0.510	0.613	0.501	0.15	0.63	23.97	**0.47**
Titanium 47	10	1.0	1.538	1.284	1.424	1.864	1.308	1.332	1.283	0.21	1.43	14.73	**0.66**
Vanadium 51	2.0	0.5	0.539	0.610	0.662	0.724	0.627	0.765	0.669	0.07	0.66	11.36	**0.23**
Chromium 52	1.0	0.5	0.685	0.712	0.754	0.764	0.688	0.717	0.692	0.03	0.72	**4.45**	**0.10**
Manganese 55	5.0	0.5	0.657	0.547	0.542	0.604	0.529	0.523	0.504	0.05	0.56	**9.62**	**0.17**
Cobalt 59	15	0.5	0.517	0.475	0.478	0.509	0.494	0.567	0.544	0.034	0.51	**6.64**	**0.11**
Nickel 60	2.0	0.1	0.134	0.115	0.126	0.111	0.104	0.104	0.096	0.01	0.11	11.83	**0.04**
Copper 63	1.0	1.0	1.063	1.152	1.639	1.574	1.392	1.299	1.106	0.23	1.32	17.30	**0.72**
Copper 65	1.0	1.0	1.074	1.129	1.612	1.535	1.359	1.264	1.079	0.22	1.29	16.89	**0.69**
Zinc 66	10	0.5	0.143	0.120	0.186	0.170	0.140	0.195	0.272	0.05	0.18	28.77	**0.16**
Arsenic 75	1.0	0.5	0.555	0.583	0.471	0.572	0.556	0.514	0.593	0.04	0.55	**7.80**	**0.13**
Selenium 82	1.0	0.5	0.306	0.403	0.310	0.335	0.397	0.414	0.387	0.05	0.36	12.65	**0.14**
Strontium 88	5.0	0.1	0.023	0.014	0.023	0.015	0.014	0.015	0.018	0.00	0.02	23.15	**0.013**
Molybdenum 98	25	0.1	0.148	0.119	0.122	0.107	0.104	0.099	0.099	0.02	0.11	15.38	**0.06**
Silver 107	0.5	0.5	0.761	0.776	0.774	0.824	0.794	0.776	0.786	0.02	0.78	**2.58**	**0.06**
Cadmium 114	0.2	0.1	0.116	0.108	0.107	0.108	0.108	0.104	0.107	0.00	0.11	**3.40**	**0.012**
Antimony 121	1.0	0.5	0.460	0.446	0.461	0.563	0.504	0.481	0.455	0.04	0.48	**8.48**	**0.13**
Barium 137	5.0	0.1	0.103	0.133	0.089	0.084	0.091	0.090	0.089	0.02	0.10	17.42	**0.05**
Thallium 205	2.0	0.1	0.109	0.108	0.115	0.109	0.109	0.109	0.109	0.00	0.11	**2.15**	**0.01**
Lead 208	1.0	5.0	3.360	3.440	3.226	3.325	2.925	3.483	3.453	0.19	3.32	**5.84**	**0.61**

Table 3: MDL Studies (continued)

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 2/28/2003
ANALYST: KS
METHOD: Compendium method 10-3.1 / 10-3.5
MATRIX: Filter
INSTRUMENT: ICP/MS-6100
SUPERVISOR APPROVAL:

ICPMS Method Detection Limit Study

Analyte	RDL ug/L	Spike Value ug/L	REP #1 ug/L	REP #2 ug/L	REP #3 ug/L	REP #4 ug/L	REP #5 ug/L	REP #6 ug/L	REP #7 ug/L	STANDARD DEVIATION	MEAN ug/L	%RSD	MDL ug/L
Beryllium 9	5.0	0.5	0.449	0.491	0.489	0.502	0.498	0.473	0.490	0.02	0.48	3.74	**0.06**
Vanadium 51	5.0	0.5	0.930	1.029	0.914	0.912	0.977	0.762	0.865	0.08	0.91	9.27	**0.27**
Manganese 55	5.0	10	34.195	32.268	33.469	33.352	34.329	32.384	35.906	1.26	33.70	3.73	**3.94**
Cobalt 59	5.0	0.5	0.750	0.791	0.811	0.756	0.714	0.702	0.750	0.04	0.75	5.13	**0.12**
Nickel 60	5.0	5.0	12.700	10.562	10.562	14.477	10.644	10.902	10.941	1.50	11.54	12.97	**4.70**
Arsenic 75	5.0	0.5	0.567	0.570	0.563	0.565	0.549	0.586	0.603	0.02	0.57	2.89	**0.05**
Chromium 52	5.0	5.0	27.901	28.105	28.180	27.712	26.828	27.535	28.131	0.48	27.77	1.72	**1.50**
Molybdenum 98	5.0	0.5	1.340	1.320	1.400	1.382	1.319	1.304	1.374	0.04	1.35	2.73	**0.12**
Cadmium 114	1.0	0.1	0.266	0.334	0.268	0.251	0.284	0.240	0.295	0.03	0.28	11.33	**0.10**
Lead 208	1.0	1.0	13.205	13.267	13.311	12.990	13.448	12.921	13.035	0.19	13.17	1.46	**0.60**

* MDL in ng/m^3 is based on an air flow volume of 2000m^3.

Table 3: MDL Studies (continued)

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 4/28/2003
ANALYST: KS
METHOD: 3050B-DigiBloc* / 200.8
MATRIX: Sediment
INSTRUMENT: ICP/MS-9000
SUPERVISOR APPROVAL:

ICPMS Method Detection Limit Study

Analyte	RDL ug/G	Spike Value ug/G	REP #1 ug/G	REP #2 ug/G	REP #3 ug/G	REP #4 ug/G	REP #5 ug/G	REP #6 ug/G	REP #7 ug/G	STANDARD DEVIATION	MEAN ug/G	%RSD	MDL ug/G
Beryllium 9	200	250	273.90	276.40	270.55	263.70	272.50	252.50	261.70	8.44	267.32	3.16	**26.50**
Titanium 47	1000	250	341.40	349.55	351.20	357.35	366.95	365.45	368.65	10.32	357.22	2.89	**32.39**
Vanadium 51	1000	250	304.10	369.60	330.40	352.80	223.50	310.00	378.15	52.56	324.08	16.22	**165.03**
Manganese 55	1000	250	255.35	261.85	259.85	261.20	260.50	249.60	246.50	6.15	256.41	2.40	**19.31**
Cobalt 59	2000	250	232.70	238.10	236.85	241.35	238.60	230.20	229.65	4.52	235.35	1.92	**14.18**
Nickel 60	5000	500	516.70	501.90	469.95	479.60	484.95	471.95	463.85	18.97	484.13	3.92	**59.56**
Copper 63	1000	250	218.90	220.95	228.25	235.65	245.95	217.50	227.50	10.19	227.81	4.47	**32.01**
Copper 65	1000	250	255.55	250.85	256.20	279.75	276.20	251.80	270.15	12.12	262.93	4.61	**38.04**
Arsenic 75	500	250	243.90	217.40	240.75	224.85	209.20	220.70	235.65	12.92	227.49	5.68	**40.56**
Chromium 52	2000	250	322.55	343.00	355.30	345.80	354.25	331.60	341.80	11.75	342.04	3.44	**36.91**
Selenium 82	500	250	158.85	159.70	130.10	139.05	137.75	129.45	130.50	13.20	140.77	9.37	**41.43**
Strontium 88	1000	250	281.95	288.75	288.20	285.00	290.90	275.00	279.25	5.72	284.15	2.01	**17.97**
Molybdenum 98	5000	250	287.60	271.50	259.90	250.20	254.60	253.75	247.55	14.20	260.73	5.45	**44.58**
Silver 107	250	250	343.75	342.90	340.05	338.35	331.05	326.80	321.65	8.53	334.94	2.55	**26.79**
Cadmium 114	2000	250	254.60	258.85	262.10	262.10	258.95	253.80	249.15	4.78	257.08	1.86	**14.99**
Antimony 121	1000	250	432.85	349.70	309.90	294.10	279.55	279.05	273.35	57.46	316.93	18.13	**180.44**
Barium 137	1000	250	264.55	290.90	275.45	270.35	425.75	262.15	265.40	59.12	293.51	20.14	**185.63**
Thallium 205	1000	250	231.60	248.40	245.60	243.10	240.95	236.45	233.65	6.27	239.96	2.61	**19.69**
Lead 208	5000	250	246.15	264.30	252.15	248.00	250.80	242.45	246.15	7.08	250.00	2.83	**22.22**
Aluminum 27	5000	2500	3763.40	3639.05	3529.50	3625.10	3612.35	3626.20	3921.05	128.84	3673.81	3.51	**404.57**
Zinc 66	5000	250	222.80	363.95	259.55	340.40	495.80	227.05	254.00	98.76	309.08	31.95	**310.09**

MDL samples were prepared as Reagent Blank Spikes without the addition of a blank sediment matrix. No Sediment matrix was found to be suitable due to ele levels of contamination. Results were calculated based on a theoretical preparation of 1gram of sediment in a 50mL volume to achieve an MDL in ug/G.

Table 4: Initial Precision and Recovery Studies

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 2/2/2001
ANALYST: KS
METHOD: 200.8
MATRIX: WATER
INSTRUMENT: ICP/MS-6100
SUPERVISOR APPROVAL:

ICPMS Initial Demonstration of Capability

Analyte	Spike Value (units)	REP #1	REP #2	REP #3	REP #4	STANDARD DEVIATION	MEAN	%RSD
Beryllium 9	50	49.31	49.96	49.88	48.35	0.74	49.38	1.50
Titanium 48	50	50.12	50.69	50.98	49.36	0.71	50.29	1 42
Vanadium 51	50	49.65	49 52	49.38	48.96	0 30	49.38	0 61
Manganese 55	50	49.19	49.99	49.40	49.42	0 34	49.50	0 69
Cobalt 59	50	49.81	49.98	50 12	49.28	0 37	49 80	0.74
Nickel 60	50	49 59	49.80	50 58	48.77	0.74	49.69	1.50
Copper 63	50	49.70	50.46	49.38	48.54	0.79	49.52	1.61
Copper 65	50	50.14	50.80	49.49	49.19	0 72	49.91	1 44
Arsenic 75	50	49.72	49.12	49.40	49 72	0 29	49 49	0.58
Selenium 77	50	50.01	48 60	49.41	49 22	0.58	49.31	1 18
Selenium 82	50	48.73	48.94	49.20	48.23	0 41	48.78	0.84
Strontium 88	50	50 32	50 15	50 59	50.74	0.26	50.45	0.53
Molybdenum 98	50	50.98	50.85	50 94	50.13	0.40	50.73	0 79
Silver 107	50	52.29	51.83	51.63	50.40	0.81	51.54	1.57
Cadmium 114	50	50.20	49.56	50.17	48.84	0.64	49.69	1.29
Antimony 123	50	50.38	50 02	50.52	50.38	0.21	50.33	0.42
Barium 137	50	51 08	51.52	50.40	51.37	0 50	51.09	0 97
Thallium 205	50	52 72	53.60	52.42	52.80	0.50	52.89	0.95
Lead 208	50	51.82	52 07	51.22	51 64	0 36	51 69	0.69
Aluminum 27	50	49.44	49 81	50.35	48.65	0 71	49 56	1 44
Zinc 66	50	50.60	50.61	49.96	49.71	0.46	50.22	0.91

Table 4: Initial Precision and Recovery Studies (continued)

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 8/12/2002
ANALYST: KS
METHOD: 200.8
MATRIX: Aqueous
INSTRUMENT: ICP/MS-9000
SUPERVISOR APPROVAL:

ICPMS Initial Demonstration of Capability

Analyte	Spike Value (units)	REP #1	REP #2	REP #3	REP #4	STANDARD DEVIATION	MEAN	%RSD
Beryllium 9	50 ug/L	54.467	53.855	54.834	55.124	0.55	54.57	1.00
Titanium 47	50 ug/L	48.423	46.832	46.988	48.407	0.87	47.66	1.83
Vanadium 51	50 ug/L	48.764	48.080	47.298	48.720	0.69	48.22	1.42
Manganese 55	50 ug/L	51.137	50.335	51.277	52.075	0.71	51.21	1.39
Cobalt 59	50 ug/L	52.011	51.045	51.965	52.465	0.60	51.87	1.15
Nickel 60	50 ug/L	47.262	46.825	47.518	47.804	0.42	47.35	0.88
Copper 63	50 ug/L	49.102	48.946	48.747	49.038	0.15	48.96	0.32
Copper 65	50 ug/L	50.317	49.669	50.366	49.827	0.35	50.04	0.70
Arsenic 75	50 ug/L	50.673	50.842	50.789	51.123	0.19	50.86	0.38
Chromium 52	50 ug/L	46.860	47.619	46.755	47.364	0.41	47.15	0.87
Chromium 53	50 ug/L	65.931	65.433	65.107	65.656	0.35	65.53	0.53
Strontium 88	50 ug/L	55.015	54.863	55.049	55.826	0.43	55.19	0.78
Molybdenum 98	50 ug/L	50.348	49.444	50.517	50.287	0.48	50.15	0.96
Silver 107	50 ug/L	51.347	50.385	50.944	51.289	0.44	50.99	0.87
Cadmium 114	50 ug/L	51.914	51.435	51.664	51.998	0.25	51.75	0.49
Antimony 121	50 ug/L	52.599	52.037	53.079	52.830	0.44	52.64	0.85
Barium 137	50 ug/L	54.237	54.438	55.101	55.401	0.55	54.79	1.00
Thallium 205	50 ug/L	57.977	57.698	58.443	60.081	1.07	58.55	1.82
Lead 208	50 ug/L	56.955	56.090	56.765	57.687	0.66	56.87	1.15
Aluminum 27	50 ug/L	32.671	32.256	32.143	32.418	0.23	32.37	0.71
Zinc 66	50 ug/L	50.971	49.567	52.108	50.773	1.04	50.85	2.05

Table 5: Linear Dynamic Range Studies

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

DATE: 8/12/2002
ANALYST: KS
METHOD: 200.8
MATRIX: Aqueous
INSTRUMENT: ICP/MS-9000
SUPERVISOR APPROVAL:

ICPMS Linear Dynamic Range Study

Analyte	250 ug/L	500 ug/L	600 ug/L	1000 ug/L	2000 ug/L	5000 ug/L	10,000 ug/L	Linear Range ug/L
Beryllium 9			587.31	945.86	1904.88	4615.86	9460.20	10000
Titanium 47			558.29	1094.68	1763.38	4629.86	9352.47	10000
Vanadium 51			601.40	952.93	1889.87	4681.58	9842.06	10000
Manganese 55			561.99	946.99	1888.99	4685.82	9830.93	10000
Cobalt 59			569.61	919.57	1817.15	4521.62	9435.56	10000
Nickel 60			550.97	981.79	1730.26	4466.86	8698.33	1000
Copper 63			544.49	952.86	1707.26	4268.47	8490.00	1000
Copper 65		484.37	532.22	937.63	1685.43	4270.13	8217.84	1000
Arsenic 75			565.84	912.18	1814.09	4480.48	8890.11	2000
Chromium 52			540.09	868.69	1673.44	3904.28	8606.84	600
Chromium 53			546.77	867.19	1646.51	3844.34	8430.55	600
Selenium 77			590.73	940.15	1872.44	4763.51	8408.09	5000
Selenium 82			609.64	981.70	1899.55	4713.11	8579.62	5000
Strontium 88			605.16	999.87	1968.38	5178.01	10588.55	10000
Molybdenum 98			559.80	934.12	1808.68	4644.01	9387.72	10000
Silver 107	243.35		415.80	894.96	1798.69	4413.50	8310.12	250
Cadmium 114	239.39	483.68	527.68	970.81	1850.71	4697.87	8950.63	1000
Antimony 121			558.14	933.12	1852.77	4852.02	9884.94	10000
Barium 137			568.08	946.94	1850.53	4756.18	9844.71	10000
Thallium 205			578.77	985.12	1962.11	5159.34	10295.83	10000
Lead 208			552.91	948.28	1892.68	4910.21	9679.15	10000
Aluminum 27			513.91	903.72	1633.88	4334.71	7958.01	1000
Zinc 66			594.51	954.73	1878.39	4578.56	9067.93	10000

Table 6: ICPMS Quality Control Summary

Michigan Department of Environmental Quality
Environmental Science and Services Division
Laboratory Section
3350 N. Martin Luther King Jr. Blvd.
Lansing MI, 48909-0777

Date: 2003
Analyst: KS
Method: 3005A-DigiBloc* / 200.8
Matrix: Aqueous
Instrument: ICP/MS - 6100, 9000
Supervisor Approval:

2003 ICPMS Quality Control Summary

				ACCURACY				PRECISION*		
			CONC.	AC % RECOVERY				ICV ug/L		
ELEMENT	EPA NO.	MATRIX	ug/L	MEAN	SD	% RSD	N	MEAN	SD	N
Be 9	200.8	WATER	50	101.2	17.0	0.17	220	102.3	16.6	223
Al 27	200.8	WATER	50	102.1	24.8	0.24	188	103.2	18.9	223
Ti 48	200.8	WATER	50	101.6	16.9	0.17	220	100.6	15.6	225
V 51	200.8	WATER	50	103.0	18.5	0.18	220	101.8	16.0	224
Cr 52	200.8	WATER	50	101.0	17.9	0.18	222	102.1	16.1	227
Mn 55	200.8	WATER	50	101.9	28.9	0.28	194	102.3	16.3	227
Co 59	200.8	WATER	50	98.7	16.6	0.17	224	102.2	16.7	227
Ni 60	200.8	WATER	50	97.0	19.0	0.20	225	102.2	17.2	227
Cu 63	200.8	WATER	50	96.1	21.6	0.22	227	103.3	18.3	229
Cu 65	200.8	WATER	50	95.5	17.3	0.18	226	102.9	17.0	231
Zn 66	200.8	WATER	50	98.0	17.9	0.18	203	103.2	18.0	227
As 75	200.8	WATER	50	99.7	17.8	0.18	228	103.5	16.8	228
Se 78	200.8	WATER	50	101.0	33.5	0.33	86	106.7	22.7	89
Se 82	200.8	WATER	50	96.4	22.0	0.23	227	104.4	17.4	228
Sr 88	200.8	WATER	50	100.1	18.2	0.18	190	103.1	16.7	227
Mo 98	200.8	WATER	50	104.6	17.7	0.17	220	101.2	14.4	228
Ag 107	200.8	WATER	50	98.4	14.0	0.14	219	102.0	9.2	220
Cd 114	200.8	WATER	50	100.2	16.6	0.17	227	102.6	16.6	228
Sb 121	200.8	WATER	50	101.3	19.2	0.19	201	101.9	19.0	211
Ba 138	200.8	WATER	50	100.4	29.8	0.30	214	101.9	18.3	228
Tl 205	200.8	WATER	50	97.3	18.5	0.19	226	101.3	16.9	228
Pb 208	200.8	WATER	50	97.4	17.2	0.18	228	101.9	16.3	228

* Precision is based on samples of known concentration and indicates between run precision.

Table 7: Digestion Batch Run Log Summary

Seq #	Sample ID	Matrix	Initial Volume mL	Final Volume mL	Sample pH	Comments
1	BLANK1		50	50	<2	
2	CONTROL1		50	50	<2	
3	AA43126	Total	50	50	<2	
4	AA43127	Total	50	50	<2	
5	AA43186	Total	50	50	<2	
6	AA43187	Total	50	50	<2	
7	AA43188	Total	50	50	<2	
8	AA43189	Total	50	50	<2	
9	AA43190	Total	50	50	<2	
10	AA43191	Total	50	50	<2	
11	AA43192	Total	50	50	<2	
12	AA43193	Total	50	50	<2	
13	AA43194	Total	50	50	<2	
14	AA43243	Dissolved	50	50	<2	
15	AA43244	Dissolved	50	50	<2	
16	AA43245	Dissolved	50	50	<2	
17	AA43246	Dissolved	50	50	<2	
18	AA43247	Dissolved	50	50	<2	
19	AA43248	Dissolved	50	50	<2	
20	AA43249	Dissolved	50	50	<2	
21	AA43250	Dissolved	50	50	<2	
22	AA43251	Dissolved	50	50	<2	
23	AA43251 MS1	Dissolved	50	50	<2	
24	AA43251 MSD1	Dissolved	50	50	<2	
25	BLANK2		50	50	<2	
26	CONTROL2		50	50	<2	
27	AA43252	Dissolved	50	50	<2	
28	AA43253	Dissolved	50	50	<2	
29	AA43254	Dissolved	50	50	<2	
30	AA43255	Dissolved	50	50	<2	
31	AA43256	Dissolved	50	50	<2	
32	AA43257	Dissolved	50	50	<2	
33	AA43258	Dissolved	50	50	<2	
34	AA43259	Dissolved	50	50	<2	
35	AA43260	Dissolved	50	50	<2	
36	AA43261	Dissolved	50	50	<2	
37	AA43262	Dissolved	50	50	<2	
38	AA43263	Dissolved	50	50	<2	
39	AA43264	Dissolved	50	50	<2	
40	AA43265	Dissolved	50	50	<2	
41	AA43266	Dissolved	50	50	<2	
42	AA43267	Dissolved	50	50	<2	
43	AA43268	Dissolved	50	50	<2	
44	AA43269	Dissolved	50	50	<2	
45	AA43270	Dissolved	50	50	<2	
46	AA43271	Dissolved	50	50	<2	
47	AA43271 MS2	Dissolved	50	50	<2	
48	AA43271 MSD2	Dissolved	50	50	<2	

Table 9: Analysis Run Log Summary

Dilution Factor	Sample ID	Sample Type	Cr52	Ni60	Cu63	Cu65	Zn66	As75	Se78	Se82	Ag107	Cd114	Ba138	Pb208
1	Blank													
1	Standard 1													
1	Standard 2		20.30	20.02	20.25	20.41	20.12	20.30	20.45	20.41	20.06	20.23	19.93	19.92
1	Standard 3		97.90	98.64	97.09	98.67	99.27	98.92	101.28	97.57	81.77	98.16	95.23	97.18
1	QC Std 1 IC-755, EL-1911		50.96	51.31	51.61	51.98	51.31	51.34	51.09	52.12	50.75	50.47	53.42	52.12
1	QC Std 2 EL-1912, EL-19		48.35	47.16	49.19	48.93	47.82	48.16	47.03	48.25	23.98	47.30	49.64	48.97
1	QC Std 3 IC-755, EL-1911		0.99	1.05	0.98	1.00	1.00	0.97	0.49	1.00	0.95	0.96	1.02	1.00
1	QC Std 4 IC-755, EL-1911		49.19	48.90	49.56	49.77	49.21	49.58	49.42	49.35	48.47	48.76	50.84	49.40
1	QC Std 5 EL-1745, EL-17(		0.03	0.00	0.00	-0.01	0.00	0.02	0.13	0.06	0.03	0.00	-0.01	0.00
1	BLANK1	QC Blank	0.02	-0.01	-0.01	-0.02	0.11	-0.12	-0.03	-0.07	-0.04	0.00	-0.01	0.00
1	CONTROL1	QC Spike	50.61	49.98	50.64	50.38	50.30	49.97	49.58	49.54	48.83	49.35	50.66	50.21
1	AA43126	Sample	0.15	2.18	0.65	1.00	1.29					0.01		0.17
1	AA43127	Sample	0.13	2.10	0.25	0.64	0.99					0.00		0.10
1	AA43186	Sample	83.25		73.49	74.15	444.82	[illegible]	[illegible]	[illegible]	0.06	0.24	[illegible]	7.18
1	AA43187	Sample	138.65		249.81	253.78	571.23	[illegible]	14.52	0.12	1.00	1.84	[illegible]	[illegible]
1	AA43188	Sample	2.75		10.82	10.77	14.05	1.54	-2.03	-0.02	-0.04	0.03	40.85	1.00
1	AA43189	Sample	1.55		6.69	6.81	147.50	0.74	0.82	0.06	0.05	0.03	41.87	0.48
1	AA43190	Sample	526.59		940.97	967.12	840.07	[illegible]	[illegible]	0.13	1.15	1.59	[illegible]	39.14
1	QC Std 4 IC-755, EL-1911		50.44	50.39	51.88	51.39	50.27	50.31	49.67	50.14	49.96	49.98	51.70	51.30
1	QC Std 5 EL-1745, EL-17(		-0.01	-0.01	0.04	0.03	0.00	-0.08	0.41	0.09	-0.04	0.00	0.02	0.00
1	AA43191	Sample	7.12		8.81	8.88	81.47	0.58	0.02	0.13	0.04	0.03	27.29	0.55
1	AA43192	Sample	90.11		118.57	118.16	186.67	1.74	[illegible]	[illegible]	0.11	0.10	[illegible]	11.59
1	AA43193	Sample	224.10		200.44	202.06	348.56	[illegible]	[illegible]	0.10	0.42	1.01	[illegible]	22.37
1	AA43194	Sample	13.97		23.11	23.45	199.13	[illegible]	[illegible]	[illegible]	0.02	0.07	86.74	4.06
1	AA43243D	Sample												2.00
1	AA43244D	Sample												2.05
1	AA43245D	Sample												0.18
1	AA43246D	Sample												0.24
1	AA43247D	Sample												7.53
1	AA43248D	Sample												0.20
1	QC Std 4 IC-755, EL-1911		50.82	51.11	51.29	51.08	49.50	50.61	49.01	49.05	50.37	49.55	50.23	50.64
1	QC Std 5 EL-1745, EL-17(		0.01	0.01	-0.01	0.01	0.00	0.00	0.20	0.10	0.05	0.00	0.00	-0.01
1	AA43249D	Sample												0.15
1	AA43250D	Sample												0.44
1	AA43251D	QC Sample	0.21	6.36	0.47	0.69	3.75	11.81	0.10	0.45	0.06	0.05	[illegible]	0.32
1	AA43251D	QC Duplicate	53.31	56.89	49.72	49.52	53.66	53.25	48.47	51.10	49.37	51.47	[illegible]	50.82
1	AA43251D	QC Spike	52.11	56.35	48.05	48.82	52.75	53.24	50.14	51.00	47.91	50.19	[illegible]	51.09
1	BLANK2	QC Blank	0.17	0.00	0.00	0.03	0.28	0.14	0.60	-0.06	-0.04	0.00	0.01	0.01
1	CONTROL2	QC Spike	54.03	52.47	53.31	53.20	52.89	51.21	48.80	50.83	52.20	51.84	51.14	53.06
1	AA43252D	Sample												0.93
1	AA43253D	Sample												26.71
1	AA43254D	Sample												0.38
1	QC Std 4 IC-755, EL-1911		49.72	48.38	50.05	50.19	49.01	48.51	46.97	47.22	48.51	48.49	48.59	49.76
1	QC Std 5 EL-1745, EL-17(		0.10	0.00	-0.01	0.01	0.02	-0.08	0.02	0.04	-0.04	0.00	-0.01	0.00
1	AA43255D	Sample												0.46
1	AA43256D	Sample												6.58
1	AA43257D	Sample												0.58
1	AA43258D	Sample												0.23
1	AA43259D	Sample												1.10
1	AA43260D	Sample												0.26
1	AA43261D	Sample												0.61
1	AA43262D	Sample												0.04
1	AA43263D	Sample												0.01
1	AA43264D	Sample												0.09
1	QC Std 4 IC-755, EL-1911		49.37	50.41	51.24	51.60	50.03	48.72	46.92	48.42	48.57	48.05	48.50	51.55
1	QC Std 5 EL-1745, EL-17(		0.00	0.01	0.01	0.01	0.00	-0.01	-0.47	-0.01	-0.05	0.00	0.01	0.01
1	AA43265D	Sample												0.07
1	AA43266D	Sample												0.05
1	AA43267D	Sample												0.04
1	AA43268D	Sample												0.01
1	AA43269D	Sample												0.04
1	AA43270D	Sample												0.01
1	AA43271D	QC Sample	0.30	4.24	1.19	1.71	5.07	0.11	0.82	0.16	0.06	0.21	[illegible]	0.04
1	AA43271D	QC Duplicate	52.44	55.29	50.01	50.19	55.98	50.53	47.74	49.62	48.41	51.00	[illegible]	52.94
1	AA43271D	QC Spike	51.17	55.37	50.16	50.84	55.12	51.47	46.24	50.71	49.17	51.40	[illegible]	51.77
-	LIN RNG VER	Sample	478.62	485.67	492.01	500.65	485.09	481.96	466.12	473.74	197.34	466.91	[illegible]	464.96
1	QC Std 4 IC-755, EL-1911		51.45	51.07	52.56	51.41	50.83	49.78	47.26	49.02	50.18	49.01	48.99	54.11
1	QC Std 5 EL-1745, EL-17(		0.04	-0.01	0.01	0.01	0.00	0.06	-0.09	0.12	0.00	0.00	0.00	0.00
-	LIN RNG VER	Sample	949.45	1013.94	988.59	1017.66	1005.11	1004.79	979.84	982.89	410.72	955.92	948.79	1004.62
1	QC Std 6 IC-755, EL-1911		51.45	51.28	52.47	52.08	50.57	49.38	47.21	49.76	50.88	50.08	48.96	54.05
1	QC Std 7 EL-1745, EL-17(		0.06	0.02	0.02	0.03	0.01	0.10	0.50	-0.04	0.17	0.01	0.01	0.01

Table 10: Data Upload Summary

Sample_ID	Analyte	Result		Date	Time	Analyst
AA43126	CD	ND		11/7/2004	14:52:20	KS 305
AA43126	CR	ND		11/7/2004	14:52:20	KS 305
AA43126	CU	ND		11/7/2004	14:52:20	KS 305
AA43126	NI		2.182	11/7/2004	14:52:20	KS 305
AA43126	PB	ND		11/7/2004	14:52:20	KS 305
AA43126	ZN	ND		11/7/2004	14:52:20	KS 305
AA43127	CD	ND		11/7/2004	14:55:35	KS 305
AA43127	CR	ND		11/7/2004	14:55:35	KS 305
AA43127	CU	ND		11/7/2004	14:55:35	KS 305
AA43127	NI		2.095	11/7/2004	14:55:35	KS 305
AA43127	PB	ND		11/7/2004	14:55:35	KS 305
AA43127	ZN	ND		11/7/2004	14:55:35	KS 305
AA43186	AG	ND		11/7/2004	14:58:51	KS 305
AA43186	AS		4.22	11/7/2004	14:58:51	KS 305
AA43186	BA		201.871	11/8/2004	13:30:17	KS 305
AA43186	CD		0.239	11/7/2004	14:58:51	KS 305
AA43186	CR		83.248	11/7/2004	14:58:51	KS 305
AA43186	CU		73.485	11/7/2004	14:58:51	KS 305
AA43186	PB		7.179	11/7/2004	14:58:51	KS 305
AA43186	SE	ND		11/7/2004	14:58:51	KS 305
AA43186	ZN		444.82	11/7/2004	14:58:51	KS 305
AA43187	AG		1.002	11/7/2004	15:02:08	KS 305
AA43187	AS		13.924	11/7/2004	15:02:08	KS 305
AA43187	BA		767.076	11/8/2004	13:32:28	KS 305
AA43187	CD		1.844	11/7/2004	15:02:08	KS 305
AA43187	CR		138.647	11/7/2004	15:02:08	KS 305
AA43187	CU		249.81	11/7/2004	15:02:08	KS 305
AA43187	PB		130.391	11/8/2004	13:32:28	KS 305
AA43187	SE	ND		11/7/2004	15:02:08	KS 305
AA43187	ZN		571.229	11/7/2004	15:02:08	KS 305
AA43188	AG	ND		11/7/2004	15:05:25	KS 305
AA43188	AS		1.54	11/7/2004	15:05:25	KS 305
AA43188	BA		40.659	11/7/2004	15:05:25	KS 305
AA43188	CD	ND		11/7/2004	15:05:25	KS 305
AA43188	CR		2.75	11/7/2004	15:05:25	KS 305
AA43188	CU		10.774	11/7/2004	15:05:25	KS 305
AA43188	PB	ND		11/7/2004	15:05:25	KS 305
AA43188	SE	ND		11/7/2004	15:05:25	KS 305
AA43188	ZN		14.05	11/7/2004	15:05:25	KS 305

Michigan Department of Environmental Quality

Laboratory Services Standard Operating Procedure Document

EFFECTIVE DATE: 05/2006 SOP# 400 REVISION # 1

GEL-PERMEATION CHROMATOGRAPHY (GPC)

Table of Contents

1.0 Applicable Analytical Methods 1
2.0 Matrix or Matrices 1
3.0 Method Detection Limits (MDLs) 2
4.0 Scope and Application 2
5.0 Method Summary 2
6.0 Definitions 2
7.0 Interferences 3
8.0 Safety 3
9.0 Equipment and Supplies 3
10.0 Reagents and Standards 6
11.0 Sample Collection, Preservation, Shipment, and Storage 7
12.0 Quality Control (QC) 7
13.0 Calibration and Standardization 8
14.0 Procedure 10
15.0 Calculations 16
16.0 Method Performance 17
17.0 Pollution Prevention 17
18.0 Data Assessment 17
19.0 Corrective Actions 17
20.0 Waste Management 18
21.0 References 18
22.0 Attachments 18
Signature Page 20

1.0 Applicable Analytical Methods

1.1 Gel-Permeation Cleanup, U.S. Environmental Protection Agency, Method 3640C, SW846, Revision 1, September 1994.

1.2 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.3 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996.

1.4 Cleanup, U.S. Environmental Protection Agency, Method 3600C, SW846, Revision 3, December 1996.

2.0 Matrix or Matrices

2.1 Aqueous.

2.2 Soil.

2.3 Sediment.

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Solid or liquid waste.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs shall be performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 MDLs are extracted according to internal procedures SOP 401 or SOP 405.

4.0 Scope and Application

4.1 GPC is a size exclusion cleanup. The packing gel is porous. The size of the packing material is such that it excludes molecules larger than the compounds of interest. The compounds of interest can be found in internal procedures SOP 500 and SOP 502.

4.2 GPC can be used for both polar and non-polar analytes.

4.3 GPC is most effective at removing high boiling materials that condense in the injection port of a gas chromatograph (GC) or in the front of a GC column. This residue usually reduces separation efficiency because of adsorption of the target analytes on the active sites. Pentachlorophenol is especially susceptible to this problem.

5.0 Method Summary

5.1 Water samples are extracted by following internal procedure SOP 405. Soil samples are extracted by following internal procedure SOP 401. Oil samples are prepared as defined in internal procedure SOP 404. All extracts must be in methylene chloride.

5.2 The column is purchased prepackaged with Envirosep-ABC bio-beads or Envirogel. The column is continuously flushed with methylene chloride. The column is calibrated. Sample extract is loaded onto the column. A fraction of the eluate is collected and then concentrated.

6.0 Definitions

6.1 Method Preparation Blank (MPB) – An aliquot of a blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.2 Laboratory Control Sample (LCS) – An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction, cleanup, and analysis.

6.3 Matrix Spike (MS) – An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.4 Matrix Spike Duplicate (MSD) – A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

7.0 Interferences

7.1 Interferences from contaminants can occur from solvents, glassware, and other sample processing equipment. Pesticide quality solvents (or better) and solvent rinsing of all glassware should help minimize contaminants.

7.2 The use of plastic must be minimized to prevent phthalate contamination.

7.3 Soap residue must be thoroughly rinsed from all glassware to avoid degradation of some pesticide compounds.

7.4 Interferences from compounds with similar molecular size to the target analytes will not be removed by this method.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (internal procedure SOP 100).

8.4 Hexane, 1-chlorobutane, acetone, methyl alcohol, and methylene chloride material safety data sheets (MSDSs) are attached.

8.5 Nitrile or other solvent resistant gloves must be worn when handling solvents.

9.0 Equipment and Supplies

9.1 Culture tubes – Glass, 16 mm x 100 mm, VWR catalog #60825-618 or equivalent.

9.1.1 Place 2 or 10 mL of hexane into each tube from a calibrated bottle top dispenser. Check the dispenser with a volumetric flask prior to use.
9.1.2 Mark the meniscus with a lab marker.
9.1.3 Dispose of the hexane. Let tube air dry.
9.1.4 Hexane may also be saved for reuse. Transfer used hexane to the container labeled "for pre-marking only."

9.2 Snap caps – Zymark, "star" cut, part #ZB7216.

9.3 Aluminum foil.

9.4 Vials – 2 mL crimp cap, HP #5181-3375.

9.4.1 Place 1 mL of hexane into each vial from a calibrated bottle top dispenser. (Section 9.9) Check the dispenser with a volumetric flask prior to use.
9.4.2 Mark the meniscus with a lab marker.
9.4.3 Dispose of the hexane. Let vial air dry.
9.4.4 Hexane may also be saved for reuse. Transfer used hexane to the container labeled "for pre-marking only."

9.5 Crimp caps – HP #5181-1210.

9.6 Turbovap tubes – 50 and 250 mL capacity.

9.7 Turbovap concentration workstation – With temperature control up to 95°C and nitrogen pressure from zero to 20 psi (usual settings – temperature = 35°C and pressure = 0 – 15 psi).

9.8 Pasteur pipets – Disposable, glass.

9.9 Bottle top solvent dispensers – adjustable.

9.9.1 Calibrate to desired volume by filling appropriate volumetric flasks and adjusting dispenser.

9.10 Pipets – Glass, class A, various sizes.

9.11 Volumetric flasks – Various sizes.

9.12 Column – Envirosep-ABC, 350 x 21.2 mm, Phenomenex #OOW-3035-PO, or Waters Envirogel GPC, 300 x 19mm, Waters #WAT036554 and Waters Envirogel GPC 150 x 19MM, Waters #WAT036555.

9.13 Guard column – Envirosep-ABC, 60 x 21.2 mm, Phenomenex #03R-3035-PO, or Waters Envirogel GPC, 30 x 4.6mm, Waters #186001913.

9.14 UV detector.

9.14.1 J2 Scientific DT0001, or equivalent.
9.14.2 ISCO UA-6, or equivalent.

9.14.2.1 Noise filter – 1.5 sec.
9.14.2.2 Peak separator – 0.3 min.
9.14.2.3 Chart speed
9.14.2.3.1 Calibration – 30 cm/hr.
9.14.2.3.2 Samples – 3 cm/hr.

9.14.2.4 Sensitivity
9.14.2.4.1 Calibration – 0.1
9.14.2.4.2 Samples – 0.05 (except GPC #16, which is 0.1)

9.15 Zymark (Caliper) benchmate preparation station, OI GPC 2000, J2 AccuPrep GPC System, or equivalent.

9.16 ISCO Foxy 200 fractionator/collector – For use with the Zymark (Caliper) benchmate preparation station.

9.17 SSI Model 300 LC pump or equivalent – For use with the Zymark (Caliper) benchmate preparation station.

9.17.1 Speed

9.17.1.1 Calibration and analysis – 5 setting on pumps. The measured flow should be between 4.5 and 5.5 mL/minute.
9.17.1.2 Standby mode – 0.2.

9.18 Computer –

9.18.1 With Zymark (Caliper) benchmate software.
9.18.2 With 0.1. Analytical software.
9.18.3 With J2 Scientific software.

9.19 Bottles – Amber, with teflon lined caps.

9.20 Filters – Acrodisc, 0.45 µm membrane syringe filter, Pall Life Science #4219, VWR #28143-924.

9.21 Syringes – 10 mL, slip tip, disposable, plastic.

9.22 Vortex mixer.

9.23 Tape.
9.24 Tubes – Screw cap, glass, 13 x 100 mm, VWR #60826-701.

9.24.1 Place 2 or 5 mL of hexane into each tube from a calibrated bottle top dispenser. (Section 9.9)
9.24.2 Mark the meniscus with a lab marker.
9.24.3 Dispose of the hexane. Let the tube air dry.
9.24.4 Hexane may also be saved for reuse. Transfer used hexane to the container labeled "for pre-marking only."

9.25 Screw caps – For tubes, VWR #60827-110.

9.26 Teflon liners – For screw caps, Thomas Scientific #2390J60.

10.0 **Reagents and Standards**

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 Nitrogen – Liquid.

10.6 Hexane (95% n-hexane) – Pesticide grade, demonstrated to be free of target analytes.

10.7 Methylene chloride (MeCl)– Pesticide grade, demonstrated to be free of target analytes.

10.8 GPC calibration solution – Absolute Standards, part #20041, in methylene chloride, 5 mL.

Corn oil	250 mg/mL
Bis (2-ethylhexyl phthalate)	10 mg/mL
Methoxychlor	2 mg/mL
Perylene	0.2 mg/mL
Sulfur	0.8 mg/mL

10.8.1 Place approximately 60 mL of methylene chloride (Section 10.7) into a 100 mL volumetric flask.

10.8.2 Open two ampules of GPC calibration solution. Pipet a total of 10 mL into the volumetric flask.

10.8.3 Dilute to the mark with methylene chloride. Mix.

10.8.4 Transfer to an amber bottle containing a teflon lined cap. Label.

10.8.5 Fill out the semi-volatile standard logbook (Attachment 22.2). Standard is good for up to six months.

10.8.6 Store in a refrigerator.

10.9 1-chlorobutane – J.T. Baker, E738-07 or equivalent.

10.9.1 Zymark (Caliper) – 2 mL run as samples.

10.9.2 J2 and OI – 2 mL and 8 mL MeCl, two filtered and run as samples.

10.10 Helium gas.

10.11 Acetone – HPLC grade, demonstrated to be full of target analytes.

10.12 Methyl Alcohol – HPLC grade, demonstrated to be full of target analytes.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Aqueous samples – See internal procedure SOP 405.

11.2 Solid samples – See internal procedure SOP 401.

11.3 Waste samples – See internal procedure SOP 404.

11.4 Holding times – Sample extracts may be analyzed for up to 40 days from the extraction date.

11.5 Storage – Sample extracts must be stored in a refrigerator until GPC cleanup. After this, samples are stored in crimp cap vials, at 4°C or below, and protected from light until analysis.

11.5.1 Pesticide/PCB soil and oil samples also have an aliquot stored in 13 X 100 mm vials (Section 9.24) for possible additional cleanup or analysis.

12.0 Quality Control (QC)

12.1 All associated QC samples must be processed through this cleanup method along with the sample extracts.

12.2 Extracted sample batches.

12.2.1 Extracted sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS.

NOTE: *If a MS/MSD is not available, a laboratory control sample duplicate (LCSD) must be analyzed.*

12.2.2 MSs and MSDs are actual samples that are selected at random from within the batch of 20.

12.2.3 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction or during cleanup of individual samples.

12.2.4 The MS, MSD, LCS, and LCSD are spiked at a known concentration with target analyte compounds. The replicate MSs or LCSs are used to evaluate the entire batch for precision and accuracy.

12.3 Initial demonstration of ability (IDOA) – Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for target analytes. This is accomplished by extraction and cleanup of four aliquots of a reference sample.

12.3.1 Five aliquots of reagent water or sand are extracted using internal procedures SOP 401 or SOP 405. One of these is a MPB. The other four are spiked at a mid-range concentration with all of the analytes of interest.

12.3.2 Sample extracts are taken through all the normal sample cleanup methods.

12.3.3 Extracts are then analyzed by GC-electron capture detector or gas chromatograph/mass spectrometry. See internal procedures SOP 500 or SOP 502.

13.0 Calibration and Standardization

13.1 All GPC columns must be calibrated at least once per week unless not in use.

13.2 All GPC calibration information must be completed in a calibration logbook. Room temperature must also be recorded.

13.3 Zymark (Caliper) GPC.

NOTE: *The Zymark (Caliper) benchmates are never turned off unless there is a problem.*

13.3.1 Make sure that the pump is on. Check to make sure that there is sufficient MeCl in the reservoir. Fill if needed. Adjust the flow to 5.0. Mobile phase is continuously sparged with helium.

13.3.2 Empty waste container into steel drum labeled "Chlorinated Waste."

13.3.3 Turn the detector on (Section 9.14). The green "ready" light will indicate when the detector is warmed up. Make sure that the pen is inserted into the recorder and that the cap is off. Check to make sure that the sensitivity is set at 0.1. Check to make sure that the chart speed is set at 30 cm/hr.

13.3.4 Calibration solution preparation.

13.3.4.1 Pipet 1 mL of GPC calibration solution (Section 10.8.4) into each of two culture tubes (Section 9.1).

13.3.4.2 Place the tube in position 1, rack 1, on the benchmate #16, and in the appropriate position for the program, rack 1, on the benchmate #14 and #15.

13.3.4.3 Place waste containers in positions 1 and 2 on the Foxy 200 of all benchmates.

13.3.4.4 Place a tube with 1 mL of MeCl in position 2, rack 1, for the benchmate #16, and in the appropriate position for the program, rack 1, for the benchmate #14 and #15.

13.3.5 Turn the Foxy 200 on by choosing "run." Leave it in the "waiting for external (re)start" position.

13.3.6 Check the filter holder. Fill as needed. Place the writing side of the filter in the "up" position.

13.3.7 Zero the recorder by choosing "autobaseline." Adjust the recorder offset to the first heavy line on the right side of the recorder paper.

13.3.8 Place the appropriate benchmate calibration diskette into the benchmate. Choose "load." (See Attachment 22.3 for the programs).

NOTE: *The diskettes for the benchmate I (#14 and #15) are not compatible with the benchmate II (#16) and vice versa.*

13.3.9 When the runs are completed, choose "stop" on the Foxy 200. Return the pump to 0.2 mL/min. if no samples are to be run. Return the chart speed to 3. Turn the detector off.

13.3.10 Remove the diskette from the benchmate when the run is completed (as signified by a beep or when the pump is off).

13.3.11 Proceed to section 15 for calculations.

13.4 OI Analytical GPC

13.4.1 Check to make sure that there is sufficient MeCl in the reservoir. If necessary, add more MeCl. Sparge with helium.

13.4.2 Empty waste container into the steel drum labeled "chlorinated waste."

13.4.3 Turn the detector on (Section 9.14.2). The green "ready" light will indicate when the detector is warmed up. Make sure that the pen is inserted into the recorder and that the cap is off. Check to make sure that the sensitivity is set at 0.1. Check to make sure that the chart speed is set at 30 cm/hr.

13.4.4 Choose the "WinSEP" icon on the computer. (See Attachment 22.18 for the program.) Choose "on/off" located in the front of the GPC. The "run" light should come on. Run in "bypass" mode until priming is completed.

13.4.5 Choose "prime" on the front of the GPC. Attach a luerlock syringe to the prime port on the right side of the unit. Open the black knob by turning counterclockwise. Slowly draw the air out of the GPC lines by pulling back on the syringe plunger. Close the black knob. Repeat as needed until all bubbles are removed from the system.

13.4.6 Choose "prime" again. In the "WinSEP" program, open the "status" window. Choose "prime syringe." Check the coiled tubing on the right side of the GPC for bubbles. Choose "prime syringe" again if bubbles are observed.

13.4.7 Open the "status" window. Choose "calibration" from the "sequence name" pull down menu. Check to make sure that it is correct.

13.4.8 Select "equilibrate" in the "status" window. The run will automatically switch from "bypass" mode to "in line." Equilibration takes approximately 30 minutes. The pressure should be approximately 250 psig. This can be checked in the "status" window. Choose "autobaseline" on the UV detector. Adjust the recorder pen to the first heavy line from the right edge using the "recorder offset" knob.

13.4.9 Calibration solution preparation – Take out of refrigerator to warm up (Section 10.8).

- **13.4.9.1** Pipet 1 mL of GPC calibration solution (Section 10.8.4) into a 10 mL pre-marked culture tube (Section 9.1).
- **13.4.9.2** Dilute to the mark with methylene chloride.
- **13.4.9.3** Attach an acrodisc filter (Section 9.20) to a syringe (Section 9.21).
- **13.4.9.4** Pour diluted calibration solution into the syringe. Filter into a culture tube (Section 9.1). The tube does not need foil.
- **13.4.9.5** Place the tube in the second spot in the sample tray.

13.4.10 Place a rinse tube of 10 mL filtered MeCl into the first and third spots in the sample tray.

13.4.11 When equilibration has finished and when the baseline is free of interferences, choose "start" in the "status" window. When the instrument begins the "dump" stage of the calibration sample, make a mark on the chromatogram by adjusting the "recorder offset" knob on the front of the recorder.

13.4.12 When the run is completed, the pump will turn off automatically. Recap the chart recorder pen when not in use.

13.4.13 Proceed to section 15 for calculations.

13.5 J2 Scientific GPC

13.5.1 Check to make sure there is sufficient MeCl in the reservoir. If necessary, add more MeCl.

13.5.2 Turn detector on. The green "ready" light will indicate when the detector is warmed up.

13.5.3 Choose the Accuprep icon on the computer. When program opens, choose "Use Autoinjector." Allow unit to initialize.

13.5.4 Click on the "Solvent Pump" icon. Click "Enable." Click "OK."

13.5.5 Prime solvent pump by removing top screw and screwing in priming syringe. Withdraw air by slowly pulling back on syringe plunger. When MeCl flows freely, remove syringe and replace top screw.

13.5.6 In AccuPrep program, choose "Prime Syringe." Observe syringe pump. If syringe pump pulls out air, prime again.

13.5.7 On main screen of AccuPrep, click "Put In Line" to put the column in line. Autozero the sensor on the main screen. The pressure should be around 250psig.

13.5.8 Open the Sequence shortcut by clicking on the sequence icon. In "Designation (ID)" #1, type "Rinse #1." In ID #2, type "#CalMMDDYY," where "#" is the unit number (1 or 2), and MMDDYY is the date of the calibration, i.e., December 2, 2004, would be 120204. In ID #3, type "Rinse#3." Change sample type to reflect what the sample is. Calibration solutions are "Calibration," rinse solutions are "Solvent Blank."

13.5.9 Save sequence as "#calMMDDYY," using the name format as step 13.5.8.

13.5.10 Prepare Calibration solution as in 13.4.9.

13.5.11 Place a rinse tube of 10 mL filtered Methylene Chloride in first and third spot of sample tray.

13.5.12 Run sequence.

13.5.13 After sequence is finished, click the AccuChrome button. When AccuChrome opens, click File, Import V 1.0 Data. Ensure that browser opens in correct unit data – J2 #63 or J2 #64. If in the wrong browser, search back until in the correct J2 system, then click on folder "Data." Files should end in "XML," NOT ".seq."

13.5.14 Double click on file that was saved when sequence was made. Depending on number of samples, it may take a few minutes to open. Left side of screen will be blank when file is loaded. Click on cylinder in upper left corner. Search through dates and times for correct runtime of sequence.

13.5.15 Click on date and time. Double lick on "Sequence #calXXXX." Double click "Sample [2] #calXXXX" Double click "Method." Double click "Data Plot."

13.5.16 When plot opens, click "Find Peaks." Adjust baseline by clicking, holding and moving the purple diamond. Adjust peak lines by clicking and holding triangle associated with line. When all lines are correct, click "Store."

13.5.17 On top tool bar, click "Reports," then "Column Calibration Report." Click Print. Computer automatically generates retentions and if results pass or fail.

13.5.18 Proceed to Section 15 for calculations.

14.0 Procedure

14.1 Zymark (Caliper) GPCs.

14.1.1 Make sure the pump is on. Check to make sure that there is sufficient MeCl in the reservoir. Fill and sparge if needed. Adjust the flow to 5.0.

14.1.2 Empty all waste containers into the waste drum labeled "chlorinated waste."

14.1.3 Check the filter holder. Fill as needed.

14.1.4 Turn the detector on (Section 9.14.2). The green "ready" light indicates when the detector is warmed up. Make sure that the pen is inserted into the recorder and that the cap is off. Check to make sure that the sensitivity is set at 0.05 for instruments #14 and #15 or 0.1 for instrument #16. Make sure that the chart speed is 3 cm/hr. Adjust the baseline by choosing "recorder offset" or "auto baseline."

14.1.5 Turn the Foxy 200 sample collector on. Adjust the window if necessary (section 15). Leave it in the "waiting for external signal" position. (See Attachment 22.6 for the program if the power has been out or if the window needs to be adjusted).

14.1.6 Sequence creation.

14.1.6.1 Place the appropriate program disk into the computer. The programs are listed in Attachment 22.4 for each benchmate.

NOTE: *The diskettes for the benchmate I (#14 and #15) are not compatible with the benchmate II (#16) and vice versa.*

14.1.6.2 Choose "5" on the menu for benchmate #14 or benchmate #15. Choose "2" for benchmate #16.

14.1.6.3 Choose "sample data." Choose "input."

14.1.6.3.1 Heading 1 contains the name of the program.

14.1.6.3.2 Heading 2 contains the batch number(s) and the type of scan.

14.1.6.3.3 Heading 3 contains the analyst's initials.

14.1.6.3.4 The initial volume is 2 or 10.

14.1.6.4 Determine which program to use and its order on the diskette prior to entering sample numbers into the spreadsheet. The benchmate reads program #1 first, program #2 second, etc. The sample number information should be entered starting on the same line that corresponds to the order in which the program is on the diskette (i.e., if the program required is #3 on the diskette, the first sample of the run should be entered on the third line, and the first sample should go into position #3 on the benchmate).

14.1.6.5 Enter the sample number. Choose "enter." Choose the "enter" again. Continue entering up to 18 samples in this manner (36 for the dual injector). Choose "*I*." Choose "P" (Attachment 22.5).

14.1.6.6 Tape the printout to the hood above the benchmate. Choose "*I*." Choose "save." Choose "done." Choose "exit" two times. Take the disk out.

14.1.7 Loading samples

14.1.7.1 Soil samples are extracted according to internal procedure SOP 401. Oils are diluted according to internal procedure SOP 404. Two mL of extract is placed into a culture tube (Section 9.1). Samples may be diluted to 10 mL if GPC is programmed for a 10 mL start volume. Samples that are unusually thick should be pre-filtered (Attachment 22.16). All extracts must be in MeCl. Foil is placed over the tube and held in place with a star cap (Section 9.2).

14.1.7.2 Label each sample tube using a marker and a labeled piece of tape.

14.1.7.3 Single injector loading – Load samples into rack 1 of the benchmate according to the printout (#1 is the bottom right spot, and #11 is directly behind it).

NOTE: *The Benchmate moves from right to left and from front to back.*

14.1.7.4 Dual injector loading – Samples should be loaded alternately onto rack 1. The benchmate #14 uses the odd-numbered spots. The benchmate #15 uses the even-numbered spots.

14.1.7.5 The Foxy 200 requires samples to be in increments of 3. Place MeCl rinses in any remaining spots. Both batches must contain the same number of tubes in rack 1 and must also be divisible by three for the dual injector.

14.1.8 Load rack 3 with transfer tubes (Section 9.1). Load enough empty tubes to match the number and placement in rack 1.

14.1.9 If pesticides/PCBs are to be analyzed, place 30 mL of hexane into rinsed 250 mL turbovap tubes. If semi-volatiles samples are to be analyzed, use empty turbovap tubes. Place them on the Foxy 200. Transfer the sample ID tape from the sample tubes to the turbovap tubes. The Foxy 200 moves from left to right and from front to back (#1 is the bottom left spot, and #4 is directly behind it).

14.1.10 Foxy 200 operation – Refer to Attachment 22.6. Settings should rarely be changed, with the exception of window settings.

14.1.11 Choose "Run A or B" on the Foxy 200 to return the autosampler arm to the "wait" position. The screen should read "waiting for external signal."

14.1.12 Place the benchmate diskette (Section 14.1.6) into the benchmate. Choose "load."

14.1.13 The Foxy 200 shuts the pump off when the run is completed. Turn the pump back on when the run is completed by choosing "stop" on the Foxy 200. Choose "run" on the ATS pumps. Adjust the pump speed (Section 9.17.1). Recap the chart recorder pen when not in use.

14.1.14 Remove the diskette from the benchmate when the run is completed (as signified by a "beep" or when the pump and run light are off).

14.1.15 Place the diskette into the computer. Repeat Section 14.1.6. Choose "sample data." Choose "review output data." The diskette holds up to two benchmate runs (output1.dat and output2.dat). Choose the correct data output file. Choose "*I*." Choose "print." Tape the printout into the run logbook (Attachment 22.14).

NOTE: *The diskettes only hold two output files. They overwrite the previous ones.*

14.1.16 After the GPC run is completed, concentrate on the turbovap.

14.1.16.1 Semi-volatile soil extracts – Transfer the contents with MeCl to 1 mL pre-marked crimp cap vials (Section 9.4.2). Cap. Label. Complete the run logbook. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the ASE run logbook page.

14.1.16.2 Pesticide/PCB soil extracts – Transfer the contents with hexane to 2 mL pre-marked screw cap vials (Section 9.24.2). Mix. Transfer approximately 0.5 mL to unmarked 2 mL crimp cap vials (Section 9.4). Cap the vials and tubes. Label the vials and tubes. Complete the run logbook. Mark the meniscus on the screw cap tubes. Label. Store the tubes in the refrigerator located in Room 302. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the ASE run logbook page.

14.1.16.3 Semi-volatile oil extracts – Transfer the contents to 5 mL pre-marked tubes (section 9.24.2). Mix. Transfer 1.0 mL to 1 mL pre-marked crimp cap vials (section 9.4.2). Cap the vials and tubes. Label. Complete the run logbook. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the ASE run logbook page.

14.1.16.4 Pesticide/PCB oil extracts – Transfer the contents with Hexane to 2 mL pre-marked screw cap vials (section 9.24.2). Mix. Follow SOP 402 for silica gel cleanup.

14.1.16.5 Place the extracts into corresponding refrigerators or freezers. Place the paperwork in the appropriate bins.

14.2 OI analytical GPC

NOTE: *The OI GPC is used exclusively for cleanup of water extracts for pesticide/PCB analysis.*

14.2.1 Follow Section 13.4.1 and Section 13.4.2.

14.2.2 Turn the detector on (Section 9.14.2). The green "ready" light indicates when the detector is warmed up. Make sure the pen is inserted in the recorder and that the cap is off. Check to make sure that the sensitivity is set at 0.05. Check to make sure that the chart speed is set at 3 cm/hr.

14.2.3 Follow Section 13.4.4 through Section 13.4.6.

14.2.4 Sequence creation

14.2.4.1 Open the sequence folder on the left side of the "WinSEP" screen.

14.2.4.2 Double click on a recent batch.

14.2.4.3 Save this sequence using the new batch number.

14.2.4.4 Change the sample IDs. Verify that all other information is correct. Check to make sure that the correct method is listed.

14.2.4.5 Choose "save."

14.2.5 Open the "status" window. Choose the batch from the "sequence name" pull down menu.

14.2.6 Choose "equilibrate" in the "status" window. Equilibration takes approximately 30 minutes. The pressure should be approximately 250 psig and can be checked in the "status" window.

14.2.7 Sample preparation

14.2.7.1 Water samples are extracted according to internal procedure SOP 405 and are brought to 10 mL in methylene chloride.
14.2.7.2 Attach an acrodisc filter (Section 9.20) to a syringe (Section 9.21).
14.2.7.3 Pour the sample extract into the syringe. Filter into a culture tube (Section 9.1).
14.2.7.4 Transfer the label to the new tube.
14.2.7.5 Filter all extracts in the batch including the MPB and the LCS.
14.2.7.6 Cover the tubes with aluminum foil. Secure with tape.
14.2.7.7 Mark the meniscus on each tube with a sharpie.
14.2.7.8 Place the filtered extracts in sample trays according to the sequence file (Section 14.2.4). Tape the tubes together in the trays to prevent them from moving.

14.2.8 Rinse 50 mL turbovap tubes with methylene chloride. Label them according to the sequence file (Section 14.2.4). Place them in the collection tray.
14.2.9 Choose "start" in the "status" window when equilibration has finished and when the baseline looks free of interferences.
14.2.10 When the run is completed, the pump will turn off automatically. Recap the chart recorder pen when not in use.
14.2.11 After the GPC run is complete, concentrate on the turbovap to <1.0 mL. Complete the run logbook. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the water extraction logbook page.

14.2.11.1 Rinse the walls of the turbovap down with 10 mL of hexane. Return to the turbovap. Concentrate to <1.0 mL. Perform the florisil procedure (see internal procedure SOP 403). Complete the florisil run logbook. Make a copy of the florisil run logbook page onto yellow paper. Attach it to the other two logbook copies.
14.2.11.2 Place the extracts into corresponding refrigerators or freezers. Place the paperwork in the appropriate bins.

14.3 J2 Scientific GPC

14.3.1 Follow Section 13.5.1 through 13.5.7.
14.3.2 Sequence creation

14.3.2.1 Open the sequence window by clicking the sequence button.
14.3.2.2 In "Designation (ID)" type in the sample number for each sample, beginning with "Rinse#1," followed by the sample numbers, and ending the sequence with "Rinse #2." If two batches are run, place "Rinse #2" between the last sample of the first batch, and the first sample of the second batch, and run "Rinse #3" at the end.
14.3.2.3 Change "Sample Type" to method selected for cleanup of samples.
14.3.2.4 Verify that all other information is correct. Check to make sure that the correct method is listed.
14.3.2.5 Choose "save." Save as sample batch number.

14.3.3 Sample preparation

14.3.3.1 Water samples are extracted according to internal procedure SOP 405 and are brought to 10 mL in methylene chloride. Soil samples are extracted according to internal procedure SOP 401 and are brought up to 10 mL in methylene chloride.

14.3.3.2 Attach an acrodisc filter (Section 9.20) to a syringe (Section 9.21).

14.3.3.3 Pour the sample extract into the syringe. Filter into a culture tube (Section 9.1).

14.3.3.4 Transfer the label to the new tube.

14.3.3.5 Filter all extracts in the batch including the MPB and the LCS.

14.3.3.6 Cover the tubes with aluminum foil. Secure with tape.

14.3.3.7 Mark the meniscus on each tube with a sharpie.

14.3.3.8 Place the filtered extracts in sample trays according to the sequence file (Section 14.3.2). Tape the tubes together in the trays to prevent them from moving.

14.3.4 For pesticide/PCB samples – rinse 200 or 50 mL turbovap tubes with methylene chloride. Label them according to the sequence file (Section 14.3.2). Place them in the collection tray.

14.3.5 For semi-volatile samples – rinse 200 mL turbovap tubes with methylene chloride. Label them according to the sequence file (Section 14.3.2). Place them in the collection tray.

14.3.6 Click the Run Sequence button.

14.3.7 When the run is completed, the pump will turn off automatically.

14.3.8 Create run log printout.

14.3.8.1 After sequence has run, Click File -> Export Sequence report to File. Save sequence report in the appropriate report section (i.e. C:/Program Files/J2 Scientific/J2#63/Reports).

14.3.8.2 Go to desktop and click reports folder for appropriate unit, #63 or #64.

14.3.8.3 Find saved report, open. When prompted for file conversion, click yes to open report.

14.3.8.4 Highlight and delete extraneous information at top of report. Highlight run log and change font to size 8. Go to File ->Page Layout and click to change to Landscape layout.

14.3.8.5 Click print.

14.3.8.6 On top of printout, write which J2 unit was used, date, and initial. At bottom of printout, write "Dump," "Collect" and "Rinse." Write the appropriate time in minutes for each function. Record final volume.

14.3.9 For water pesticide/PCB samples – after the GPC run is complete, place foil over each turbovap tube. Evaporate on the turbovap to <1 mL. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the water extraction logbook.

14.3.9.1 Rinse the walls of the turbovap down with 10 mL of hexane. Return to the turbovap. Concentrate to <1.0 mL. Perform the florisil procedure (see internal procedure SOP 403). Complete the florisil run logbook. Make a copy of the florisil run logbook page onto yellow paper. Attach it to the other two logbook copies.

14.3.9.2 Place the extracts into corresponding refrigerators or freezers. Place the paperwork in the appropriate bins.

14.3.10 For soil samples – After the GPC run is completed add 30 mL hexane to the Turbovap tube. Place foil over each turbovap tube. Concentrate on the turbovap.

14.3.10.1 Semi-volatile extracts – Transfer the contents with MeCl to 1 mL pre-marked crimp cap vials (Section 9.4). Cap. Label. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the ASE run logbook page.

14.3.10.2 Pesticide/PCB extracts – Transfer the contents with hexane to 2 mL pre-marked screw cap vials (Section 9.24). Mix. Transfer approximately 0.5 mL to unmarked 2 mL crimp cap vials (Section 9.4). Cap the vials and tubes. Label the vials and tubes. Mark the meniscus on the screw cap tubes and vials. Label. Store the tubes in the refrigerator located in Room 302. Make a copy of the GPC run logbook page onto salmon paper. Attach it to the copy of the ASE run logbook page.

14.3.10.3 Place the extracts into corresponding refrigerators or freezers. Place the paperwork in the appropriate bins.

14.4 Glassware cleaning.

14.4.1 Glassware is rinsed with MeCl. It is then placed in the dishwasher. Glassware is also rinsed with MeCl prior to use. Run dishwasher as in attachment 22.23.

15.0 Calculations

15.1 Resolution – See Attachment 22.12 for peak identification of calibration solution compounds. Resolution must be calculated between:

Corn oil and bis (2-ethylhexyl) phthalate
Bis (2-ethylhexyl) phthalate and methoxychlor
Methoxychlor and perylene
Perylene and sulfur

% resolution = (A/B) x 100

A = height of the valley between the peaks.
B = height of the smaller peak.

15.1.1 Measurements for A and B can be found in Attachment 22.8.

15.2 Windows – Windows are determined from the calibration solution analysis in Section 13.

15.2.1 Semi-volatile Windows – Extract is collected just prior to bis (2-ethylhexyl) phthalate and ends just prior to the start of the sulfur peak.

15.2.2 Pesticide/PCB windows – Extract is collected just prior to methoxychlor and ends just prior to the start of the sulfur peak.

15.3 Retention time shift (RTS) – RTS is determined between the newest calibration and the previous calibration.

RTS = ((new RT – previous RT)/previous RT) x 100

RT = retention time.

16.0 Method Performance

16.1 Each MDL study must be labeled with the analyst's name and the date.

16.2 Each IDOA study must be labeled with the analyst's name and the date. A copy must be placed into the analyst's training file.

17.0 Pollution Prevention

17.1 This method uses large quantities of methylene chloride. The waste that is produced is collected for disposal and labeled as chlorinated waste. See SOP 111.

17.2 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Calibration solution

18.1.1 Check to make sure that all five compounds are present.
18.1.2 Check to make sure that the peaks are symmetrical.
18.1.3 RTS

18.1.3.1 The retention times for bis (2-ethylhexyl) phthalate and perylene must not shift more than 5% from the previous calibration.

18.1.4 Resolution

18.1.4.1 The following resolution must be attained with the calibration solution, or corrective action must be taken:

Corn oil and bis (2-ethylhexyl) phthalate	>85%
Bis (2-ethylhexyl) phthalate and methoxychlor	>85%
Methoxychlor and perylene	>85%
Perylene and sulfur	>90%

19.0 Corrective Actions

19.1 Quality assurance/quality control (QA/QC) – If the QA/QC is not met and if it is determined to be attributed to the extraction or cleanup, samples may be repeated through this cleanup process.

19.2 Procedure if resolution criteria is not met.

19.2.1 Disconnect the guard column. Replace it as necessary.
19.2.2 Reverse the flow through the analytical column dumping it directly into a waste container.
19.2.3 Set the pump flow at 2.5 mL/min.
19.2.4 Place 6 culture tubes containing 1-chlorobutane (Section 10.9) onto the GPC. Run as samples.
19.2.5 Reconnect the guard column to the analytical column. Restore the proper flow direction.
19.2.6 Set the pump flow at 5.0 mL/min.
19.2.7 Equilibrate for at least one hour.
19.2.8 Recalibrate as in Section 13.
19.2.9 If resolution fails again, repeat section 19.2.1 thru 19.2.8.
19.2.10 The column(s) may need to be replaced if resolution continues to fail.

NOTE: *Retain all used columns for possible repacking.*

19.3 RTs

19.3.1 If RTs shift more than 5% and no obvious reason is apparent (i.e.: new column or new lines on the GPC), check to be sure flow is between 4.5 and 5.5 mL/minute.
19.3.2 If flow is not correct, check for leaks or plugs.
19.3.3 If flow is correct, run another calibration. If it agrees with the new RTs, change windows and run samples.

19.4 Flow must always be measured when the columns are changed or any other major instrument change.

20.0 Waste Management

20.1 The Laboratory Safety Officer arranges for proper waste disposal. See SOP 111.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, D.C., Appendix A and B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition, 1986, Final Update III, December 1996.

22.0 Attachments

22.1 Stock standard logbook page.

22.2 Semi-volatile standard logbook page.

22.3 Benchmate calibration program.

22.4 Benchmate clean up program 3.10

22.4.1 Benchmate clean up program 2.5.

22.5 Benchmate sample ID example.

22.6 Foxy program.

22.7 GPC run logbook page.

22.8 GPC calibration logbook page.

22.9 Hexane MSDS.

22.10 Methylene chloride MSDS.

22.11 1-chlorobutane MSDS.

22.12 Calibration solution chromatogram.

22.13 OI program.

22.14 Benchmate example of output data.

22.15 OI example of output data.

22.16 Benchmate 10 mL start procedures.

22.17 OI sample ID example.

22.18 OI calibration sequence method.

22.19 J2 Method Data page example

22.20 J2 Sequence Setup Example

22.21 J2 Example of Output data

22.22 J2 Example of Calibration Data

22.23 Lancer Dishwasher Procedure

22.24 Acetone MSDS

22.25 Methyl Alcohol MSDS

Signature Page

APPROVED BY _____ DATE 5/30/06
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 5/30/06
COMPLIANCE OFFICER

APPROVED BY _____ DATE 5/30/06
QA OFFICER

APPROVED BY _____ DATE 5-30-06
UNIT MANAGER

APPROVED BY _____ DATE 5/26/06
SECOND SHIFT MANAGER

APPROVED BY _____ DATE 5/25/06
ANALYST

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									

ATTACHMENT 22.1

FILE:ST-STD
12/30/98

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											

ATTACHMENT 22.2

FILE:SV-STD
12/30/98

Zymark BenchMate 2.5

Zymark BenchMate Procedure : DUAL INJECTOR CALIBARTION PROGRAM

Step 1 : Add 9 ml of MeCl2 1
Step 2 : Vortex for 5 seconds at speed 2
Step 3 : Wash syringe with 10 ml of MeCl2 1
Step 4 : Wash LC injector with 10 ml of MeCl2 1
Step 5 : Inject sample on Alternate LC with run time of 5 minutes
Step 6 : Wash syringe with 10 ml of MeCl2 1
Step 7 : Wash LC injector with 10 ml of MeCl2 1
Step 8 : END

SETUP PARAMETERS - 1

SAMPLE TUBE
Initial Volume: 1.00 ml

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 1.00 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Filter: .210 ml/sec
Air Push: 0.15 ml/sec

DISPENSING
Liquid driven: Y Y=YES N=NO

AUTOWASH PARAMETERS
Int Vol: 0.00 ml
Smple Vol: 0.00 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y=YES N=NO
Tolerance: 20%
Tare Sample Tubes: N Y=YES N=NO

RACK PARAMETERS
LV Tube Numbering: Y Y=YES N=NO
Reset to Sample 1: N Y=YES N=NO

SETUP PARAMETERS - 2

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Elute Flow: 0.15 ml/sec
Push Delay: 5 sec
Air Factor: 1.0
Save Columns: N Y=YES N=NO

LC PARAMETERS
Inject Load Vol: 10.0 ml
Calibrate every: 0 samples
Calib Replicates: 1
Calibration Reagent: 1
Calib Wash Vol: 0.00 ml

Zymark BenchMate Procedure : DUAL INJECTOR CALIBARTION PROGRAM

NAME REAGENTS

Reagent 1 : MeCl2 1 ; Density : 1.3170
Reagent 2 : IPA 2 ; Density : 0.0037
Reagent 3 : Hexane 3 ; Density : 0.6600
Reagent 4 : REAGENT 4 ; Density : 1.0000
Reagent 5 : REAGENT 5 ; Density : 1.0000
Reagent 6 : REAGENT 6 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 14.4 MINUTES.

NO FILTERS ARE USED.
NO SPE COLUMNS ARE USED.

Tubes will be processed starting at Rack 1 position 1,
through all Racks until an empty position is encountered.

Zymark BenchMate 3.10

Zymark BenchMate Procedure : CALIB #16 WITH PAUSE

Step 1 : Add 9 ml of MeCl2
Step 2 : Vortex for 3 seconds at speed 2
Step 3 : Wash syringe with 10 ml of MeCl2
Step 4 : Wash LC injector with 10 ml of MeCl2
Step 5 : Inject sample on LC with run time of 5 minutes
Step 6 : Wash LC injector with 10 ml of MeCl2
Step 7 : Wash syringe with 10 ml of MeCl2
Step 8 : Pause for 22 minutes
Step 9 : END

SETUP PARAMETERS

SAMPLE TUBE
Initial Volume: 1.00 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y=YES N=NO
Tare Sample Tubes: N Y=YES N=NO

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 0.25 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Air Push: 0.15 ml/sec

RACK PARAMETERS
LV Tube Numbering: Y Y=YES N=NO
Reset to Sample 1: N Y=YES N=NO

FILTER PARAMETERS
Filter Flow Rate: 0.21 ml/sec
Filtrate Confirm: N Y=YES N=NO
Filtrate Density: 1.00 g/ml
Minimum Amount: 0%

DISPENSING
Liquid driven: Y Y=YES N=NO

AUTOWASH PARAMETERS
Rinse Reagent: 1
nt Vol: 0.00 ml
mple Vol: 0.00 ml

SETUP SPE PARAMETERS

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Aspirate Flow: 0.50 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Elute Flow: 0.15 ml/sec
Push Delay: 5 sec
Air Factor: 1.0
Save Columns: N Y=YES N=NO
Save Samples: N Y=YES N=NO

SETUP LC PARAMETERS

LC PARAMETERS LC CALIBRATION STANDARDS
Inject Sip Vol: 10.0 ml Calibrate every: 0 samples
Inject Delay Time: 99 sec
Loop in Load Pos: Y Y=YES N=NO INJECT START DURING END
Inject Loop Time: 99 sec LC Std 1: 0 0 0
LC Std 2: 0 0 0
LC Std 3: 0 0 0
ENCORE PARAMETERS LC Std 4: 0 0 0
Load disk methods: Y Y=YES N=NO LC Std 5: 0 0 0
Lock pump keypad: Y Y=YES N=NO LC Std 6: 0 0 0
Initialization Time: 0 min Calib Wash Vol: 0.00 ml
Equilibration Time: 0 min Calib Wash Reagent: 1
Shutdown method: 0

SETUP EasyFill PARAMETERS

EasyFill PARAMETERS
EasyFill vial type: 2
Sense vials: Y Y=YES N=NO
External needle wash: Y Y=YES N=NO

Zymark BenchMate Procedure : CALIB #16 WITH PAUSE

NAME REAGENTS

Reagent 1 : MeCl2 ; Density : 1.3170
Reagent 2 : IPA ; Density : 0.0037
Reagent 3 . Hexane ; Density : 0.6600
Reagent 4 : REAGENT 4 ; Density : 1.0000
Reagent 5 : REAGENT 5 ; Density : 1.0000
Reagent 6 : REAGENT 6 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 38.7 MINUTES.

NO FILTERS ARE USED.
NO SPE COLUMNS ARE USED.

Tubes will be processed starting at Rack 1 position 1,
through all Racks until an empty position is encountered.

Zymark BenchMate 3.10

Zymark BenchMate Procedure : 10ML CLEANUP WITH FILTER

Step 1 : Wash syringe with 10 ml of MECL2
Step 2 : Wash LC injector with 10 ml of MECL2
Step 3 : Prewet filter with 10 ml of ACETONE
Step 4 : Prewet filter with 10 ml of MEOH
Step 5 : Prewet filter with 10 ml of MECL2
Step 6 : Prewet filter with 10 ml of MECL2
Step 7 : Vortex for 10 seconds at speed 2
Step 8 : Filter 9.8 ml of sample into next tube
Step 9 : Rinse filter holder with 10 ml of ACETONE
Step 10 : Rinse filter holder with 10 ml of MEOH
Step 11 : Rinse filter holder with 10 ml of MECL2
Step 12 : Rinse filter holder with 10 ml of MECL2
Step 13 : Wash syringe with 10 ml of MECL2
Step 14 : Inject sample on LC with run time of 9 minutes
Step 15 : Pause for 3 minutes
Step 16 : Wash syringe with 10 ml of ACETONE
Step 17 : Wash syringe with 10 ml of MEOH
Step 18 : Wash syringe with 10 ml of MECL2
Step 19 : Wash LC injector with 10 ml of ACETONE
Step 20 : Wash LC injector with 10 ml of MEOH
Step 21 : Wash LC injector with 10 ml of MECL2
Step 22 : Wash LC injector with 10 ml of MECL2
Step 23 : END

SETUP PARAMETERS

SAMPLE TUBE
Initial Volume: 10.0 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y-YES N-NO
Tare Sample Tubes: N Y-YES N-NO

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 1.00 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Air Push: 0.15 ml/sec

RACK PARAMETERS
LV Tube Numbering: Y Y-YES N-NO
Reset to Sample 1: N Y-YES N-NO

FILTER PARAMETERS
Filter Flow Rate: 0.10 ml/sec
Filtrate Confirm: N Y-YES N-NO
Filtrate Density: 1.00 g/ml
Minimum Amount: 0%

DISPENSING
Liquid driven: Y Y-YES N-NO

AUTOWASH PARAMETERS
Rinse Reagent: 1
Reagent Vol: 1.00 ml
Sample Vol: 0.20 ml

SETUP SPE PARAMETERS

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Aspirate Flow: 0.25 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Elute Flow: 0.15 ml/sec
Push Delay: 5 sec

Air Factor: 1.0
Save Columns: N Y-YES N-NO
Save Samples: N Y-YES N-NO

SETUP LC PARAMETERS

LC PARAMETERS
Inject Sip Vol: 8.50 ml
Inject Delay Time: 99 sec
Loop in Load Pos: N Y-YES N-NO
Inject Loop Time: 99 sec

LC CALIBRATION STANDARDS
Calibrate every: 0 samples
INJECT START DURING END
LC Std 1: 0 0 0
LC Std 2: 0 0 0
LC Std 3: 0 0 0
LC Std 4: 0 0 0
LC Std 5: 0 0 0
LC Std 6: 0 0 0
Calib Wash Vol: 0.00 ml
Calib Wash Reagent: 1

ENCORE PARAMETERS
Load disk methods: Y Y-YES N-NO
Lock pump keypad: Y Y-YES N-NO
Initialization Time: 0 min
Equilibration Time: 0 min
Shutdown method: 0

SETUP EasyFill PARAMETERS

EasyFill PARAMETERS
EasyFill vial type: 2
Sense vials: Y Y-YES N-NO
External needle wash: Y Y-YES N-NO

Zymark BenchMate Procedure : 10ML CLEANUP WITH FILTER

NAME REAGENTS

Reagent 1 : MECL2 ; Density : 1.3255
Reagent 2 : ACETONE ; Density : .78800
Reagent 3 : MEOH ; Density : 0.7866
Reagent 4 : REAGENT 4 ; Density : 1.0000
Reagent 5 : REAGENT 5 ; Density : 1.0000
Reagent 6 : REAGENT 6 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 41.9 MINUTES.

PLACE FILTERS IN FILTER DISPENSER.
NO SPE COLUMNS ARE USED.

Samples will be processed starting at Rack 1 position 1,
through position 50, then Rack 2 positions 1 through 50
or until an empty position is encountered.

Final tubes are in Racks 3 and 4.

Zymark BenchMate 2.5

Zymark BenchMate Procedure : INJECTOR #14 GPC CLEAN-UP(8 MIN PAUSE)

Step 1 : Add 8 ml of MeCl2
Step 2 : Wash syringe with 10 ml of MeCl2
Step 3 : Wash LC injector with 10 ml of MeCl2
Step 4 : Prewet filter with 10 ml of MeCl2
Step 5 : Prewet filter with 10 ml of MeCl2
Step 6 : Prewet filter with 10 ml of MeCl2
Step 7 : Vortex for 10 seconds at speed 2
Step 8 : Filter 9.8 ml of sample into next tube
Step 9 : Rinse filter holder with 10 ml of ACETONE
Step 10 : Wash syringe with 10 ml of MEOH
Step 11 : Wash syringe with 10 ml of MeCl2
Step 12 : Wash syringe with 10 ml of MeCl2
Step 13 : Inject sample on LC 1 with run time of 9 minutes
Step 14 : Wash syringe with 10 ml of ACETONE
Step 15 : Wash syringe with 10 ml of MEOH
Step 16 : Wash syringe with 10 ml of MeCl2
Step 17 : Wash syringe with 10 ml of MeCl2
Step 18 : Wash LC injector with 10 ml of ACETONE
Step 19 : Wash LC injector with 10 ml of MEOH
Step 20 : Wash LC injector with 10 ml of MeCl2
Step 21 : Wash LC injector with 10 ml of MeCl2
Step 22 : END

SETUP PARAMETERS - 1

SAMPLE TUBE
ial Volume: 2.00 ml

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 1.00 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Filter: 0.21 ml/sec
Air Push: 0.15 ml/sec

DISPENSING
Liquid driven: Y Y=YES N=NO

AUTOWASH PARAMETERS
Reagent Vol: 0.00 ml
Sample Vol: 0.00 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y=YES N=NO
Tolerance: 20%
Tare Sample Tubes: N Y=YES N=NO

RACK PARAMETERS
LV Tube Numbering: Y Y=YES N=NO
Reset to Sample 1: N Y=YES N=NO

SETUP PARAMETERS - 2

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Flute Flow: 0.15 ml/sec
ih Delay: 5 sec
Air Factor: 1.0
Save Columns: N Y=YES N=NO

LC PARAMETERS
Inject Load Vol: 8.00 ml
Calibrate every: 0 samples
Calib Replicates: 1
Calibration Reagent: 1
Calib Wash Vol: 0.00 ml

Zymark BenchMate Procedure : INJECTOR #14 GPC CLEAN-UP(8 MIN PAUSE)

NAME REAGENTS

Reagent 1 : MeCl2 ; Density : 1.3255
Reagent 2 : ACETONE ; Density : 0.7880
Reagent 3 : IPA ; Density : 0.7850
Reagent 4 : MEOH ; Density : 0.7915
Reagent 5 : HEXANE ; Density : 0.6600
Reagent 6 : DI H20 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 40.8 MINUTES.

PLACE FILTERS IN FILTER DISPENSER.
NO SPE COLUMNS ARE USED.

Samples will be processed starting at Rack 1 position 1,
through position 50, then Rack 2 positions 1 through 50
or until an empty position is encountered.

Final tubes are in Racks 3 and 4.

Heading 1: GPC CLEAN-UP #14
Heading 2: BATCH 1532 PCB PPS
Heading 3: TM
Final Vol: 2
Entered: Wed Jun 26 11:45:00 2002

Position	Sample ID	Initial Wt
1	MPB 1532	0.0000
2	LCS 1532	0.0000
3	MS 1532	0.0000
4	MSD 1532	0.0000
5	06 194 01	0.0000
6	06 218 21	0.0000
7	06 218 22	0.0000
8	06 218 24	0.0000
9	06 218 26	0.0000
10	06 218 27	0.0000
11	06 218 28	0.0000
12	06 218 29	0.0000
13	06 218 32	0.0000
14	06 218 33	0.0000
15	06 207 01	0.0000
16	06 207 02	0.0000
17	06 207 03	0.0000
18	RINSE	0.0000

Attachment 22.6

FOXY COLLECTION PARAMETERS

Settings are the same for foxy units on all Benchmates unless noted. Press button under bold choice or hit enter.

Edit A (B for #14)
TIME/DROP/VOLUME
TIME
Time windows: Yes

Programming for RACK 1 (front)
Tube size: custom A ENTER Tubes/rack=9 ENTER
Custom rack: Max # tubes/row=3 ENTER
Drop former will move to position of tubes #1 and #9. Check to see positioning is correct.
Example coordinates are approximate.
1 F to B=1421 L to R=0309 ENTER
9 F to B=0924 L to R=1010 ENTER
Peak = Rack 1&2 Nonpeak=Drain ENTER
Peak Fraction size=25:00 ENTER
Rack 2 Different
Tube size: custom B ENTER Tubes/rack=9 ENTER
Custom rack: # tubes per row=3 ENTER
Drop former will move to position of tubes #10 and #18. Check to see positioning is correct.
Example coordinates are approximate.
1 F to B=0600 L to R=0313 ENTER
9 F to B=0090 L to R=1000 ENTER
Peak Fraction size=25:00 ENTER
PEAK
Time Windows Only ENTER
Times are approximate – see chart in front of FOXY 200
BNA – 12:00 – 23:00
Pest/PCB – 13:30 – 22:50
Exit

Page 2
RESTART
MOMENTARY
# Of collections before advancing=1 ENTER
Restart=NEXT TUBE
Select program for restart A (B for #14)

Page 3
Technical
Pattern= ALWAYS LEFT TO RIGHT (14)
=ONE DIRECTION (#15 and #16)
Drop Wait=
Should drop former wait? YES

STOP (Red key)
If changes were made, press Save As A full (B for #14)
If no changes were made, press Ready A (B for #14)
If you want to check program, press Quick Review
More changes can be made in Edit A (B for #14)
RUN A (or B) to run.

MDEQ-Environmental Lab
GPC Cleanup Logbook- Organics

Method: 3640
Date:________
Analyst:________

MeCl #

Hexane #

Benchmate #	Window (minutes)	Batch #	Fraction Size (minutes)
14*			
15*			
16			

Sample ID		Final Volume (mL)	Comments

COMMENTS	NOTE: 2mL of sample extract is diluted to 10mL and then 5mL is injected onto the GPC Column.	Note: The final solvent for Pesticide and PCB analysis is hexane.	*Dual injection occurs when #14 & #15 are both circled.(Then odd #'s = #14; even #'s = #15)

MDEQ-Environmental Lab
GPC Cleanup Logbook- Organics
Instrument # 41

Analyst________
Method 3640

Minutes	
Dump Time:	
Collect Time:	
Wash Time:	

MeCl #	
Hexane #	

Date	Start Time	Injection time	End Time	Results	Method	Sample Vial	Sample ID	Final Volume (mL)	Comments

NOTE: 10mL of filtered sample extract is placed in the GPC tube. 5mL is injected onto the GPC Column.

Comments:

NOTE: The final solvent for Pesticide & PCB analysis is Hexane.

ATTACHMENT 22.7

Method: 3640
Date:_____
Analyst:_____

MDEQ-Environmental Lab
GPC Calibration Logbook
Organics
Instrument # 16

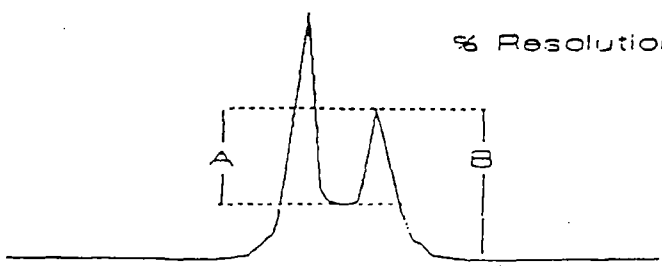
Noise Filter: _____
Peak Separation _____
Sensitivity _____
Chart Speed _____

Flow Rate mL/min _____
GPC Calibration Solution # _____
Volume Injected (mL) _____
Room Temperature _____

Peak #	Compound	Peak Start Time (minutes)	Peak Time (minutes)	Valley After Peak (minutes)	
1	Corn Oil				
2	Bis(2-ethylhexyl) phthalate				
3	Methoxychlor				
4	Perylene				
5	Sulfur				

	Resolution Criteria	A = depth of valley (mm)	B = height of shorter peak (mm)	Calculated Resolution (%)	Acceptable (yes/no initials)
	Corn Oil & Phthalate (>85%)				
	Phthalate & Methoxychlor (>85%)				
	Methoxychlor & Perylene (>85%)				
	Perylene & Sulfur (>90%)				

$$\% \text{ Resolution} = \frac{A}{B} \times 100$$



	BNA Collect Start Time (min)	BNA Collect End Time (min)	Pesticide/PCB Collect Start Time (min)	Pesticide/PCB Collect End Time (min)	Acceptable (yes/no & initials)
		Retention time shift of phthalate from last calibration (not more than +/- 5%)	Retention time shift of perylene from last calibration (not more than +/- 5%)		

$$\text{Retention Time Shift} = \frac{(\text{New RT} - \text{Last RT}) \times 100}{\text{Last RT}}$$

COMMENTS

ATTACHMENT 22.9

MSDS Number: **H2381** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

HEXANE

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9262, 9304, 9308, N168

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazard
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.

Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.

Skin Contact:
May cause redness, irritation, with dryness, cracking.

Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.

Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists

indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Light odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly

bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------------------------------

Ingredient	TSCA	EC	Japan	Australia

Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	10	U019	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **M4420** * * * * * *Effective Date:* ***10/06/05*** * * * * * *Supercedes:* ***05/14/03***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

METHYLENE CHLORIDE

1. Product Identification

Synonyms: MC; Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride
CAS No.: 75-09-2
Molecular Weight: 84.93
Chemical Formula: CH2Cl2
Product Codes: 9235, 9264, 9266, 9295, 9315, 9324, 9329, 9330, 9348, 9350, 9965, Q480

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazard
Methylene Chloride	75-09-2	> 99%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes formation of carbon monoxide in blood which affects cardiovascular system and central nervous system. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. Exposure may make the symptoms of angina (chest pains) worse.

Ingestion:
May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.

Skin Contact:
Causes irritation, redness and pain. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

Eye Contact:
Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.

Chronic Exposure:
Can cause headache, mental confusion, depression, liver effects, kidney effects, bronchitis,

loss of appetite, nausea, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact. Methylene chloride may cause cancer in humans.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Autoignition temperature: 556C (1033F)
Flammable limits in air % by volume:
lel: 12; uel: 23
Forms flammable vapor-air mixtures above 100C (212F).

Explosion:

Concentrated can be ignited by a high intensity ignition source. Vapor may form flammable mixture in atmosphere that contains a high percentage of oxygen. Sealed containers may rupture when heated.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases.

Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. This material may corrode plastic and rubber. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Odor Threshold: 205 - 307 ppm. The odor threshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Methylene Chloride (Dichloromethane):
- OSHA Permissible Exposure Limit (PEL) -
25 ppm (TWA), 125 ppm (STEL), 12.5 ppm (8-hour TWA - Action Level)
- ACGIH Threshold Limit Value (TLV) -

50 ppm (TWA), A3 - suspected human carcinogen.

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. The cartridges recommended for this material have a predicted service of less than 30 minutes at concentrations of ten times (10x) the exposure limits. Actual service life will vary considerbly, depending on concentration levels, temperature, humidity, and work rate. This substance has poor warning properties.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material for personal protective equipment. Natural rubber and polyvinyl chloride ARE NOT recommended materials for personal protective equipment.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:

Do not use closed circuit rebreathing system employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. See OSHA Standard for medical surveillance, record keeping, and reporting requirements for methylene chloride (29 CFR 1910.1052).

9. Physical and Chemical Properties

Appearance:

Clear, colorless liquid.

Odor:

Chloroform-like odor.

Solubility:

1.32 gm/100 gm water @ 20C.

Specific Gravity:

1.318 @ 25C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:
39.8C (104F)
Melting Point:
-97C (-143F)
Vapor Density (Air=1):
2.9
Vapor Pressure (mm Hg):
350 @ 20C (68F)
Evaporation Rate (BuAc=1):
27.5

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers, strong caustics, plastics, rubber, nitric acid, water + heat, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs. Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Dichloromethane: Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 52 gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Dichloromethane has been linked to spontaneous abortions in humans.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category

Methylene Chloride (75-09-2)	No	Yes	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of greater than 30 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

International (Water, I.M.O.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

International (Air, I.C.A.O.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methylene Chloride (75-09-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methylene Chloride (75-09-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\---------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methylene Chloride (75-09-2)	1000	U080	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2Z
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Do not get in eyes, on skin, or on clothing.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 14.
Disclaimer:
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intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

ATTACHMENT 22.11

MSDS Number: **C2618** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/02/01***

MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC 613-996-6666

Outside U.S. and Canada
Chemtrec 703-527-3887

NOTE: CHEMTREC, CANUTEC and Natural Response Center emergency numbers to be used only in the event of chemical emergencies involving [illegible] leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

1-CHLOROBUTANE

1. Product Identification

Synonyms: Butylchloride; n-Butyl Chloride; n-propylcarbinyl chloride
CAS No.: 109-69-3
Molecular Weight: 92.58
Chemical Formula: CH3(CH2)3Cl
Product Codes:
J.T. Baker: E738, E740
Mallinckrodt: 1872

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazard
Butyl Chloride	109-69-3	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY AFFECT CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. High concentrations have a narcotic effect.
Ingestion:
Causes irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea. Toxic! May cause systemic poisoning with symptoms paralleling those of inhalation.
Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
Similar compounds demonstrate toxic effects after repeated exposures too low to result in acute effects.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.

Skin Contact:

In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Call a physician.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Flash point: -9C (16F) CC
Autoignition temperature: 240C (464F)
Flammable limits in air % by volume:
lel: 1.8; uel: 10.1
Extremely Flammable.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. This highly flammable liquid must be kept from sparks, open flame, hot surfaces, and all sources of heat and ignition.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal

protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the substance is apparent and engineering controls are not feasble, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Unpleasant odor.
Solubility:
Practically insoluble in water.
Specific Gravity:
0.88 @ 25C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
78C (172F)
Melting Point:
-123C (-189F)
Vapor Density (Air=1):
3.2
Vapor Pressure (mm Hg):
80 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable at room temperature in sealed containers.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition. Oxides of carbon as well as ionic or oxidized halogen.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.

Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 2670 mg/kg Irritation data: skin rabbit, Open Draize, 10mg/24H, mild. Eye rabbit, Standard Draize, 500mg/24-hour, mild. Investigated as a tumorigen and mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Butyl Chloride (109-69-3)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: CHLOROBUTANES
Hazard Class: 3
UN/NA: UN1127
Packing Group: II
Information reported for product/size: 4L

International (Water, I.M.O.)

Proper Shipping Name: CHLOROBUTANES
Hazard Class: 3
UN/NA: UN1127
Packing Group: II
Information reported for product/size: 4L

International (Air, I.C.A.O.)

Proper Shipping Name: CHLOROBUTANES
Hazard Class: 3
UN/NA: UN1127
Packing Group: II
Information reported for product/size: 4L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------------------------------

Ingredient	TSCA	EC	Japan	Australia
Butyl Chloride (109-69-3)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------------------------------

Ingredient	Korea	Canada DSL	Canada NDSL	Phil.
Butyl Chloride (109-69-3)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------------

	-SARA 302-	------SARA 313------

Ingredient	RQ	TPQ	List	Chemical Catg.
Butyl Chloride (109-69-3)	No	No	No	No

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Butyl Chloride (109-69-3)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY AFFECT CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Avoid breathing vapor.
Use only with adequate ventilation.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing, give artificial

respiration. If breathing is difficult, give oxygen. In all cases call a physician.

Product Use:
Laboratory Reagent.

Revision Information:
No Changes.

Disclaimer:
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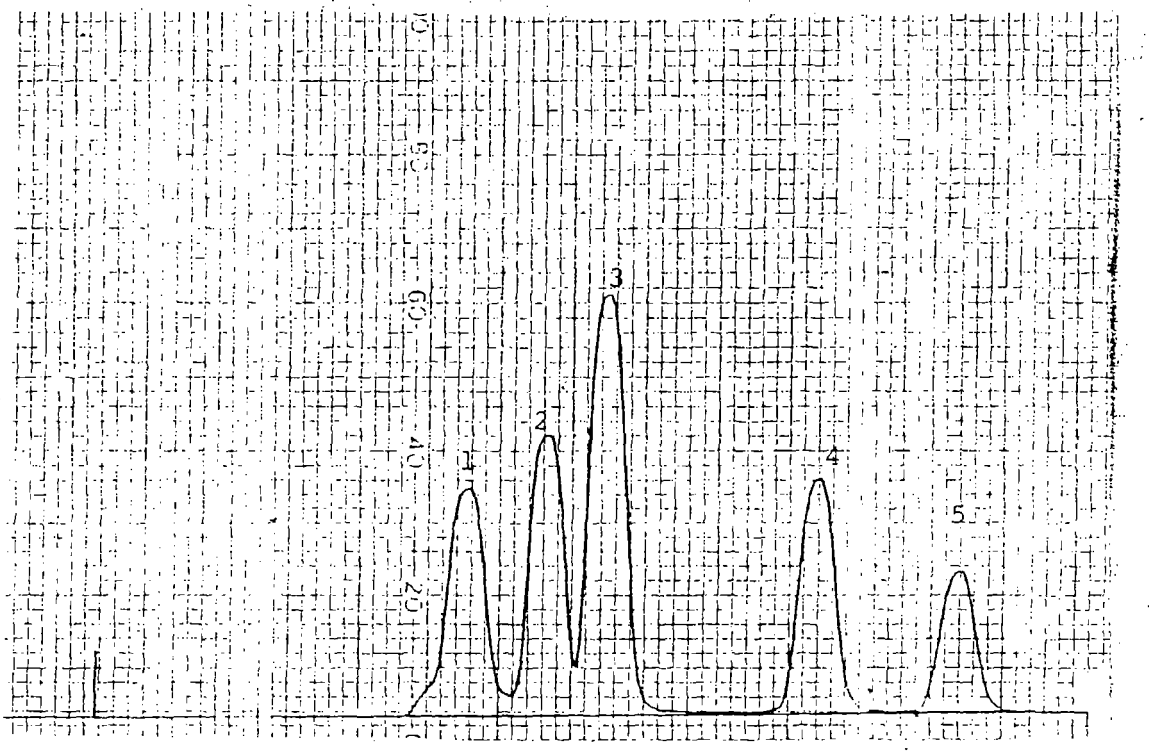
Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

CALIBRATION SOLUTION CHROMATOGRAM



1 - Corn Oil
2 - Bis(2-ethylhexyl) phthalate
3 - Methoxychlor
4 - Perylene
5 - Sulfur

WinSEP v1.0

Details of method PCB/Pest Cleanup5

6/27/02 3:28:08 PM

Method Description: PCB/Pest Cleanup 5□□Made10/08/01 ST

Method is Cleanup type
Dump Time1: 13.00 min
Collect Time1: 9.70 min
Dump Time2: 0.00 min
Collect Time2: 0.00 min
Wash Time: 10.00 min

Pump Rate: 5.00 ml/min
No of Rinses: 1
Time needle is rinsed: 10 sec
Column Type: EnviroSEP-ABC

Heading 1: CPC CLEANUP #16
Heading 2: BATCH 1482 BNA
Heading 3: TM
Initial Vol: 2.00000
Run: Thu Jan 01 00:00:00 1970 Entered: Mon Mar 04 15:51:27 2002

Position	Sample ID	Initial Wt	CAN.DISP	VTX LOSS	FIL ASP	FIL DISP	HPLC.NUM	HPLC.ASP
1	MPB 1482	0.0000	9.8066	-0.0262	-12.0268	11.2868	1.0000	-8.6170
2	LCS 1482	0.0000	9.7982	-0.0348	-11.9856	11.2830	2.0000	-8.4240
3	MS 1482	0.0000	9.6185	-0.0165	-12.0198	11.4887	3.0000	-8.3868
4	MSD 1482	0.0000	9.5806	-0.0263	-11.6361	11.0680	4.0000	-8.4751
5	02 128 01	0.0000	9.6051	-0.0354	-11.9338	11.2939	5.0000	-8.3738
6	02 128 02	0.0000	9.5695	-0.0219	-11.8437	11.5758	6.0000	-8.3351
7	02 128 03	0.0000	9.5293	-0.0280	-11.4772	11.0126	7.0000	-8.3380
8	02 128 04	0.0000	9.5569	-0.0307	-11.8237	11.3518	8.0000	-8.4410
9	02 128 05	0.0000	9.5106	-0.0232	-11.9625	11.3966	9.0000	-8.3637
10	02 128 06	0.0000	9.6094	-0.0215	-11.9701	11.4254	10.0000	-8.3801
11	02 128 07	0.0000	9.5879	-0.0378	-11.4869	10.9140	11.0000	-8.4851
12	02 128 08	0.0000	9.6299	-0.0211	-11.9220	11.0937	12.0000	-8.3106
13	02 128 09	0.0000	9.6021	-0.0307	-11.8795	11.1316	13.0000	-8.3125
14	02 128 10	0.0000	9.4512	-0.0244	-11.6654	10.9399	14.0000	-8.4418
15	02 128 11	0.0000	9.5090	-0.0782	-11.2849	10.7734	15.0000	-8.3351
16	02 128 12	0.0000	9.5022	-0.0219	-11.6725	11.0919	16.0000	-8.3389
17	RINSE	0.0000	9.4821	-0.0255	-12.1338	11.6314	17.0000	-8.4527
18	RINSE	0.0000	9.4093	-0.0194	-11.5657	11.5300	18.0000	-8.4568

Date	Start Time	Inject Time	End Time	Results	Method	Vial	Sample ID	Final Volume
6/24/02	2:24:37 PM	2:26:18 PM	2:59:09 PM	Completed run	PCB/Pest Cleanup5	1	Rinse #1	
6/24/02	2:59:09 PM	3:00:50 PM	3:33:41 PM	Completed run	PCB/Pest Cleanup5	2	MPB 4954	
6/24/02	3:33:41 PM	3:35:22 PM	4:08:13 PM	Completed run	PCB/Pest Cleanup5	3	LCS 4954	
6/24/02	4:08:13 PM	4:09:54 PM	4:42:45 PM	Completed run	PCB/Pest Cleanup5	4	MS (193-01)	
6/24/02	4:42:45 PM	4:44:26 PM	5:17:17 PM	Completed run	PCB/Pest Cleanup5	5	MSD (193-01)	
6/24/02	5:17:17 PM	5:18:58 PM	5:51:49 PM	Completed run	PCB/Pest Cleanup5	6	0206176-01	
6/24/02	5:51:49 PM	5:53:31 PM	6:26:22 PM	Completed run	PCB/Pest Cleanup5	7	0206188-01	
6/24/02	6:26:22 PM	6:28:03 PM	7:00:54 PM	Completed run	PCB/Pest Cleanup5	8	0206188-02	
6/24/02	7:00:54 PM	7:02:36 PM	7:35:27 PM	Completed run	PCB/Pest Cleanup5	9	0206188-03	
6/24/02	7:35:27 PM	7:37:09 PM	8:09:59 PM	Completed run	PCB/Pest Cleanup5	10	0206188-04	
6/24/02	8:09:59 PM	8:11:42 PM	8:44:32 PM	Completed run	PCB/Pest Cleanup5	11	0206188-05	
6/24/02	8:44:32 PM	8:46:15 PM	9:19:05 PM	Completed run	PCB/Pest Cleanup5	12	0206188-06	
6/24/02	9:19:05 PM	9:20:48 PM	9:53:38 PM	Completed run	PCB/Pest Cleanup5	13	0206188-07	
6/24/02	9:53:38 PM	9:55:21 PM	10:28:11 PM	Completed run	PCB/Pest Cleanup5	14	0206193-01	
6/24/02	10:28:12 PM	10:29:53 PM	11:02:44 PM	Completed run	PCB/Pest Cleanup5	15	0206193-02	
6/24/02	11:02:44 PM	11:04:26 PM	11:37:17 PM	Completed run	PCB/Pest Cleanup5	16	0206195-01	
6/24/02	11:37:17 PM	11:38:59 PM	12:11:49 AM	Completed run	PCB/Pest Cleanup5	17	0206195-02	
6/25/02	12:11:49 AM	12:13:31 AM	12:46:22 AM	Completed run	PCB/Pest Cleanup5	18	0206195-04	
6/25/02	12:46:22 AM	12:48:03 AM	1:20:54 AM	Completed run	PCB/Pest Cleanup5	19	0206195-05	
6/25/02	1:20:54 AM	1:22:35 AM	1:55:26 AM	Completed run	PCB/Pest Cleanup5	20	0206222-01	
6/25/02	1:55:26 AM	1:57:07 AM	2:29:58 AM	Completed run	PCB/Pest Cleanup5	21	Rinse #2	

O-I-CORPORATION

EQ Environmental Lab
Lansing, MI 48906
Phone: 517-335-9800
Fax: 517-335-9600
WWW:

	Name	Date
Approval 1:		
Approval 2:		

Sequence:	4954	Start of Run:	6/24/02 2:24:37PM
Operator:	DEQDWRP	Overall Results:	Completed run

Configuration Details:

Syringe Size(ml):	10.00	Detector Type:	ISCO UA-6	Sample Tray:	60 16 * 100 mm tubes
Loop Size (ml):	5.00	Using UV Detector:	Yes	Collect Tray:	TurboVap 125 mL tubes
Flow Rate(ml/min):	5.00	Plotting UV Data:	No	Column Type:	EnviroSEP-ABC
Bypass Valve:	Yes			Solvent Type:	Methylene chloride

Sample Details:

Sample ID: 0206176-01

Sample Vial:	6	Sample Type:	Sample		
First Collect Vial:	6	Sample Vol (ml)	10.00		
Last Collect Vial:	6	Sample Wt/Vol:		Priority:	Normal
Method:	PCB/Pest Cleanup5				
Comments:					

Sample ID: 0206188-01

Sample Vial:	7	Sample Type:	Sample		
First Collect Vial:	7	Sample Vol (ml)	10.00		
Last Collect Vial:	7	Sample Wt/Vol:		Priority:	Normal
Method:	PCB/Pest Cleanup5				
Comments:					

Sample ID: 0206188-02

Sample Vial:	8	Sample Type:	Sample		
First Collect Vial:	8	Sample Vol (ml)	10.00		
Last Collect Vial:	8	Sample Wt/Vol:		Priority:	Normal
Method:	PCB/Pest Cleanup5				
Comments:					

Sample ID: 0206188-03

Sample Vial:	9	Sample Type:	Sample		
First Collect Vial:	9	Sample Vol (ml)	10.00		
Last Collect Vial:	9	Sample Wt/Vol:		Priority:	Normal
Method:	PCB/Pest Cleanup5				
Comments:					

Sequence:	4954	Start of Run:	6/24/02 2:24:37PM
Operator:	DEQDWRP	Overall Results:	Completed run

Sample ID: 0206188-04

Sample Vial:	10	Sample Type:	Sample		
First Collect Vial:	10	Sample Vol (ml)	10.00		
Last Collect Vial:	10	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206188-05

Sample Vial:	11	Sample Type:	Sample		
First Collect Vial:	11	Sample Vol (ml)	10.00		
Last Collect Vial:	11	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206188-06

Sample Vial:	12	Sample Type:	Sample		
First Collect Vial:	12	Sample Vol (ml)	10.00		
Last Collect Vial:	12	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206188-07

Sample Vial:	13	Sample Type:	Sample		
First Collect Vial:	13	Sample Vol (ml)	10.00		
Last Collect Vial:	13	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206193-01

Sample Vial:	14	Sample Type:	Sample		
First Collect Vial:	14	Sample Vol (ml)	10.00		
Last Collect Vial:	14	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206193-02

Sample Vial:	15	Sample Type:	Sample		
First Collect Vial:	15	Sample Vol (ml)	10.00		
Last Collect Vial:	15	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206195-01

Sample Vial:	16	Sample Type:	Sample		
First Collect Vial:	16	Sample Vol (ml)	10.00		
Last Collect Vial:	16	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sequence: 4954 Start of Run: 6/24/02 2:24:37PM
Operator: DEQDWRP Overall Results: Completed run

Sample ID: 0206195-02

Sample Vial: 17 Sample Type: Sample
First Collect Vial: 17 Sample Vol (ml) 10.00
Last Collect Vial: 17 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206195-04

Sample Vial: 18 Sample Type: Sample
First Collect Vial: 18 Sample Vol (ml) 10.00
Last Collect Vial: 18 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206195-05

Sample Vial: 19 Sample Type: Sample
First Collect Vial: 19 Sample Vol (ml) 10.00
Last Collect Vial: 19 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: 0206222-01

Sample Vial: 20 Sample Type: Sample
First Collect Vial: 20 Sample Vol (ml) 10.00
Last Collect Vial: 20 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: LCS 4954

Sample Vial: 3 Sample Type: Sample
First Collect Vial: 3 Sample Vol (ml) 10.00
Last Collect Vial: 3 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: MPB 4954

Sample Vial: 2 Sample Type: Sample
First Collect Vial: 2 Sample Vol (ml) 10.00
Last Collect Vial: 2 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sample ID: MS (193-01)

Sample Vial: 4 Sample Type: Sample
First Collect Vial: 4 Sample Vol (ml) 10.00
Last Collect Vial: 4 Sample Wt/Vol: Priority: Normal
Method: PCB/Pest Cleanup5
Comments:

Sequence:	4954	Start of Run:	6/24/02 2:24:37PM
Operator:	DEQDWRP	Overall Results:	Completed run

Sample ID: MSD (193-01)

Sample Vial:	5	Sample Type:	Sample		
First Collect Vial:	5	Sample Vol (ml)	10.00		
Last Collect Vial:	5	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: Rinse #1

Sample Vial:	1	Sample Type:	Sample		
First Collect Vial:	1	Sample Vol (ml)	10.00		
Last Collect Vial:	1	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sample ID: Rinse #2

Sample Vial:	21	Sample Type:	Sample		
First Collect Vial:	21	Sample Vol (ml)	10.00		
Last Collect Vial:	21	Sample Wt/Vol:		Priority:	Normal

Method: PCB/Pest Cleanup5
Comments:

Sequence Summary:

Calibrations and Check Standards Processed:	0
Fatal Errors Encountered:	0
Total Run Time:	0 Day(s), 12 Hour(s), 5 Minute(s), 21 Second(s)

Method Details:

Name: PCB/Pest Cleanup5

Dump Time 1 (min):	13.00	Quantity of Rinses:	1	Creator:	DEQDWRP
Dump Time 2 (min):	0.00	Needle Rinse Time (sec):	10	Last Edited:	10/8/01 11:46:23AM
Collect Time 1 (min):	9.70			Revision:	1
Collect Time 2 (min):	0.00	Rinse Time (min):	10.00	Type:	Cleanup

Comments: PCB/Pest Cleanup 5
Made10/08/01 ST

Sequence: 4954 Start of Run: 6/24/02 2:24:37PM

Operator: DEQDWRP Overall Results: Completed run

Result Details

Start Time	Completion Time	Results	Sample Vial No.	First Collect Vial	Last Collect V Number
6/24/02 2:24:37PM	6/24/02 2:59:09PM	Completed run	1	1	1
6/24/02 2:59:09PM	6/24/02 3:33:41PM	Completed run	2	2	2
6/24/02 3:33:41PM	6/24/02 4:08:13PM	Completed run	3	3	3
6/24/02 4:08:13PM	6/24/02 4:42:45PM	Completed run	4	4	4
6/24/02 4:42:45PM	6/24/02 5:17:17PM	Completed run	5	5	5
6/24/02 5:17:17PM	6/24/02 5:51:49PM	Completed run	6	6	6
6/24/02 5:51:49PM	6/24/02 6:26:22PM	Completed run	7	7	7
6/24/02 6:26:22PM	6/24/02 7:00:54PM	Completed run	8	8	8
6/24/02 7:00:54PM	6/24/02 7:35:27PM	Completed run	9	9	9
6/24/02 7:35:27PM	6/24/02 8:09:59PM	Completed run	10	10	10
6/24/02 8:09:59PM	6/24/02 8:44:32PM	Completed run	11	11	11
6/24/02 8:44:32PM	6/24/02 9:19:05PM	Completed run	12	12	12
6/24/02 9:19:05PM	6/24/02 9:53:38PM	Completed run	13	13	13
6/24/02 9:53:38PM	6/24/02 10:28:11PM	Completed run	14	14	14
6/24/02 10:28:12PM	6/24/02 11:02:44PM	Completed run	15	15	15
6/24/02 11:02:44PM	6/24/02 11:37:17PM	Completed run	16	16	16
6/24/02 11:37:17PM	6/25/02 12:11:49AM	Completed run	17	17	17
6/25/02 12:11:49AM	6/25/02 12:46:22AM	Completed run	18	18	18
6/25/02 12:46:22AM	6/25/02 1:20:54AM	Completed run	19	19	19
6/25/02 1:20:54AM	6/25/02 1:55:26AM	Completed run	20	20	20
6/25/02 1:55:26AM	6/25/02 2:29:58AM	Completed run	21	21	21

Occasionally, samples will be too thick to be filtered through the benchmate. These samples need to be hand filtered using the following procedure:

Soil samples are extracted according to internal procedure SOP 401 and brought to 10 mL in MeCl.

- Attach an Acrodisc filter (Section 9.20) to a syringe (Section 9.21).
- Pour the sample extract into the syringe. Filter into a 10 mL pre-marked culture tube (Section 9.1).
- Transfer the label to the new tube.

Cover the tube with foil. Cover with a star cap to hold the fill in place (Section 9.2). Samples are run on either benchmate #14 or benchmate #16 with the 10 mL start procedure.

Zymark BenchMate 2.5

Zymark BenchMate Procedure - BM #14 10 ML START GPC CLEAN-UP

Step 1 : Wash syringe with 10 ml of MeCl2
Step 2 : Wash LC injector with 10 ml of MeCl2
Step 3 : Vortex for 10 seconds at speed 2
Step 4 : Inject sample on LC 1 with run time of 9 minutes
Step 5 : Wash syringe with 10 ml of MeCl2
Step 6 : Wash LC injector with 10 ml of MeCl2
Step 7 : Pause for 18 minutes
Step 8 : Wash syringe with 10 ml of MeCl2
Step 9 : Wash syringe with 10 ml of MeCl2
Step 10 : Wash LC injector with 10 ml of MeCl2
Step 11 : Wash LC injector with 10 ml of MeCl2
Step 12 : END

SETUP PARAMETERS - 1

SAMPLE TUBE
Initial Volume: 10.0 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y=YES N=NO
Tolerance: 20%
Tare Sample Tubes: N Y=YES N=NO

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 1.00 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Filter: 0.10 ml/sec
Air Push: 0.15 ml/sec

RACK PARAMETERS
LV Tube Numbering: Y Y=YES N=NO
Reset to Sample 1: N Y=YES N=NO

DISPENSING
Liquid driven: Y Y=YES N=NO

AUTOWASH PARAMETERS
Reagent Vol: 0.00 ml
Sample Vol: 0000 ml

SETUP PARAMETERS - 2

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Elute Flow: 0.15 ml/sec
Push Delay: 5 sec
Air Factor: 1.0
Save Columns: N Y=YES N=NO

LC PARAMETERS
Inject Load Vol: 7.00 ml
Calibrate every: 0 samples
Calib Replicates: 1
Calibration Reagent: 1
Calib Wash Vol: 0.00 ml

Zymark BenchMate Procedure : BM #14 10 ML START GPC CLEAN-UP

NAME REAGENTS

Reagent 1 : MeCl2 ; Density : 1.3170
Reagent 2 : REAGENT 2 ; Density : 1.0000
Reagent 3 : REAGENT 3 ; Density : 1.0000
Reagent 4 : REAGENT 4 ; Density : 1.0000
Reagent 5 : REAGENT 5 ; Density : 1.0000
Reagent 6 : REAGENT 6 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 40.2 MINUTES.

NO FILTERS ARE USED.
NO SPE COLUMNS ARE USED.

Tubes will be processed starting at Rack 1 position 1,
through all Racks until an empty position is encountered.

Zymark BenchMate 3.10

Zymark BenchMate Procedure : BM II 10 ML START GPC CLEAN-UP

Step 1 : Wash syringe with 10 ml of MeCl2
Step 2 : Wash LC injector with 10 ml of MeCl2
Step 3 : Vortex for 10 seconds at speed 2
Step 4 : Inject sample on LC with run time of 9 minutes
Step 5 : Wash LC injector with 10 ml of MeCl2
Step 6 : Wash syringe with 10 ml of MeCl2
Step 7 : Pause for 18 minutes
Step 8 : Wash syringe with 10 ml of MeCl2
Step 9 : Wash syringe with 10 ml of MeCl2
Step 10 : Wash LC injector with 10 ml of MeCl2
Step 11 : Wash LC injector with 10 ml of MeCl2
Step 12 : END

SETUP PARAMETERS

SAMPLE TUBE
Initial Volume: 10.0 ml

FLOW RATES
Aspirate: 0.50 ml/sec
Dispense: 1.00 ml/sec
Internal Std: 0.12 ml/sec
Mix: 1.50 ml/sec
Air Push: 0.15 ml/sec

DISPENSING
Liquid driven: Y Y=YES N=NO

AUTOWASH PARAMETERS
Reagent Vol: 0.00 ml
Sample Vol: 0.00 ml

GRAVIMETRIC PARAMETERS
Gravimetric on: Y Y=YES N=NO
Tare Sample Tubes: N Y=YES N=NO

RACK PARAMETERS
LV Tube Numbering: Y Y=YES N=NO
Reset to Sample 1: N Y=YES N=NO

FILTER PARAMETERS
Filter Flow Rate: 0.21 ml/sec
Filtrate Confirm: N Y=YES N=NO
Filtrate Density: 1.00 g/ml
Minimum Amount: 0%

Rinse Reagent: 1

SETUP SPE PARAMETERS

SPE PARAMETERS
Cond Flow: 0.25 ml/sec
Aspirate Flow: 0.25 ml/sec
Load Flow: 0.15 ml/sec
Rinse Flow: 0.25 ml/sec
Elute Flow: 0.15 ml/sec
Push Delay: 5 sec
Air Factor: 1.0
Save Columns: N Y=YES N=NO
Save Samples: N Y=YES N=NO

SETUP LC PARAMETERS

LC PARAMETERS LC CALIBRATION STANDARDS
Inject Sip Vol: 7.00 ml Calibrate every: 0 samples
Inject Delay Time: 99 sec
Loop in Load Pos: N Y=YES N=NO INJECT START DURING END
Inject Loop Time: 99 sec LC Std 1: 0 0 0
LC Std 2: 0 0 0
LC Std 3: 0 0 0
ENCORE PARAMETERS LC Std 4: 0 0 0
Load disk methods: Y Y=YES N=NO LC Std 5: 0 0 0
Lock pump keypad: Y Y=YES N=NO LC Std 6: 0 0 0
Initialization Time: 0 min Calib Wash Vol: 0.00 ml
Equilibration Time: 0 min Calib Wash Reagent: 1
Shutdown method: 0

SETUP EasyFill PARAMETERS

EasyFill PARAMETERS
EasyFill vial type: 2
Sense vials: Y Y=YES N=NO
External needle wash: Y Y=YES N=NO

Zymark BenchMate Procedure : BM II 10 ML START GPC CLEAN-UP

NAME REAGENTS

Reagent 1 : MeCl2 ; Density : 1.3170
Reagent 2 : REAGENT 2 ; Density : 1.0000
Reagent 3 : REAGENT 3 ; Density : 1.0000
Reagent 4 : REAGENT 4 ; Density : 1.0000
Reagent 5 : REAGENT 5 ; Density : 1.0000
Reagent 6 : REAGENT 6 ; Density : 1.0000

NAME INTERNAL STANDARD

Standard : INTERNAL STD ; Density : 1.0000

BenchMate Table Setup

THE ESTIMATED TIME FOR ONE SAMPLE IS: 34.1 MINUTES.

NO FILTERS ARE USED.
NO SPE COLUMNS ARE USED.

Tubes will be processed starting at Rack 1 position 1,
through all Racks until an empty position is encountered.

OI SAMPLE ID EXAMPLE

Sample	Sample ID	Method	Sample Ty	Comments	First Collect	Last Collect
1	Rinse #1	PCB/Pest Cleanup	Sample		1	1
2	MPB 4954	PCB/Pest Cleanup	Sample		2	2
3	LCS 4954	PCB/Pest Cleanup	Sample		3	3
4	MS (193-01)	PCB/Pest Cleanup	Sample		4	4
5	MSD (193-01)	PCB/Pest Cleanup	Sample		5	5
6	0206176-01	PCB/Pest Cleanup	Sample		6	6
7	0206188-01	PCB/Pest Cleanup	Sample		7	7
8	0206188-02	PCB/Pest Cleanup	Sample		8	8
9	0206188-03	PCB/Pest Cleanup	Sample		9	9
10	0206188-04	PCB/Pest Cleanup	Sample		10	10
11	0206188-05	PCB/Pest Cleanup	Sample		11	11
12	0206188-06	PCB/Pest Cleanup	Sample		12	12
13	0206188-07	PCB/Pest Cleanup	Sample		13	13
14	0206193-01	PCB/Pest Cleanup	Sample		14	14
15	0206193-02	PCB/Pest Cleanup	Sample		15	15
16	0206195-01	PCB/Pest Cleanup	Sample		16	16
17	0206195-02	PCB/Pest Cleanup	Sample		17	17
18	0206195-04	PCB/Pest Cleanup	Sample		18	18
19	0206195-05	PCB/Pest Cleanup	Sample		19	19
20	0206222-01	PCB/Pest Cleanup	Sample		20	20
21	Rinse #2	PCB/Pest Cleanup	Sample		21	21

OI CALIBRATION SEQUENCE METHOD

Sample	Sample ID	Method	Sample Ty	Comments	First Collect	Last Collect
1	Rinse	calib	Calibrati		1	1
2	Cal	calib	Calibrati		1	1
3	Rinse	calib	Calibrati		1	1

Details of method calib

6/27/02 3:59:29 PM

Method Description: 5 ml/min calib

Method is Cleanup type
Dump Time1: 30.00 min
Collect Time1: 0.00 min
Dump Time2: 0.00 min
Collect Time2: 0.00 min
Wash Time: 10.00 min

Pump Rate: 5.00 ml/min
No of Rinses: 1
Time needle is rinsed: 10 sec
Column Type: EnviroSEP-ABC

Configuration settings for sequence Calibration

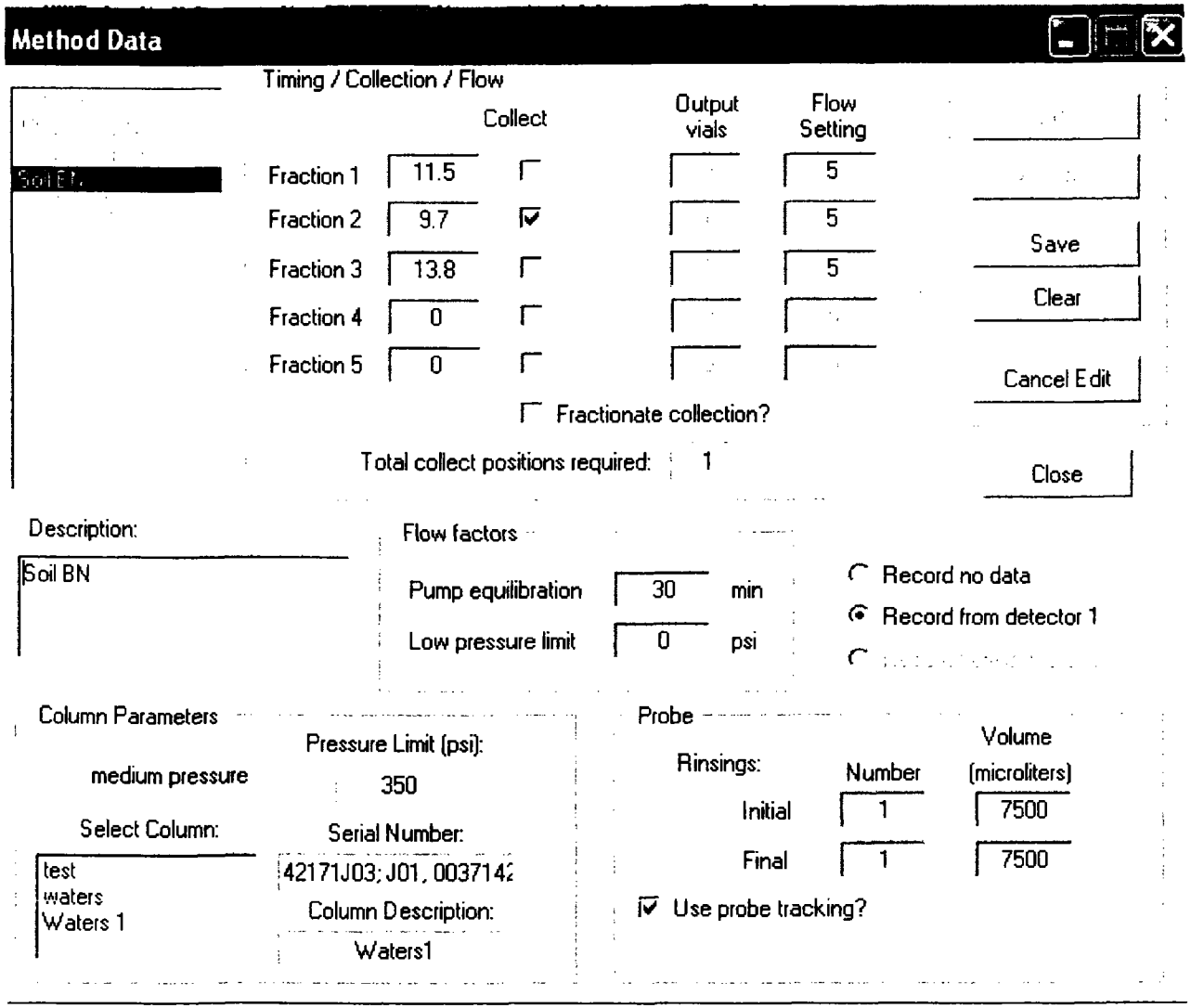
3/11/02 8:14:23 AM

Pump Rate: 5.00 ml/min
Loop Size: 5.00 ml
Syringe Size: 10 ml

Column Type: EnviroSEP-ABC
Detector Type: ISCO UA-6
Number of Detectors: 1

Sample Tray: 60 16 * 100 mm tubes
Collect Tray: TurboVap 125 mL tubes

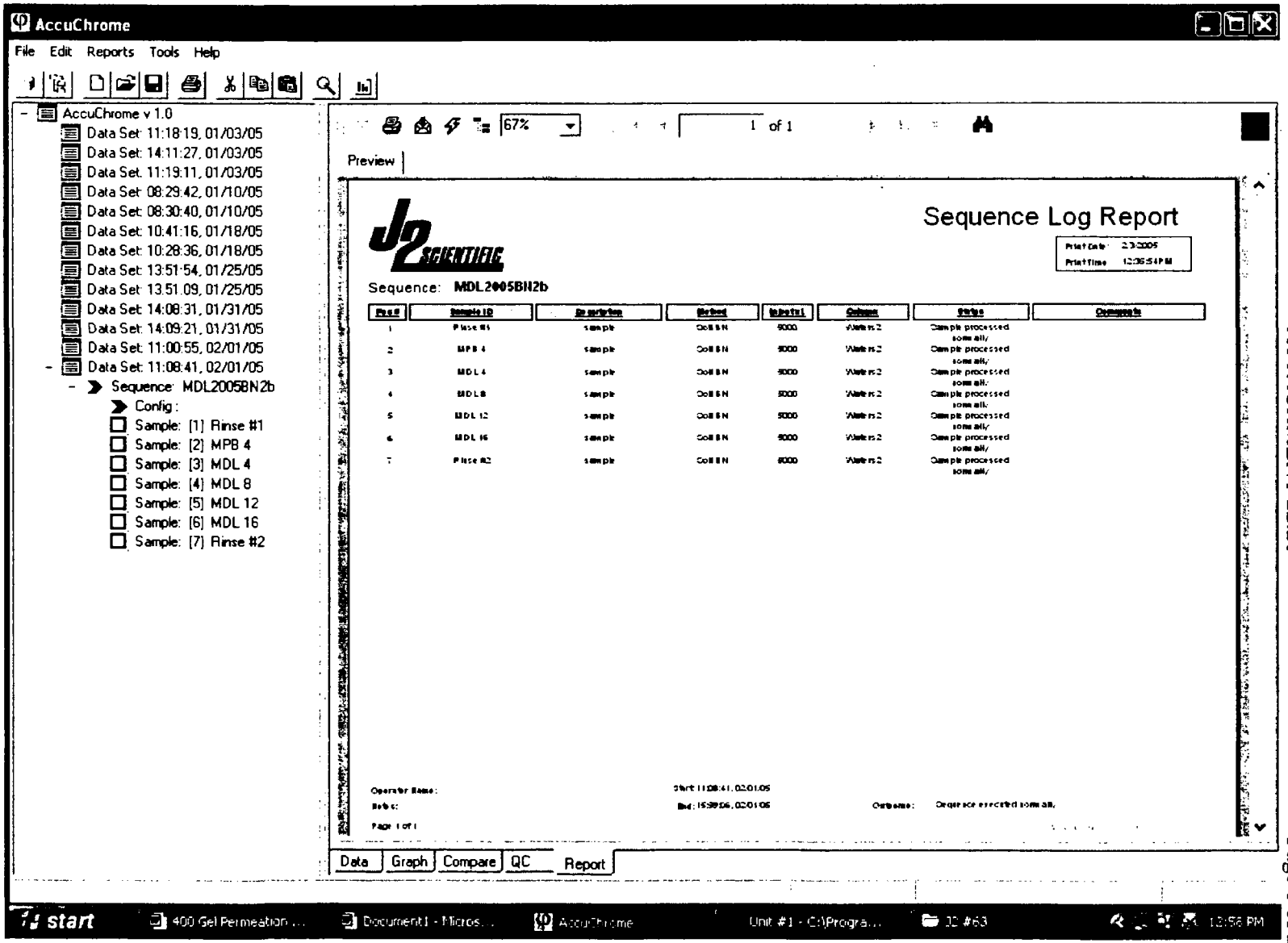
Plotting Detector Data: NO
Bypass Valve installed: YES


Method Data
Timing / Collection / Flow
Collect
Output vials
Flow Setting
Soil BN
Fraction 1 11.5 5
Fraction 2 9.7 5
Fraction 3 13.8 5
Fraction 4 0
Fraction 5 0
Save
Clear
Cancel Edit
Fractionate collection?
Total collect positions required: 1
Close
Description:
Soil BN
Flow factors
Pump equilibration 30 min
Low pressure limit 0 psi
Record no data
Record from detector 1
Column Parameters
medium pressure
Pressure Limit (psi):
350
Select Column:
test
waters
Waters 1
Serial Number:
42171J03; J01, 0037142
Column Description:
Waters1
Probe
Rinsings:
Number
Volume (microliters)
Initial 1 7500
Final 1 7500
Use probe tracking?

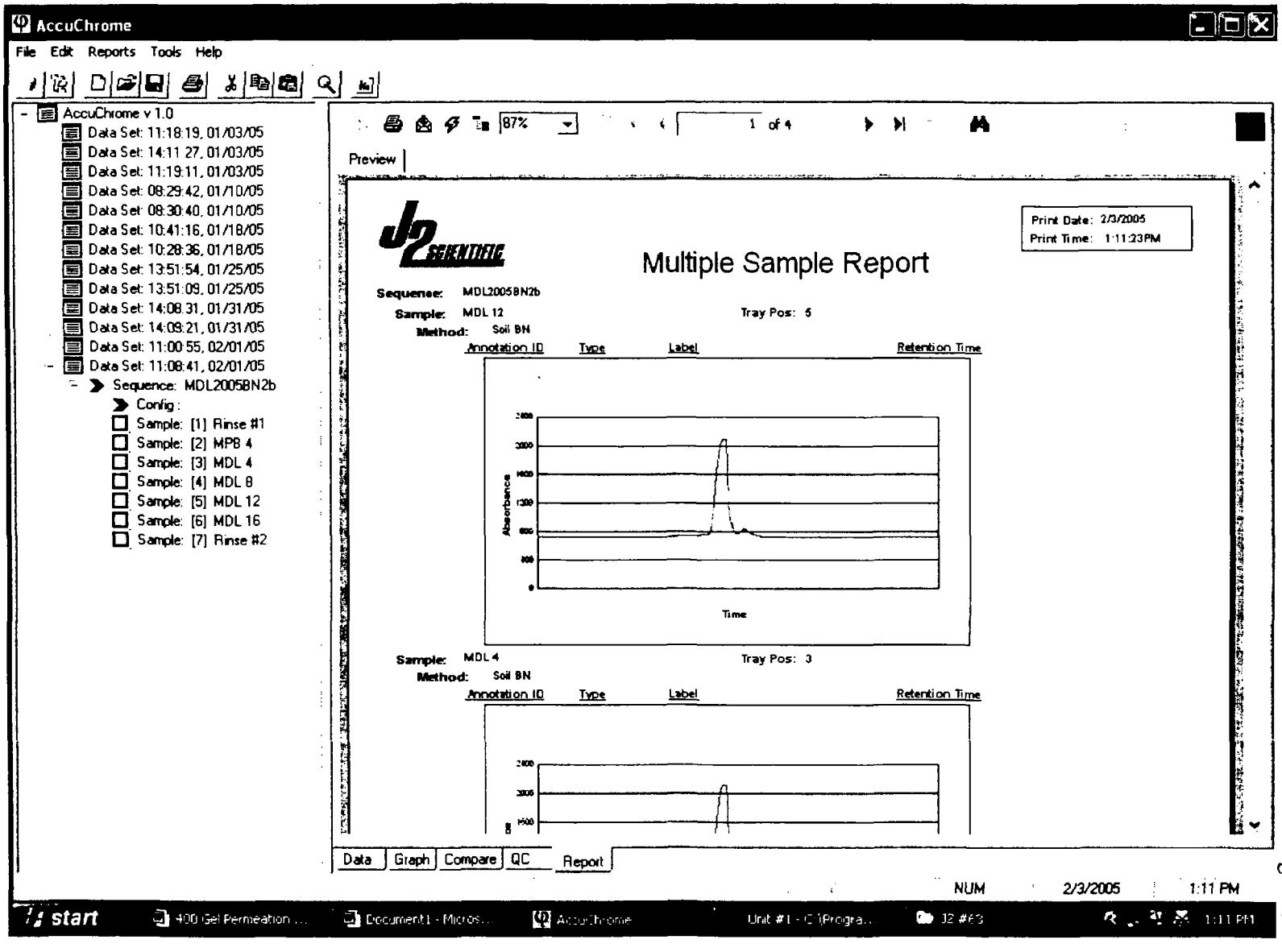
Select/Modify/Execute sequence

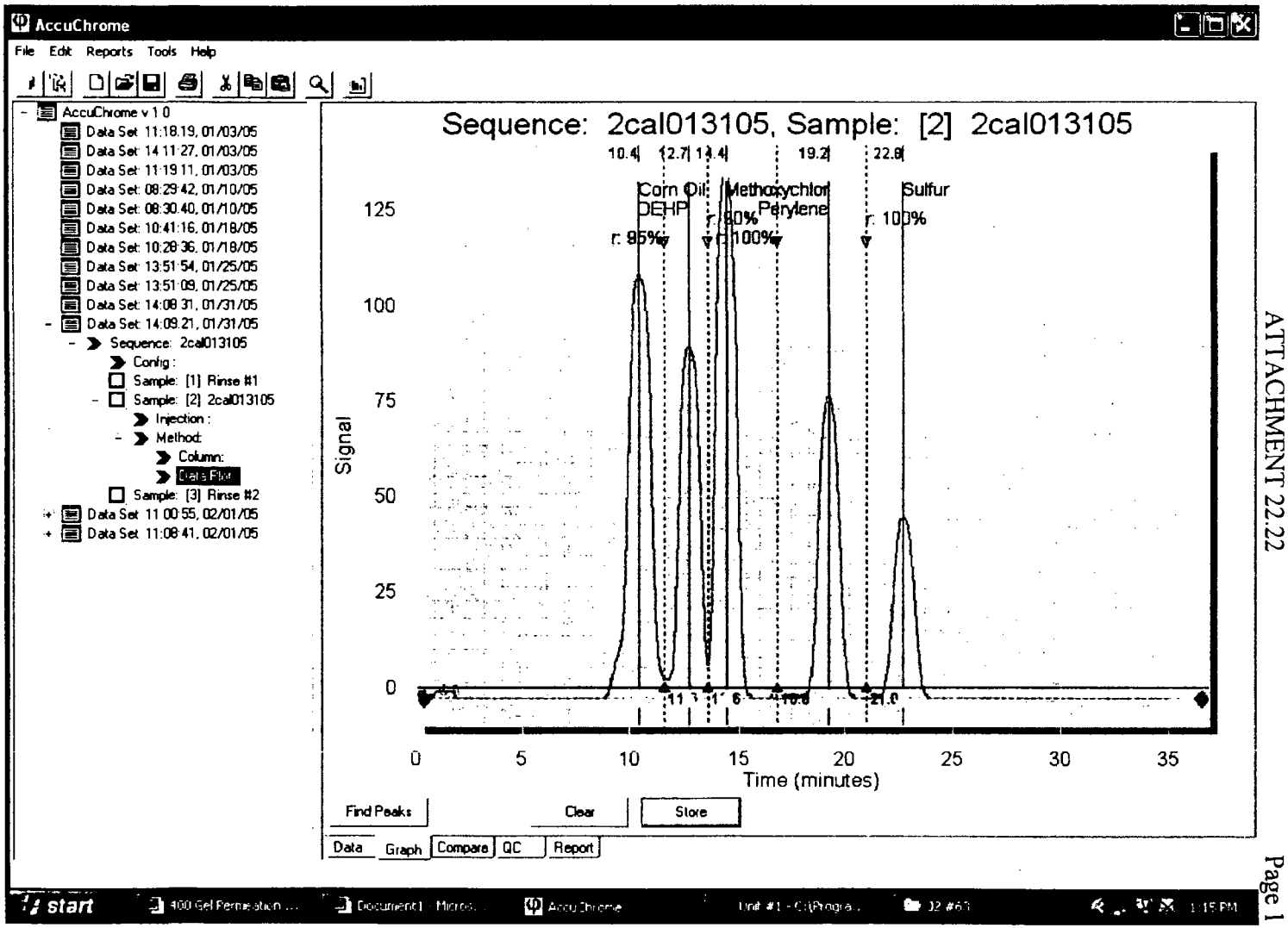
Close

	Designation (ID)	Description	Sample Type	Inj's	Volume	Method	Column	Collect First	Collect Last
1				1 of 1			Waters 1	1	1
2				1 of 1			Waters 1	2	2
3				1 of 1			Waters 1	3	3
4				1 of 1			Waters 1	4	4
5				1 of 1			Waters 1	5	5
6				1 of 1			Waters 1	6	6
7				1 of 1			Waters 1	7	7
8			sample			Calibration			
9			sample			Calibration			
10			sample			Calibration			
11			sample			Calibration			
12			sample			Calibration			
13			sample			Calibration			
14			sample			Calibration			
15			sample			Calibration			
16			sample			Calibration			
17			sample			Calibration			
18			sample			Calibration			
19			sample			Calibration			
20			sample			Calibration			



ATTACHMENT 22.21


AccuChrome
File Edit Reports Tools Help
AccuChrome v 1.0
Data Set: 11:18:19, 01/03/05
Data Set: 14:11 27, 01/03/05
Data Set: 11:19:11, 01/03/05
Data Set: 08:29:42, 01/10/05
Data Set: 08:30:40, 01/10/05
Data Set: 10:41:16, 01/18/05
Data Set: 10:28:36, 01/18/05
Data Set: 13:51:54, 01/25/05
Data Set: 13:51:09, 01/25/05
Data Set: 14:08:31, 01/31/05
Data Set: 14:09:21, 01/31/05
Data Set: 11:00:55, 02/01/05
Data Set: 11:08:41, 02/01/05
Sequence: MDL2005BN2b
Config:
Sample: [1] Rinse #1
Sample: [2] MPB 4
Sample: [3] MDL 4
Sample: [4] MDL 8
Sample: [5] MDL 12
Sample: [6] MDL 16
Sample: [7] Rinse #2
87%
1 of 4
Preview
Print Date: 2/3/2005
Print Time: 1:11:23PM
Multiple Sample Report
Sequence: MDL2005BN2b
Sample: MDL 12
Tray Pos: 5
Method: Soil BN
Annotation ID
Type
Label
Retention Time
Absorbance
Time
Sample: MDL 4
Tray Pos: 3
Method: Soil BN
Annotation ID
Type
Label
Retention Time
Data
Graph
Compare
QC
Report
NUM
2/3/2005
1:11 PM
start
400 Gel Permeation ...
Document1 - Micros...
AccuChrome
Unit #1 - C:\Progra...
J2 #63
1:11 PM



ATTACHMENT 22.22

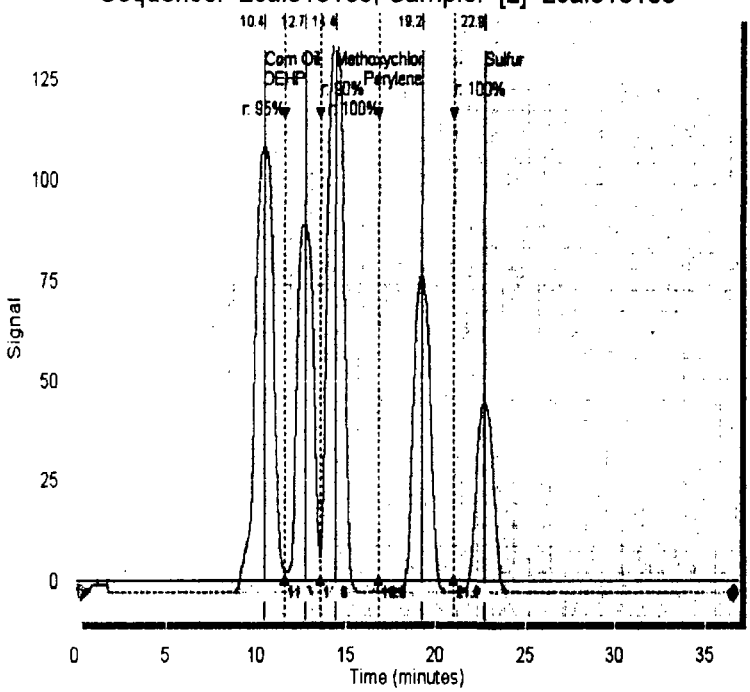
Attachment 22.22

Column Calibration Report

Sample ID: 2cal013105
Sequence: 2cal013105
Description: sample
Volume: 5000
Method: calibration
Position: 2
Outcome: Sample processed normally

Start Time: 14:50:03, 01/31/05
End Time: 15:27:20, 01/31/05
Column Name: Waters2
Description: Waters 02-092204
Serial #: 1051J, 2171J, 1681L
Pressure Limit: 350

Sequence: 2cal013105, Sample: [2] 2cal013105



2cal013105

Peak	Sample	Retention Time	Pk Ht	Base	Res.	Tol.	P/F
1	Corn Oil	10.5	107	-3.0			
2	DEHP	12.7	89	-3.0	94.6	85.0	P
3	Methoxychlor	14.4	134	-3.0	90.2	85.0	P
4	Perylene	19.2	76	-3.0	100.0	85.0	P
5	Sulfur	22.8	45	-3.0	100.0	90.0	P

Attachment 22.23

The lancer dishwasher has two programs that we use. Program 5 uses deionized water and program 4 uses tap water.

Functions	Possibility	Our Program
PREWASH 1 PERIOD	0-30 MINUTES	1 MINUTE
FILLING	HOT/COLD	HOT
PREWASH 1 TEMPERATURE	0-95°C	50°C
PREWASH 1 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 1 ADDITIVE 2 (ACID)	0-6 MINUTES	0
PREWASH 2 PERIOD	0-30 MINUTES	2 MINUTES
FILLING	HOT/COLD	HOT
PREWASH 2 TEMPERATURE	0-95°C	65°C
PREWASH 2 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 2 ADDITIVE 2	0-6 MINUTES	0
PREWASH 3 PERIOD	0-30 MINUTES	0
FILLING	HOT/COLD	0
PREWASH 3 TEMPERATURE	0-95°C	0
PREWASH 3 DETERGENT	0-6 MINUTES	0
PREWASH 3 ADDITIVE 2	0-6 MINUTES	0
WASH PERIOD	0-30 MINUTES	4 MINUTES
FILLING	HOT/COLD	HOT
WASH TEMPERATURE	0-95°C	80°C
WASH DETERGENT	0-6 MINUTES	1 MINUTE 6 SECONDS
WASH ADDITIVE 2	0-6 MINUTES	0
RUNNING WATER RINSE 1	0-9 MINUTES	2 MINUTES
ACID RINSE PERIOD	0-30 MINUTES	2 MINUTES
ACID	0-6 MINUTES	2 MINUTES
RUNNING WATER RINSE	0-9 MINUTES	7 MINUTES
COLD DEMI. WATER RINSE 1	0-30 MINUTES	0
COLD DEMI. WATER RINSE 2	0-30 MINUTES	0
COLD DEMI. WATER RINSE 3	0-30 MINUTES	0
COLD DEMI. WATER RINSE 4	0-3 MINUTES	0
HOT DEMI. WATER RINSE	0-30 MINUTES	2 MINUTES
HOT DEMI. TEMPERATURE	0-95°C	75°C
HOT DEMI. ADDITIVE	0-6 MINUTES	0
DRYING	0-90 MINUTES	25 MINUTES

ATTACHMENT 22.24

MSDS Number: **A0446** * * * * * *Effective Date:* ***05/20/04*** * * * * * *Supercedes:* ***02/12/04***

MSDS **Material Safety Data Sheet**

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC 613-996-6666

Outside U.S. and Canada
Chemtrec 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving [illegible] chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ACETONE

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5008, 5018, 5356, 5580, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9024, 9036, 9125, 9254, 9271, A134, V655
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazard
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.

Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.

Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.

Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.

Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.

Aggravation of Pre-existing Conditions:
Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:
Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion

of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless, volatile liquid.

Odor:

Fragrant, mint-like

Solubility:

Miscible in all proportions in water.

Specific Gravity:

0.79 @ 20C/4C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

56.5C (133F) @ 760 mm Hg

Melting Point:

-95C (-139F)

Vapor Density (Air=1):

2.0

Vapor Pressure (mm Hg):

400 @ 39.5C (104F)

Evaporation Rate (BuAc=1):

ca. 7.7

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the

air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 188L

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 188L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

ATTACHMENT 22.24

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.
Label Precautions:
Keep away from heat, sparks and flame.

Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

ATTACHMENT 22.25

MSDS Number: **M2015** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/12/01***

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300
National Response in Canada
CANUTEC 613-996-6666
Outside U.S. and Canada
Chemtrec 703-527-3887
NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

All non-emergency questions should be directed to Customer Service [illegible] for assistance

METHYL ALCOHOL

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5217, 5370, 5595, 5794, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9822, 9830, V654
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazard
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.

Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.

Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.

Eye Contact:
Irritant. Continued exposure may cause eye lesions.

Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may

cause skin irritation.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 6.0; uel: 36
Flammable Liquid and Vapor!
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.
Fire Extinguishing Media:
Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant

ignition source and flash back.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):

200 ppm (TWA), 250 ppm (STEL) skin

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties.

Skin Protection:

Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:

Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

). Physical and Chemical Properties

Appearance:

Clear, colorless liquid.

Odor:

Characteristic odor.

Solubility:

Miscible in water.

Specific Gravity:

0.8

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

64.5C (147F)

Melting Point:

-98C (-144F)

Vapor Density (Air=1):

1.1

Vapor Pressure (mm Hg):

97 @ 20C (68F)

Evaporation Rate (BuAc=1):
5.9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Alcohol (67-56-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the

soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR.

CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

Label Precautions:

Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Keep container closed.
Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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Phone Number: (314) 654-1600 (U.S.A.)

Michigan Department of Environmental Quality

Laboratory Services Standard Operating Procedure Document

EFFECTIVE DATE: 06/2006 SOP# 401 REVISION # 1

PRESSURIZED FLUID EXTRACTION (ACCELERATED SOLVENT EXTRACTION)

Table of Contents

1.0 Applicable Analytical Methods 1
2.0 Matrix or Matrices 1
3.0 Method Detection Limits 2
4.0 Scope and Application 2
5.0 Method Summary 2
6.0 Definitions 3
7.0 Interferences 3
8.0 Safety 4
9.0 Equipment and Supplies 4
10.0 Reagents and Standards 6
11.0 Sample Collection, Preservation, Shipment, and Storage 9
12.0 Quality Control (QC) 9
13.0 Calibration and Standardization 10
14.0 Procedure 10
15.0 Calculations 16
16.0 Method Performance 16
17.0 Pollution Prevention 17
18.0 Data Assessment 17
19.0 Corrective Actions 18
20.0 Waste Management 19
21.0 References 19
22.0 Attachments 19
Signature Page 21

1.0 Applicable Analytical Methods

1.1 Pressurized Fluid Extraction (PFE), U.S. Environmental Protection Agency, Method 3545, SW846, Revision 0, December 1996.

1.2 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996

2.0 Matrix or Matrices

2.1 Soil.

2.2 Sediment.

2.3 Clay.

2.4 Sludge.

2.5 Waste solids.

3.0 Method Detection Limits

3.1 All method detection limits (MDL) shall be performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103 and Section 12.8 of SOP 401.

3.2 Sand is the matrix used for MDL determinations.

3.3 Eight replicates are prepared.

3.4 MDLs are performed annually.

3.5 Blanks are prepared with surrogates in sand.

4.0 Scope and Application

4.1 Method 3545 is used in the extraction of semivolatile organic compounds, organochlorine pesticides, and PCBs from soils, clays, sediments, sludges, and waste solids.

4.2 Elevated temperature (100°C) and pressure (1500 – 2000 psi) are utilized to achieve analyte recovery.

4.3 See DEQ Laboratory SOP 500 for the base neutral acid compound list.

4.4 See DEQ Laboratory SOP 502 for the pesticide, chlorinated hydrocarbon, and PCB compound lists.

4.5 This method is applicable to solid samples only and is most effective on dry samples with small particle sizes.

4.6 Samples containing large amounts of oil should be extracted using another technique as they clog tubing in the extractor.

5.0 Method Summary

5.1 Standing water is poured off all samples (with the exception of sludge samples). Samples are then stirred to homogenize.

5.2 Samples are weighed, mixed with diatomaceous earth, transferred to an extraction cell, and spiked with surrogates.

5.3 The accelerated solvent extractor by Dionex (ASE200) program is run and extracted with solvents.

5.4 Extracts are dried with sodium sulfate and concentrated.

5.5 Extracts are cleaned up using gel permeation chromatography (GPC). See internal SOP 400.

5.6 A silica gel chromatography cleanup can be performed for pesticide and PCB analysis if needed. See internal SOP 402.

6.0 Definitions

6.1 Surrogate analyte (SA) - A pure analyte which is extremely unlikely to be found in any sample and which is added to a sample aliquot in known amounts before extraction or other processing and is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

6.2 Method preparation blank (MPB) - An aliquot of a blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.3 Laboratory control sample (LCS) - An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction and analysis.

6.4 Matrix spike (MS) - An aliquot of a sample to which known quantities of the method analytes are added in the laboratory. The MS is treated exactly as a sample including extraction and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.5 Matrix spike duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

7.0 *Interferences*

7.1 All glassware and hardware must be thoroughly cleaned to remove sample artifacts and/or interferences.

7.2 All solvent lots should be tested to ensure the absence of contaminants.

7.3 Interferences co-extracted from samples can often be removed by cleanup techniques. See internal SOPs 400 and 402.

7.4 The use of plastic must be avoided to prevent phthalate ester contamination.

7.5 Soap residue must be rinsed from all glassware and hardware to avoid degradation of several pesticide compounds.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (SOP 100).

8.4 Gas tanks must be secured to a wall or counter top.

8.5 Extraction cells in the ASE200 oven are hot. Allow cells to cool before handling.

8.6 During the gas purge step, some solvent vapors may exit through the vent port in the instrument. This vent port needs to have the vapor recaptured.

8.7 Protective gloves must be worn when handling samples and solvents.

8.8 Methylene chloride, methanol, phosphoric acid, diatomaceous earth, sodium sulfate, and acetone material safety data sheets (MSDSs) are attached.

9.0 Equipment and Supplies

9.1 Dionex ASE200.

9.2 Extraction cells – 22 mL and 33 mL with collars and frits made of stainless steel and capable of withstanding pressures of 2000 plus psi. See attachment 22.9.

9.3 Dionex solvent controller.

9.4 Computer - Auto ASE software.

9.5 FEP teflon filling funnel - 450mL (Big Science, Inc., part #P00007 or equivalent).

9.6 Turbovap tubes – Caliper, 250 mL.

9.7 Turbovap concentration workstation – Temperature control up to 95°C, pressure from 0 to 20 psi, and sensors set at 0.5 mL.

9.8 Culture tubes – 16 x 100 mm, straight top, VWR part #60825-618.

9.8.1 For use on GPCs - Fill each tube with 2 mL of hexane from a calibrated bottletop dispenser. (See 9.21)

9.8.2 Mark the meniscus on each tube insert.

9.8.3 Discard the hexane. Turn the tube upside down in a rack to dry.

9.8.4 For use on J2 Scientific GPCs – Fill previously marked tube (Section 9.8.1) with 10 mL hexane.

9.8.5 Mark a second meniscus on each tube.

9.8.6 Discard the hexane. Turn the tube upside down in a rack to dry.

9.9 Filter – cellulose, 19.1 mm, Type D28 (Dionex), or equivalent, part #049458.

9.10 Foil.

9.11 Beakers – glass: 150 mL or 250 mL.

9.12 Spatulas – metal or ceramic.

9.13 Crimp cap vials – 2 mL.

9.14 Pasteur pipettes – disposable.

9.15 Glass wool. Corning 3950, 8 micron fiberglass.

9.16 Vials - glass screw cap, 60 mL with teflon septum.

9.17 Oven – capable of maintaining at least 130°C.

9.18 Analytical balance – capable of weighing to 0.01 g.

9.19 Syringes – various sizes.

9.20 Bottles - amber screw cap, 250 mL with teflon lined caps.

9.21 Bottletop solvent dispensers – adjustable.

9.21.1 Calibrate to desired volume by filling appropriate volumetric flasks and adjusting dispenser.

9.22 Volumetric flasks – class A, various sizes.

9.23 Cap – plug tite caps, large; Elkay Products, Inc.; part #127-0019-200.

9.24 Soxtec – System HT2, 1045 extraction unit.

9.25 Snap Cap - Caliper "star" cut snap cap, part #ZB7216.

9.26 Screw cap vials – 13 x 100 mm, Corning, part #99449-13 or equivalent.

9.26.1 Fill each tube with 5.0 mL of hexane from a calibrated bottletop dispenser - adjustable. (See 9.21)

9.26.2 Mark the meniscus on each tube.

9.26.3 Discard the hexane. Turn the tube upside down in a rack to dry.

Note: Occasionally 16 x 100 vials are premarked at 10 mL by the same method.

9.27 Screw caps – Corning, part #99999-13 (VWR part #60827-110) or equivalent.

9.28 ASE cell funnels - Dionex #46958.

9.29 Muffle furnace – capable of maintaining 450° C.

9.30 Branson model #1210 ultrasonic cleaner or equivalent.

9.31 Pipets – Class A, various sizes.

9.32 Lancer Laboratory Glassware Washer – Model 1600up or equivalent.

9.33 Refrigerator capable of maintaining 1-6°C. See SOP 127.

9.34 Freezer capable of maintaining ≤-10°C. See SOP 127.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with the date received, the date opened, the expiration date, the tracking number, and the receiver's initials.

10.3 All prepared reagents and standards must be labeled with the date prepared, the expiration date, the preparer's initials, the tracking number, the diluent, and the description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard.

10.6 Sodium sulfate (ACS) – granular, anhydrous; store in glass containers at 130°C for a minimum of 12 hours prior to use.

10.7 Solvents – pesticide residue analysis grade, n-hexane, acetone, methylene chloride, and methanol.

10.8 Technical grade acetone (for glassware washing)

10.9 Nitrogen – technical grade or better for Turbovap concentration workstation.

10.10 Nitrogen – Grade 5, 99.999% ultra high purity for ASE.

10.11 Diatomaceous earth (powder for semi-volatiles) – JT Baker #1939-01 or equivalent.

10.12 Hydromatrix (pelletized diatomaceous earth for pesticides/PCBs) – Varian

part #198004.

10.13 Sand – free of interferences. Muffled at 450°C overnight. Stored at 105°C or higher until used.

10.14 Surrogate solutions

10.14.1 Base neutral (BN) surrogate – (for semi-volatile analysis)Absolute Standards #24016 or equivalent, 5000 ug/mL in methylene chloride.
2-Fluorobiphenyl
Nitrobenzene-d5
p-Terphenyl-d14

10.14.2 Acid surrogate - Absolute Standards #24015 or equivalent, 10,000 ug/mL in methanol.
2-Fluorophenol
Phenol-d6
2,4,6-Tribromophenol

10.14.3 Semi-volatile surrogate solution (BN = 50 ppm, A = 100 ppm)

10.14.3.1 Partially fill a 500 mL volumetric flask with methanol.
10.14.3.2 Pipette 5 mL of BN surrogate (Section 10.14.1) into the flask.
10.14.3.3 Pipette 5 mL of acid surrogate (Section 10.14.2) into the flask.
10.14.3.4 Dilute the flask to the mark with methanol. Mix.
10.14.3.5 Transfer to amber screw cap bottles. Label.
10.14.3.6 Store solution in a freezer. Replace every six months or sooner as needed.

10.14.4 Pesticide/PCB surrogate solution (1 mg/L)

10.14.4.1 Absolute Standards #20023 or equivalent, 200 ppm in acetone.
Decachlorobiphenyl
2,4,5,6-Tetrachloro-m-xylene.
10.14.4.2 Partially fill a 200 mL volumetric flask with methanol.
10.14.4.3 Inject 1000 uL of stock surrogate solution (Section 10.14.4.1) directly into the methanol in the flask.
10.14.4.4 Dilute the flask to the mark with methanol. Mix.
10.14.4.5 Transfer to amber screw cap bottles. Label.
10.14.4.6 Store solution in a freezer. Replace every six months or sooner as needed.

10.15 Spike Solutions

10.15.1 Semi-volatile spike solution (BN = 50 ug/mL, A = 100 ug/mL)

10.15.1.1 Semi-volatiles are spiked with the full list using a spike prepared commercially. Absolute part #94206 or equivalent in methanol. See attachment 22.19.

10.15.2 Pesticide spike solution

10.15.2.1 Accustandard #S-7179 or equivalent, 1000 mg/L in methanol.

Aldrin	Endosulfan I
a-BHC	Endosulfan II
b-BHC	Endosulfan sulfate
d-BHC	Endrin
g-BHC (lindane)	Endrin aldehyde
BP-6 (PBB)	Endrine ketone
a-Chlordane	Heptachlor
g-Chlordane	Heptachlor epoxide
4,4'-DDD	Hexabromobenzene
4,4'-DDE	Methoxychlor
4,4'-DDT	Mirex
Dieldrin	

10.15.2.2 Pesticide spike solution, 1000 ug/L

10.15.2.2.1 Partially fill a 200 mL volumetric flask with methanol.
10.15.2.2.2 Inject 200 uL of stock pesticide (Section 10.15.2.1) directly into the methanol in the flask.
10.15.2.2.3 Dilute to the mark with methanol. Mix.
10.15.2.2.4 Transfer to 250 mL amber screw cap bottles. Label.
10.15.2.2.5 Store in a freezer. Replace every six months or sooner as needed.
10.15.2.2.6 Transfer the remainder of the contents of the stock pesticide ampule (Section 10.15.2.1) to a crimp cap vial. Label. Store in a freezer.

10.15.3 PCB spike solution (Aroclors 1016 and 1260)

10.15.3.1 PCB mix – Absolute Standards #20064, 1000 ppm in hexane or equivalent Aroclor 1016/1260 mix.
10.15.3.2 PCB spike solution (Aroclor 1016, 5 ppm and Aroclor 1260, 5 ppm)

10.15.3.2.1 Partially fill a 100 mL volumetric flask with methanol.
10.15.3.2.2 Inject 500 µL of Aroclor 1016/1260 mix (Section 10.15.3.1) directly into the methanol in the flask.
10.15.3.2.3 Dilute the flask to the mark with methanol. Mix.
10.15.3.2.4 Transfer to amber screw cap bottles. Label.
10.15.3.2.5 Store solution in a freezer. Replace every six months or sooner as needed.

10.16 Phosphoric acid (H_3PO_4) – Baker #0260-3 or equivalent.

10.17 DI water – Organic free.

10.18 Semi-volatile extraction solvent

10.18.1 Mix 600 mL of acetone (Section 10.7) with 400 mL of methylene chloride (Section 10.7).
10.18.2 Add 20 mL of DI H_2O (Section 10.17).
10.18.3 Add 4 mL of phosphoric acid (Section 10.16). Mix. Place in bottle "C" on the ASE.

10.19 Helium – high purity for sparging GPC mobile phase.

10.20 Lancer Acid for Glasswasher (LCA 30 GL or equivalent) Raush and Associates

10.21 Lancer Clean for Glasswasher (LCD 30 GL or equivalent) Raush and Associates

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 An 8-ounce, wide mouth, glass jar sealed with aluminum-foil lined screw caps is the recommended sample container to be used.

11.2 Samples should be stored in ice until the Laboratory receives them. They are then refrigerated at 4°C until extraction.

11.3 The U.S. Environmental Protection Agency maximum holding time is 14 days from sample collection to extraction.

11.4 Sample extracts should be stored in a freezer and must be analyzed within 40 days of extraction.

12.0 Quality Control (QC)

12.1 Temperature is monitored daily. See attachment 22.16. See SOP 127 for corrective action.

12.1.1 Room temperature for Room 302.
12.1.2 Freezers Room 302 and 302B.
12.1.3 Refrigerator Room 302.
12.1.4 Oven Room 302 and 302A.

12.2 Balances are calibrated at least once per year by an outside source.

12.2.1 Balance calibrations are checked weekly and recorded in the balance check logbook. See attachment 22.18; see SOP 128 for corrective action.
12.2.2 Calibration weights are certified by an outside source. See SOP 128.

12.3 Sample batches consist of a maximum of 20 samples, one method preparation blank, one MS, one MSD, and one LCS. On rare occasions, if no suitable matrix is available, an LCSD may be added.

12.4 MSs and MSDs are actual samples that are selected at random from within the batch of 20. They may also be client designated.

12.5 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction and cleanup of individual samples.

12.6 The MSs, MSDs, and LCSs are spiked at a known concentration with the analyte compounds. The replicate matrix spikes are used to evaluate the entire batch for precision and accuracy.

12.7 Initial demonstration of capability (IDOC) – Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for target analytes.

12.7.1 Assemble five extraction cells as in Section 14.1.1 using the 22 mL cells for pesticides/PCBs or the 33 mL cells for semi-volatiles.

12.7.2 Prepare samples as in 14.1.3.1-7, using 10 g of sand for pesticide/PCBs and 25 g of sand for semi-volatiles.

12.7.3 Spike all 5 cells with 1 mL of semi-volatile surrogate (Section 10.14.3) or 1 mL of pesticide/PCB surrogate (Section 10.14.4) depending on the target compounds.

12.7.4 Spike 4 cells with 1 mL of semi-volatile spike (Section 10.15.1), 1 mL of pesticide spike (Section 10.15.2.2), or 1 mL of PCB spike (Section 10.15.3.2) depending on the target compounds. Label the un-spiked cell "MPB."

12.7.5 Place enough diatomaceous earth (Section 10.11 or 10.12) in each of the five cells to fill. Screw an end cap onto each cell.

12.7.6 Proceed with Sections 14.1.6 through 14.1.8.

12.7.7 Follow all cleanup procedures used for routine samples.

12.7.8 Analyze and calculate recoveries by the same procedures used to analyze samples (SOPs 500 or 502).

12.8 MDLs

12.8.1 Prepare MDLs at levels specified by the analyst and with spike solutions they provide.

12.8.2 Assemble twelve extraction cells as in Section 14.1.1, using the 22 mL cells for pesticides/PCBs and the 33 mL cells for semi-volatiles.

12.8.3 Prepare samples as in 14.1.3, using 10 g of sand for pesticide/PCBs and 25 g of sand for semi-volatiles.

12.8.4 Spike all twelve cells with 1 mL of semi-volatile surrogate (Section 10.14.3) or 1 mL of pesticide/PCB surrogate (Section 10.14.4) depending on the target compounds.

12.8.5 Spike eight cells with 1 mL of spike provided by the analyst. Label the un-spiked cells "MPB."

12.8.6 Place enough diatomaceous earth (Section 10.11or 10.12) in each of the twelve cells to fill. Screw an end cap onto each cell.

12.8.7 Proceed with Sections 14.1.6 through 14.1.8, using both ASE instruments and splitting samples evenly between GPCs.

12.8.8 Follow all cleanup procedures used for routine samples, splitting samples evenly between GPCs.

12.8.9 Analyze and calculate recoveries by the same procedures used to analyze samples (SOPs 500 or 502).

13.0 Calibration and Standardization

13.1 This section is not applicable to this method.

14.0 Procedure

14.1 ASE200

14.1.1 Assembly of ASE200 extraction cells

14.1.1.1 Stainless steel frits are placed into the recessed area of the end cap and secured into place by the PEEK seal and cap insert. The entire assembly is locked into place by a snap ring (See Attachment 22.9).

14.1.1.2 One end cap is screwed onto the bottom of the cell body (see Attachment 22.9). Push a filter (Section 9.9) through the cell body to rest on the frit (see Attachment 22.10). Use the 22 mL cells for pesticide/PCB analysis and the 33 mL cells for semi-volatile analysis. A small amount of diatomaceous earth (section 10.11 or 10.12) is added to cell before the sample.

14.1.2 Two hot rinses are used to clean the ASE200 lines at the end of a run. The MPB extraction cell is run as a sample utilizing the hot rinse program (Section 16.1.3). This is the only way to run hot solvent through the lines where possible contamination of polymers may have occurred.

14.1.3 Sample preparation

14.1.3.1 Allow the sample to warm to room temperature.

14.1.3.2 Decant and discard any water layer on top of the sample, unless designated a sludge.

14.1.3.3 Stir the sample with a spatula. Weigh 10.0 g for pesticide/PCB extraction or 25.0 g for semi-volatile extraction into a 150 or 250 mL beaker.

NOTE: *The sample may be weighed at this time for total solids determination (Section 14.1.5).*

14.1.3.4 Record the sample weight in the ASE runlog to 0.01g. Label the beaker.

14.1.3.5 Mix the sample with approximately 1 g of diatomaceous earth (Section 10.11 or 10.12). Allow time for the sample to dry. The sample should be stirred occasionally or it may harden.

14.1.3.6 Transfer the sample to an extraction cell. Use the large (33 mL) size for the semi-volatiles or the small (22 mL) size for pesticides/PCBs.

14.1.3.7 If the consistency of the matrix is such that it will not fit into the prescribed cell, the weight may be halved or the pesticide/PCB samples may use the larger cells. Document.

14.1.3.8 Add surrogate compounds. Add 1 mL of semi-volatile surrogate (Section 10.14.3) or 1 mL of pesticide/PCB surrogate (Section 10.14.4) depending upon the extraction type.

14.1.3.9 Fill the empty space that remains with diatomaceous earth (Section 10.11 or 10.12). Tap the cell to settle, but do not pack it tightly. Screw an end cap on the extraction cell.

14.1.4 Quality assurance/quality control (QA/QC) sample preparation.

14.1.4.1 MPB

14.1.4.1.1 Prepare one MPB by weighing 10 or 25 g of sand (depending on the extraction type) into a 150 or 250 mL beaker.

14.1.4.1.2 Record the sample weight in the ASE run log to 0.01 g. Label the beaker.

14.1.4.1.3 Mix the sample with approximately 1 g of diatomaceous earth (Section 10.11 or 10.12).

14.1.4.1.4 Transfer to an extraction cell (33 mL or 22 mL depending on the extraction type).

14.1.4.1.5 Add 1 mL of semi-volatile surrogate (Section 10.14.3) or 1 mL of pesticide/PCB surrogate (Section 10.14.4) depending on the target compounds.

14.1.4.1.6 Fill the empty space that remains with diatomaceous earth (Section 10.11 or 10.12).

14.1.4.1.7 Screw end cap on extraction cell. Label.

14.1.4.2 LCS - Prepare one LCS by following 14.1.4.1.1 through 14.1.4.1.5.

14.1.4.2.1 Add 1 mL of semi-volatile spike (Section 10.15.1), 1 mL of pesticide spike (Section 10.15.2.2), or 1 mL of PCB spike (Section 10.15.3.2) depending on the target compounds.

14.1.4.2.2 Fill the empty space that remains with diatomaceous earth (Section 10.11 or 10.12). Screw an end cap on the extraction cell.

14.1.4.2.3 Screw end cap on extraction cell. Label.

14.1.4.3 MS/MSD/matrix sample

14.1.4.3.1 Prepare three replicates of a sample in the batch by weighing 40 g (pesticide/PCB) or 80 g (semi-volatile) sample into a 250 mL beaker depending upon the target analytes. This is to obtain homogenous samples.

14.1.4.3.2 Stir the sample with a spatula. Weigh three aliquots of 10.0 g for pesticide/PCB extraction or 25.0 g for semi-volatile extraction into three separate 150 or 250 mL beakers.

14.1.4.3.3 Follow Sections 14.1.3.4 through 14.1.3.8.

14.1.4.3.4 Add 1 mL of semi-volatile spike (Section10.15.1), 1 mL of pesticide spike (Section 10.15.2.2), or 1 mL of PCB spike (Section 10.15.3.2) depending on the target compounds to two of the extraction cells (for MS/MSD only).

14.1.4.3.5 The third sample receives the surrogate only. (QC matrix sample)

14.1.4.3.6 Fill the empty space that remains with diatomaceous earth (Section 10.11 or 10.12).

14.1.4.3.7 Screw end caps on all extraction cells.

14.1.5 Percent total solids (% TS) determination (usually done by the Inorganic Unit).

14.1.5.1 Weigh an aluminum pan. Record this weight in the % total solids (% TS) logbook (see Attachment 22.7). Tare the pan.

14.1.5.2 Weigh a 10 g portion of sample into the tarred aluminum pan. Record the sample weight in the % TS logbook.

14.1.5.3 Dry in a 105°C oven overnight. Remove. Place in a desiccator. Cool to room temperature.

14.1.5.4 Weigh the sample and aluminum pan. Record this weight in the logbook.

14.1.5.5 Refer to Section 15.1 for calculations.

14.1.6 Program ASE200

14.1.6.1 With the use of autoase software and a solvent controller, the soft keypad on the ASE200 will reflect that it is on remote. The programs in Section 16.1 are the methods used.

14.1.6.2 Open the nitrogen tank valve. The pressure should be 150 pounds per square inch.

14.1.6.3 Press the "on" button on the ASE200. Wait until item 1 on the menu screen reads "Load Method/Schedule."

14.1.6.4 Turn the computer on.

14.1.6.5 Double click on the "autoase" icon.

14.1.6.6 The ASE200 screen should indicate that it is idle.

14.1.6.7 There will be two blue bars on the computer screen, one for instrument #17 (system 1) and one for instrument #61 (system 2), both should read "idle."

14.1.6.8 Load the extraction cells onto the top rack of the ASE to be used.

14.1.6.9 Place 60 mL glass screw cap collection vials (Section 9.16) on the bottom rack.

14.1.6.10 Remove the extraction cell labels and attach them to the corresponding vial in the bottom carousel.

***NOTE**: Do not leave any labels on the extraction cells. Place the labels on the vials facing in toward the carousel or a sensor will give an error reading.*

14.1.6.11 Fill all solvent bottles needed for the extraction.

14.1.6.12 Empty rinse vials (four) on the bottom of the carousel and one vial inside the ASE200. Empty two vials for hot rinses.

14.1.6.13 Schedule set up on computer.

14.1.6.13.1 Click on the blue bar for the ASE system you want to program.

14.1.6.13.2 Click "Edit".

14.1.6.13.3 Click "Schedule File".

14.1.6.13.4 Click "Open".

14.1.6.13.5 Click on an existing batch of the same type to be extracted.

14.1.6.13.6 Click "OK". Click "Save As". Changes can now be made.

14.1.6.13.7 Type in the new batch number and test code at the "Schedule Name" prompt. Click "OK".

***NOTE:** Vial numbers are not changeable and refer to the collection vials on the bottom carousel. Cell numbers are assignable and refer to the extraction cells on the top carousel. Extraction cells can be assigned to any vial and to more than one vial. Only cells that have been assigned a method will run. Extra cell numbers do not need to be deleted.*

14.1.6.13.8 Method name

14.1.6.13.8.1 Method name should be correct.
14.1.6.13.8.2 If need to change, double click on the method cell to display the dialog box.
14.1.6.13.8.3 Select the desired file. Click "OK".

14.1.6.13.9 Extraction line rinse – Click the "on" or "on D" button to rinse after the extraction.

14.1.6.13.9.1 Pesticide/PCB rinse – "on" for rinses with "A" - MeCl.
14.1.6.13.9.2 semi-volatile rinse – "on D" for rinses with D (Section 16.1) 50/50 acetone/MeCl.

14.1.6.13.10 Sample ID - Enter the sample identification for the vial number in the schedule. This can be alphabetical or numeric up to 32 characters.
14.1.6.13.11 The last two samples should be cell #1 and the last two vials. The "hot rinse" method (see Section 16) should be utilized.
14.1.6.13.12 Click "Save As". The batch number should be visible in the file name bar.
14.1.6.13.13 Click "OK". Click "Print" to print the schedule.
14.1.6.13.14 Click "Exit". The screen should return to "idle."

14.1.6.14 Load schedule

14.1.6.14.1 Click "File."
14.1.6.14.2 Click "Load Schedule." Scroll down the list of file names to the desired batch number. Click on that batch number. (It should now appear in the single line file name.)
14.1.6.14.3 The starting vial should read "1" for the starting extraction. Click "OK". The idle screen should now have the chosen batch number in the schedule line. The sample method should be in the method l ine.
14.1.6.14.4 Push the start icon (extraction cell with a down arrow).

14.1.6.15 Shutdown (After all samples have been run)

14.1.6.15.1 Exit out of the auto ASE software.
14.1.6.15.2 Turn the computer off.
14.1.6.15.3 Turn the ASE unit off.
14.1.6.15.4 Turn the nitrogen tank off.

14.1.7 Water removal from extracts

14.1.7.1 Pack a small plug of glass wool into a funnel (Section 9.5).

14.1.7.2 Add approximately two inches of cooled sodium sulfate (Section 10.6) to each funnel. Rinse them with methylene chloride until solvent runs through. Discard the rinse solvent.

14.1.7.3 Place enough sodium sulfate in the collection vial to absorb all water.

14.1.7.4 Place a 250 mL Turbovap tube under a funnel. Pour the extract onto the funnel to filter and dry the sample.

14.1.7.4.1 Rinse the collection vial with approximately 20 mL of methylene chloride. Add this to the funnel.

14.1.7.4.2 Repeat this rinse two more times collecting all rinses in the 250 mL Turbovap tube.

14.1.8 Extract concentration

14.1.8.1 Place the 250 mL Turbovap tube on the Turbovap unit at a temperature of 35°C and a pressure of 15 psi.

14.1.8.2 Evaporate the samples down to 0.5 mL. Transfer extracts for semi-volatile analysis into 10 mL pre-marked culture tubes (Section 9.8) with pasteur pipettes. Transfer extracts for pesticides and/or PCB analysis into 5.0 mL premarked vials (Section 9.26) with pasteur pipettes.

14.1.8.3 Rinse the Turbovap tube with methylene chloride. Transfer to the culture tube or vial.

14.1.8.4 Dilute the tube to the 10 mL pre-marked line and the vial to the 5 mL premarked line with methylene chloride.

14.1.8.4.1 For semi-volatile analysis utilizing the Caliper GPCs, place foil on top of the tube and cap (Section 9.25) if going immediately onto the GPC or a cap (Section 9.23) if storing in the refrigerator.

14.1.8.4.2 For semi-volatile analysis utilizing the J2 Scientific GPCs, bring the volume to 10 mL with MeCl and either cap (Section 9.23) or filter as in SOP 400.

14.1.8.4.3 For pesticide and/or PCB analysis, transfer 2 mL of extract into a culture tube (Section 9.8) if going directly onto a GPC. Place foil on top of tube and cap (Section 9.25) if using Caliper GPCs. See Section 14.1.8.4.4 for J2 Scientific GPCs. Cap the remainder (Section 9.27). Store in refrigerator.

14.1.8.4.4 For pesticide and/or PCB analysis utilizing the J2 Scientific GPCs, bring the volume to 10 mL with MeCL and either cap (Section 9.23) or filter as in SOP 400.

14.1.8.5 Samples are now ready for cleanup methods.

NOTE: *If a sample will not concentrate to approximately 1.0 mL, transfer to a premarked 5 or 10 mL vial (Section 9.26)or volumetric flask (section 9.22) and dilute with methylene chloride. Document well.*

14.2 Glassware cleaning.

14.2.1 Hand washing

14.2.1.1 Rinse beakers and spatulas with warm tap water.
14.2.1.2 Disassemble cells and rinse with warm tap water and MeCl, if discolored.
14.2.1.3 Rinse Turbovap tubes with MeCl, if discolored.
14.2.1.4 Beakers, spatulas, cell bodies and caps, and dirty Turbovap tubes need to be washed with hot, soapy water (Liqui-Nox soap).
14.2.1.5 Rinse with hot tap water.
14.2.1.6 Place in dishwasher.

14.2.2 Dishwasher

14.2.2.1 Place solvent rinsed Turbovap tubes, hand washed glassware or cell in dishwasher.
14.2.2.2 Run as in attachment 22.14.

14.2.3 Cell frit and snap ring cleaning

14.2.3.1 Place frits and snap rings into separate beakers. Cover with tap water and run in ultrasonic cleaner for at least 10 minutes.
14.2.3.2 Pour off water and rinse with acetone. Pour off acetone and repeat this procedure two more times. Cover with acetone and sonicate for at least 10 minutes.
14.2.3.3 Pour off acetone and rinse with MeCl. Pour off MeCl and repeat procedure two more times. Cover with fresh MeCl and run in the ultrasonic cleaner for at least 10 minutes.
14.2.3.4 Rinse with fresh MeCl. Discard MeCl.
14.2.3.5 Collars are ready to dry in oven.
14.2.3.6 Transfer frits to soxtech beaker and cover with MeCl.
14.2.3.7 Turn on soxtech unit and water. Run for at least 30 minutes.
14.2.3.8 Turn off soxtech unit and pour off MeCl.
14.2.3.9 Transfer frits to another beaker. Rinse with MeCl. Drain and place in oven to dry.

14.2.4 Rinse all glassware with MeCl before using.

15.0 Calculations

15.1 % TS

$$\%\ TS = \frac{[\text{weight of dry sample and pan (Section14.1.5.4)} - \text{weight of pan (Section 14.1.5.1)} \times 100}{\text{weight of wet sample (Section14.1.5.2)}}$$

16.0 Method Performance

16.1 ASE200 conditions

16.1.1 Pesticide_PCB1(or2).met

Method Editor

Preheat	0 minutes	Pressure	2000 psi
Heat	5.0 minutes	Temperature	100°C
Static	5.0 minutes	Sol. A	50%
Flush %	50 volume	Sol. B	50%
Purge	60 seconds	Sol. C	--
Cycles	1	Sol. D	--

where: Sol. A = methylene chloride.
Sol. B = acetone.
Sol. C = semi-volatile extraction solvent (Section 10.18).
Sol. D = 50/50 acetone/H_2O.

16.1.2 Sediment BNA (or BNA2).met

Method Editor

Preheat	0 minutes	Pressure	2000 psi
Heat	5.0 minutes	Temperature	100°C
Static	5.0 minutes	Sol. A	0
Flush %	50 volume	Sol. B	0
Purge	60 seconds	Sol. C	100
Cycles	1	Sol. D	0

where: Sol. A = methylene chloride.
Sol. B = acetone.
Sol. C = semi-volatile extraction solvent (Section 10.18).
Sol. D = 50/50 acetone/H_2O.

16.1.3 Hot rinse method.

Method Editor

Preheat	0 minutes	Pressure	2000 psi
Heat	7.0 minutes	Temperature	150°C
Static	5.0 minutes	Sol. A	0
Flush %	60 volume	Sol. B	0
Purge	60 seconds	Sol. C	0
Cycles	1	Sol. D	100

where: Sol. A = methylene chloride.
Sol. B = acetone.
Sol. C = semi-volatile extraction solvent (Section 10.18).
Sol. D = 50/50 acetone/H_2O.

16.2 Nitrogen (ultra high purity) at 150 pounds per square inch.

17.0 Pollution Prevention

17.1 This method uses smaller quantities of organic solvents, and the waste that is produced is collected for disposal as chlorinated waste.

17.2 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Samples must be extracted within 14 days of collection. If samples are extracted past the holding time, it must be noted in the logbook and on the Laboratory Information Management System (LIMS).

18.2 LIMS entry: Creating a batch.

18.2.1 Select the Labworks CITRIX or sharepoint icon on the desktop.
18.2.2 Enter your User ID and password. Select the ENV_PRD database. Click "OK".
18.2.3 Click "QA Batch".
18.2.4 Select "New Batches", then "Batch by Analysis".
18.2.5 Enter analysis in white box. Either E_SBA or E_PPS. Click "OK".
18.2.6 Click "OK" again. At this point, a list of possible samples for that analysis will appear. The samples included in this batch need to be marked with a red check. Uncheck those samples that are not in the batch.
18.2.7 Click "OK".
18.2.8 Make sure that the batch size matches or is greater than the number of samples. Click "OK".
18.2.9 Change the default batch name to match the extractions batch number by changing the last four numbers only. Example: from default number E_PPS-5111 to actual batch number E_PPS-4577.
18.2.10 Click on sample that is being used for QC. Change QA Group and QA Tests as needed.
18.2.11 Click "OK".
18.2.12 Click "Exit".

18.3 LIMS entry: Entering results.

18.3.1 Select the Labworks CITRIX or sharepoint icon on the desktop.
18.3.2 Enter your User ID and password. Select the ENV_PRD database. Click "OK".
18.3.3 Click "Results".
18.3.4 Results entry template should read "Extract". Select "QA/QC Batch".
18.3.5 Select appropriate analysis code. Either E_SBA or E_PPS. Click "OK".
18.3.6 Select appropriate batch. Click "OK" twice.
18.3.7 Enter CO under "Results" and check that the dates and initials are correct. Make any changes on the first sample; all following samples will be the same. Fill across. Add any qualifier codes to the "Qualify" line. Find the QC sample. Scroll down and enter surrogate and spike tracking numbers. Click "Save".
18.3.8 Click "Exit".

18.4 Back log reports

18.4.1 Log onto Labworks
18.4.2 Place pointer and click on backlog.
18.4.3 Click "Display Reports".
18.4.4 Type "o_se".
18.4.5 Click on the printer icon.
18.4.6 Click "Close". Click "Yes". Click "Close".

19.0 Corrective Actions

19.1 If surrogate recoveries fall outside the acceptance limits, has no obvious matrix interference, and the sample is within the 14-day hold time, re-extraction is performed if the sample volume is sufficient.

19.2 All data reported for samples extracted outside the hold time receives a hold time code.

19.3 Corrective Action Forms (attachment 22.17) are completed when problems/errors are discovered and corrected.

20.0 Waste Management

20.1 The ASE200 has seven waste vials which are emptied into a waste container marked "chlorinated waste".

20.2 See SOP 111 for more information.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, D.C., Appendix A & B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition, 1986, Final Update III, December 1996.

21.3 ASE200 Accelerated Solvent Extractor Operator's Manual, Dionex, Document No. 031149, Revision 03, March 1997.

21.4 Auto ASE Software User's Guide, Dionex, Document No. 031259, Revision 01, March 1997.

22.0 Attachments

22.1 Methylene chloride MSDS.

22.2 Acetone MSDS.

22.3 ASE extraction run logbook page.

22.4 Stock standard logbook page.

22.5 Semivolatile standard logbook page.

22.6 Methanol MSDS.

22.7 Total solids logbook page.

22.8 Hexane MSDS.

22.9 ASE extraction cell assembly.

22.10 Cellulose filter positioning diagram.

22.11 Phosphoric acid MSDS.

22.12 Sodium sulfate MSDS.

22.13 Diatomaceous earth MSDS.

22.14 Dishwasher program.

22.15 Hydromatrix Diatomaceous Earth MSDS.

22.16 Equipment Monitoring Record

22.17 Corrective Action Form

22.18 Weekly Balance Calibration Check

22.19 Semi-volatile spike.

Signature Page

APPROVED BY _____ DATE 6/15/06
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 6/15/06
COMPLIANCE OFFICER

APPROVED BY _____ DATE 6/15/06
QA OFFICER

APPROVED BY _____ DATE 5-25-06
UNIT MANAGER

APPROVED BY _____ DATE 5/25/06
SECOND SHIFT MANAGER

APPROVED BY _____ DATE _____
ANALYST

MSDS Number: **M4420** * * * * * *Effective Date:* ***10/06/05*** * * * * * *Supercedes:* ***05/14/03***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYLENE CHLORIDE

1. Product Identification

Synonyms: MC; Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride
CAS No.: 75-09-2
Molecular Weight: 84.93
Chemical Formula: CH2Cl2
Product Codes: 9235, 9264, 9266, 9295, 9315, 9324, 9329, 9330, 9348, 9350, 9965, Q480

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methylene Chloride	75-09-2	> 99%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes formation of carbon monoxide in blood which affects cardiovascular system and central nervous system. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. Exposure may make the symptoms of angina (chest pains) worse.
Ingestion:
May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.
Skin Contact:
Causes irritation, redness and pain. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Eye Contact:
Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.
Chronic Exposure:
Can cause headache, mental confusion, depression, liver effects, kidney effects, bronchitis, loss of appetite, nausea, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact. Methylene chloride may cause cancer in humans.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Autoignition temperature: 556C (1033F)
Flammable limits in air % by volume:
lel: 12; uel: 23
Forms flammable vapor-air mixtures above 100C (212F).
Explosion:
Concentrated can be ignited by a high intensity ignition source. Vapor may form flammable mixture in atmosphere that contains a high percentage of oxygen. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. This material may corrode plastic and rubber. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Odor Threshold: 205 - 307 ppm. The odor threshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Methylene Chloride (Dichloromethane):
- OSHA Permissible Exposure Limit (PEL) -
25 ppm (TWA), 125 ppm (STEL), 12.5 ppm (8-hour TWA - Action Level)
- ACGIH Threshold Limit Value (TLV) -
50 ppm (TWA), A3 - suspected human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. The cartridges recommended for this material have a predicted service of less than 30 minutes at concentrations of ten times (10x) the exposure limits. Actual service life will vary considerbly, depending on concentration levels, temperature, humidity, and work rate. This substance has poor warning properties.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material for personal protective equipment. Natural rubber and polyvinyl chloride ARE NOT recommended materials for personal protective equipment.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:
Do not use closed circuit rebreathing system employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. See OSHA Standard for medical surveillance, record keeping, and reporting requirements for methylene chloride (29 CFR 1910.1052).

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Chloroform-like odor.

Solubility:
1.32 gm/100 gm water @ 20C.

Specific Gravity:
1.318 @ 25C

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
39.8C (104F)

Melting Point:
-97C (-143F)

Vapor Density (Air=1):
2.9

Vapor Pressure (mm Hg):
350 @ 20C (68F)
Evaporation Rate (BuAc=1):
27.5

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers, strong caustics, plastics, rubber, nitric acid, water + heat, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs. Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Dichloromethane: Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 52 gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Dichloromethane has been linked to spontaneous abortions in humans.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methylene Chloride (75-09-2)	No	Yes	2B

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of greater than 30 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

International (Water, I.M.O.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

International (Air, I.C.A.O.)

Proper Shipping Name: RQ, DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 1000L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------

Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methylene Chloride (75-09-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methylene Chloride (75-09-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methylene Chloride (75-09-2)	1000	U080	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2Z
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Do not get in eyes, on skin, or on clothing.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 14.
Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **A0446** * * * * * *Effective Date:* ***05/20/04*** * * * * * *Supercedes:* ***02/12/04***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908 859 2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC 613 996 6666

Outside U.S. and Canada
Chemtrec 703-527-3887

NOTE

ACETONE

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5008, 5018, 5356, 5580, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9024, 9036, 9125, 9254, 9271, A134, V655
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.
Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.
Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.
Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Aggravation of Pre-existing Conditions:
Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:
Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.

Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.

Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, colorless, volatile liquid.

Odor:

Fragrant, mint-like

Solubility:

Miscible in all proportions in water.

Specific Gravity:

0.79 @ 20C/4C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

56.5C (133F) @ 760 mm Hg

Melting Point:

-95C (-139F)

Vapor Density (Air=1):

2.0

Vapor Pressure (mm Hg):

400 @ 39.5C (104F)

Evaporation Rate (BuAc=1):

ca. 7.7

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 188L

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 188L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\---------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

Label Precautions:

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Test Codes
Method: 3545
Date
Analyst
Batch #

MDEQ-Environmental Lab
ASE-Solids Extraction Logbook
Instrument # 17

Surrogate #
Spike #

ATTACHMENT 22.3

		Diatomaceous Earth #		NaSO4 #		Acetone #		Hexane #		NaCl #	
Vial	Cell	Sample ID #	Fraction #	Collection Date	Sample Weight (grams)	% Total Solids	Surrogate Volume (mL)	Spike Volume (mL)	Final Volume (mL)	Test Code	Comments
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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17											
18											
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20											
21											
22											
23											
24											

COMMENTS

Attachment 22.4

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									

Attachment 22 5

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											

*INCLUDE UNITS

MSDS Number: **M2015** * * * * * *Effective Date:* ***08/10/04*** * * * * * *Supercedes:* ***11/12/01***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service [1 800 582 2537] for assistance

METHYL ALCOHOL

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5217, 5370, 5595, 5794, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9822, 9830, V654
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS.

FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.
Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.
Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.
Eye Contact:
Irritant. Continued exposure may cause eye lesions.
Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may cause skin irritation.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 6.0; uel: 36
Flammable Liquid and Vapor!
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.
Fire Extinguishing Media:
Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Characteristic odor.

Solubility:
Miscible in water.

Specific Gravity:
0.8

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
64.5C (147F)

Melting Point:
-98C (-144F)

Vapor Density (Air=1):
1.1

Vapor Pressure (mm Hg):
97 @ 20C (68F)

Evaporation Rate (BuAc=1):
5.9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Alcohol (67-56-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

Label Precautions:

Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Keep container closed.
Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No Changes.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

SEDIMENT PREPARATION (%TOTAL SOLID & DRYING)

Oven Temperature
Initial Temp. (105 ± 5°C) _____
Final Temp. (105 ± 5°C) _____

Calibration Weights
Initial 20 g _____ Initial 50 g _____
Final 20 g _____ Final 50 g _____
Balance Centered Y N

Run # _____
Date _____
Analyst _____

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PC			#DIV/0!

MSDS Number: **H2381** * * * * * *Effective Date: **08/10/04*** * * * * * *Supercedes: **11/02/01***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

A non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANE

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9262, 9304, 9308, N168

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in

expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Light odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product

may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
Trace amount of Benzene (10 ppm) (071-43-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\---------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
Trace amount of Benzene (10 ppm)	10	U019	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

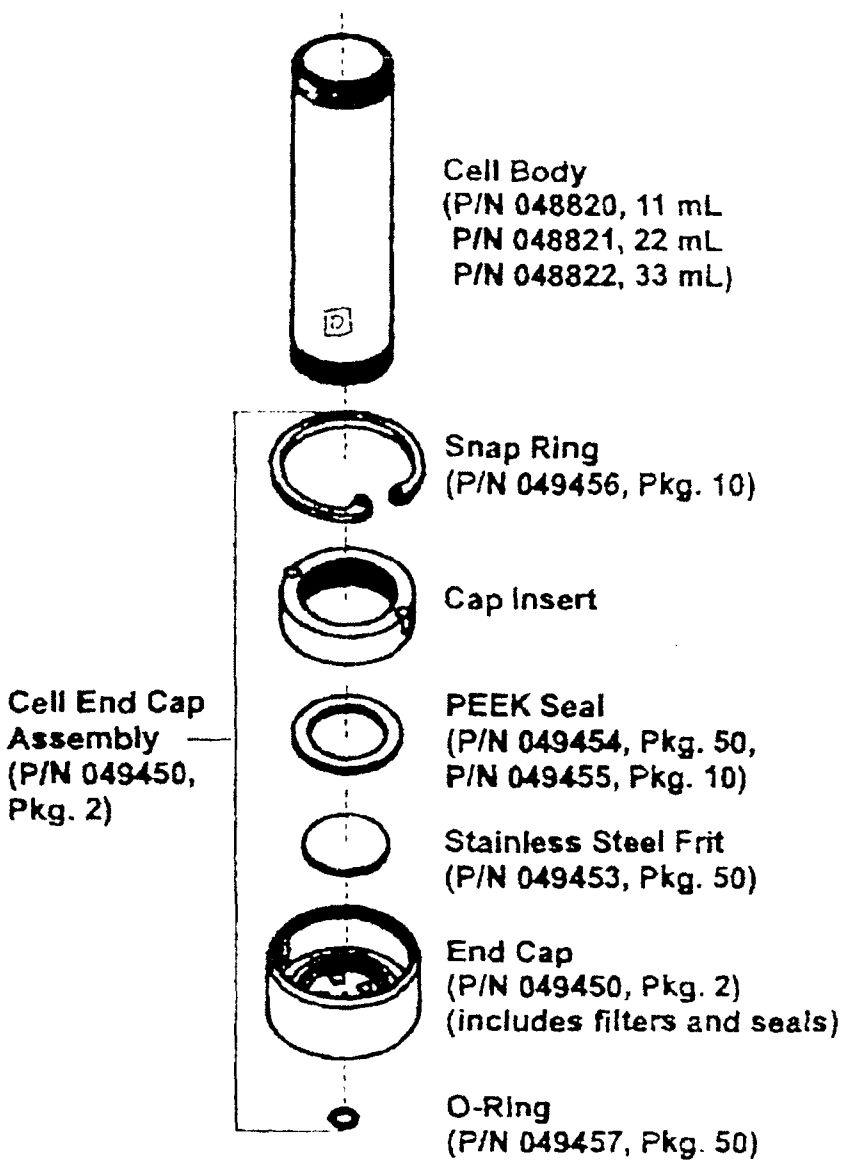

Figure 5-1. Cell Assembly

ıe stainless steel frit from the bottom of the end cap.
frit by sonicating in solvent, or replace it.

ATTACHMENT 22.10

To fill the cell:

1. Dionex recommends inserting a disposable cellulose filter (P/N 049458, box of 100) in the bottom of the cell before filling. The cellulose filter prevents blockage of the bottom cap's stainless steel frit.

IMPORTANT **Always hand-tighten the bottom cell cap onto the cell body before installing the cellulose filter. Do not place the filter in the bottom cap and then install the cap, because this creates an improper seal and causes leaks.**

To insert the filter, unscrew the top cap from the cell body. Push the filter into the cell bottom with the tool (P/N 049495) provided in the Ship Kit (see Figure 3-2).

IMPORTANT **Hand-tighten the cell caps only. The use of a wrench or other tool can damage the cell.**

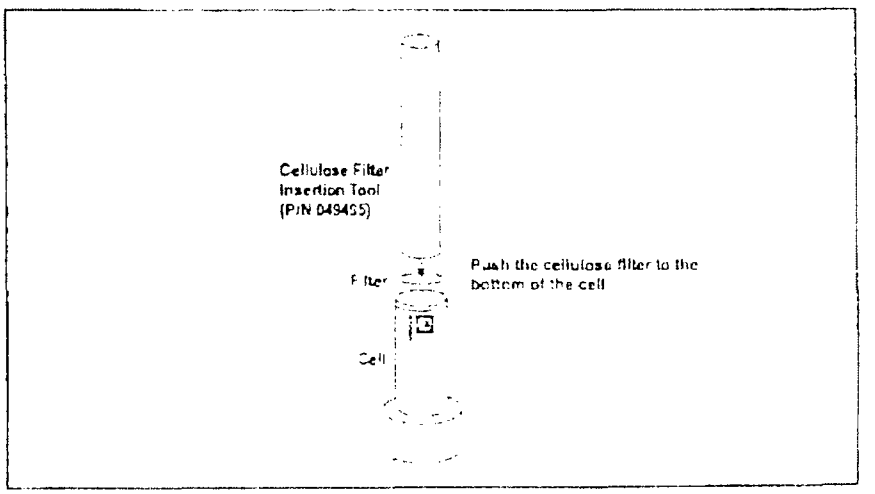

Figure 3-2 Cellulose Filter Installation

MSDS Number: **P3973** * * * * * *Effective Date:* ***01/03/06*** * * * * * *Supercedes:* ***08/31/04***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC 613-996-6666

Outside U.S. and Canada
Chemtrec 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service [1-800-582-2537] for assistance.

PHOSPHORIC ACID

1. Product Identification

Synonyms: Ortho-phosphoric acid; white phosphoric acid
CAS No.: 7664-38-2
Molecular Weight: 98.00
Chemical Formula: H3PO4 in H2O
Product Codes:
J.T. Baker: 0238, 0248, 0259, 0260, 0262, 0263, 0264, 0268, 0273, 0274, 5372, 5682, 5686, 5804, 5841, 5854, 6908
Mallinckrodt: 2779, 2788, 2796, 3563, H106, XM-223

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Phosphoric Acid	7664-38-2	55 - 95%	Yes
Water	7732-18-5	5 - 45%	No

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. CAUSES SEVERE IRRITATION AND BURNS TO EVERY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Inhalation is not an expected hazard unless misted or heated to high temperatures. Mist or vapor inhalation can cause irritation to the nose, throat, and upper respiratory tract. Severe exposures can lead to a chemical pneumonitis.
Ingestion:
Corrosive. May cause sore throat, abdominal pain, nausea, and severe burns of the mouth, throat, and stomach. Severe exposures can lead to shock, circulatory collapse, and death.
Skin Contact:
Corrosive. May cause redness, pain, and severe skin burns.
Eye Contact:
Corrosive. May cause redness, pain, blurred vision, eye burns, and permanent eye damage.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems, or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before reuse.
Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Contact with most metals causes formation of flammable and explosive hydrogen gas.

Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Water spray may be used to keep fire exposed containers cool. If water is used, use in abundance to control heat and acid build-up.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture, incompatibilities, and direct sunlight. Corrosive to mild steel. Store in rubber lined or 316 stainless steel designed for phosphoric acid. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
1 mg/m3 (TWA)

-ACGIH Threshold Limit Value (TLV):
1 mg/m3 (TWA), 3 mg/m3 (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with high efficiency dust/mist filter may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator

supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Physical data below refers to concentrated phosphoric acid.

Appearance:

Clear, colorless syrupy liquid.

Odor:

Odorless.

Solubility:

Miscible in all proportions in water.

Specific Gravity:

1.69 @ 25C

pH:

1.5 (0.1 N aqueous solution)

% Volatiles by volume @ 21C (70F):

100

Boiling Point:

158C (316F)

Melting Point:

21C (70F)

Vapor Density (Air=1):

3.4

Vapor Pressure (mm Hg):

0.03 @ 20C (68F)

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Substance can supercool without crystallizing.

Hazardous Decomposition Products:

Phosphorus oxides may form when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Liberates explosive hydrogen gas when reacting with chlorides and stainless steel. Can react violently with sodium tetrahydroborate. Exothermic reactions with aldehydes, amines, amides, alcohols and glycols, azo-compounds, carbamates, esters, caustics, phenols and cresols, ketones, organophosphates, epoxides, explosives, combustible materials, unsaturated halides, and organic peroxides. phosphoric acid forms flammable gases with sulfides,

mercaptans, cyanides and aldehydes. It also forms toxic fumes with cyanides, sulfide, fluorides, organic peroxides, and halogenated organics. Mixtures with nitromethane are explosive.

Conditions to Avoid:

Incompatibles.

11. Toxicological Information

Oral rat LD50: 1530 mg/kg; investigated as a mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Phosphoric Acid (7664-38-2)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

When released into the soil, this material may leach into groundwater. When released to water, acidity may be readily reduced by natural water hardness minerals. The phosphate, however, may persist indefinitely.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: Phosphoric Acid Solution
Hazard Class: 8
UN/NA: UN1805
Packing Group: III
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: Phosphoric Acid Solution
Hazard Class: 8
UN/NA: UN1805

Information reported for product/size: 350LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Phosphoric Acid (7664-38-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Phosphoric Acid (7664-38-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	List	------SARA 313------ Chemical Catg.
Phosphoric Acid (7664-38-2)	No	No	No	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Phosphoric Acid (7664-38-2)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! CORROSIVE. CAUSES SEVERE IRRITATION AND BURNS TO EVERY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Keep container closed.
Use only with adequate ventilation.

Do not breathe vapor or mist.
Wash thoroughly after handling.

Label First Aid:

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 14.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **S5018** * * * * * *Effective Date:* ***06/17/03*** * * * * * *Supercedes:* ***02/18/03***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC 1-800-424-9300

National Response in Canada
CANUTEC 613-996-6666

Outside U.S. and Canada
Chemtrec 703-527-3887

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service [1-800-582-2537] for assistance.

SODIUM SULFATE ANHYDROUS

1. Product Identification

Synonyms: Disodium sulfate; sodium sulfate anhydrous; sulfuric acid, disodium salt; sodium sulfate; Speed-dry
CAS No.: 7757-82-6
Molecular Weight: 142.04
Chemical Formula: Na2 SO4
Product Codes:
J.T. Baker: 3375, 3891, 3898, 3902, 8074
Mallinckrodt: 6775, 7803, 8016, 8020, 8022, 8024, 8025, 8026, 8028, 9675

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Sulfate	7757-82-6	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
Not expected to be a health hazard.
Ingestion:
Mildly toxic by ingestion. Slowly absorbed from the alimentary tract. Because of osmotic activity, it will draw water into the lumen of the bowel and may cause purging, fluid loss, blood in stools, fall of blood pressure, and high sodium levels in the blood.
Skin Contact:
No adverse effects expected.
Eye Contact:
No adverse effects expected but dust may cause mechanical irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Not expected to require first aid measures.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard, but violent explosions occur when potassium sulfate and sodium sulfate are melted with aluminum.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Fine white crystalline granules.
Odor:
Odorless.
Solubility:
Soluble in approx. 3.6 parts water, 1 in 2 parts maximum @ 33C (91F).
Density:
2.68
pH:
No information found.

% Volatiles by volume @ 21C (70F):
)

Boiling Point:
No information found.

Melting Point:
844C (1551F)

Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.

Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable in tightly closed containers under normal conditions of storage.

Hazardous Decomposition Products:
Oxides of sulfur and sodium may form when heated to decomposition.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
In combination with sodium sulfate, aluminum and magnesium will explode @ 800C (1472F); strong mineral acids and bases.

Conditions to Avoid:
Air, moisture, and incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Sulfate (7757-82-6)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to leach into groundwater. This material is not expected to significantly bioaccumulate.

Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l. The EC50/48-hour values for daphnia are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Sodium Sulfate (7757-82-6)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Sulfate (7757-82-6)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Sulfate (7757-82-6)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Sulfate (7757-82-6)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

Label Precautions:

None.

Label First Aid:

Not applicable.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **D1288** * * * * * *Effective Date: **05/08/03*** * * * * * *Supercedes: **09/14/00***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

Diatomaceous Earth

1. Product Identification

Synonyms: Diatomite; Celite®; Kieselguhr Soda Ash Flux Calcined
CAS No.: 68855-54-9
Molecular Weight: Not applicable.
Chemical Formula: Not applicable.
Product Codes: 1939

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Kieselguhr, Soda Ash Flux-calcined	68855-54-9	100%	Yes
This product may contain up to 75% crystalline silica:			
Cristobalite	14464-46-1	< 70%	Yes
Quartz	14808-60-7	< 5%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY AFFECT LUNGS. CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends upon duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Cancer Causing)
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Causes dryness and irritation to the respiratory tract. Symptoms may include coughing, sore throat, breathing difficulty (dyspnea), and wheezing. Excessive inhalation may cause decreased pulmonary function, lung damage and silicosis. Acute silicosis is manifested by dyspnea, fever, cough and weight loss. Severe respiratory symptoms may lead to death.
Ingestion:
No adverse effects expected.
Skin Contact:
Causes irritation with dryness and abrasion.
Eye Contact:
Causes irritation, redness, and pain.
Chronic Exposure:
Prolonged inhalation exposure may produce silicosis. Chronic symptoms include cough, dyspnea, wheezing, increased susceptibility to tuberculosis, decreased chest expansion, and repeated nonspecific chest illnesses. Progressive respiratory and cardiopulmonary impairment may be fatal. Chronic inhalation of crystalline silica is a lung cancer hazard.
Aggravation of Pre-existing Conditions:
Persons with pre-existing respiratory or cardiopulmonary problems may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. When pouring into a container of flammable liquid, ground both containers electrically to prevent a static electric spark. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
OSHA PERMISSIBLE LIMITS (PELs):
- For silica, amorphous, including natural diatomaceous earth (112926-00-8):
(80 mg/m3) / (%SiO2), (TWA).
- For silica, crystalline, quartz (14808-60-7):
(30mg/m3)/(%SiO2 + 2), (TWA), total dust;
(10 mg/m3)/(%SiO2 + 2), (TWA), respirable fraction;
where "%SiO2" is the percentage of crystalline silica
determined by airborne samples, as defined by
29 CFR 1910.1000, Z-3.
- For silica, crystalline, tridymite (15468-32-3) or cristobalite (14464-46-1):
Use one-half of the quartz exposure limits.

ACGIH THRESHOLD LIMIT VALUES:
- For silica gel & precipitated silica (11926-00-8):
10 mg/m3 (TWA).
- For diatomaceous earth, uncalcined (61790-53-2):
10 mg/m3 (TWA), inhalable particulate;
3 mg/m3 (TWA), respirable particulate;
(for particulate matter containing no asbestos and < 1% crystalline silica).
- For fused silica (60676-86-0):

0.1 mg/m3 (TWA), respirable fraction.
- For silica, crystalline, quartz (14808-60-7):
0.05 mg/m3 (TWA), respirable fraction, A2 - Suspected Human Carcinogen.
- For silica, crystalline, tridymite (15468-32-3):
0.05 mg/m3 (TWA), respirable fraction.
- For silica, crystalline, cristobalite (14464-46-1):
0.05 mg/m3 (TWA), respirable fraction.
- For silica, crystalline, tripoli (1317-95-9):
0.1 mg/m3 of contained respirable quartz (TWA), respirable fraction.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face high efficiency particulate respirator (NIOSH type N100 filter) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece high efficiency particulate respirator (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White to pink Crystalline solid.

Odor:
No information found.

Solubility:
Slight (0.1-1%)

Specific Gravity:
2.30

pH:
No information found.

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
No information found.

Melting Point:

No information found.
Vapor Density (Air=1):
Not applicable.
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No information found.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Reacts with hydrogen fluoride, fluorine, oxygen difluoride, chlorine trifluoride, strong acids, strong bases, and oxidizers.
Conditions to Avoid:
Moisture, extreme heat, and incompatibles.

11. Toxicological Information

Toxicological Data:
No LD50/LC50 information found relating to normal routes of occupational exposure.

Silica, Amorphous:
- diatomaceous earth: investigated as a tumorigen.

Silica, Crystalline:
- tripoli: investigated as a tumorigen.
- tridymite: investigated as a tumorigen and mutagen.
- quartz: investigated as a tumorigen and mutagen.
- cristobalite: investigated as a tumorigen.
- fused: investigated as a tumorigen.

Carcinogenicity:
For Silica, Crystalline:
- Cristobalite (14464-46-1), quartz (14808-60-7), and tridymite (15468-32-3) are listed by NTP as known to be a human carcinogen.
- NIOSH considers cristobalite, tridymite, quartz, and tripoli (1317-95-9) to be potential occupational carcinogens.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Kieselguhr, Soda Ash Flux-calcined (68855-54-9)	No	No	None
Cristobalite (14464-46-1)	Yes	No	1

Quartz (14808-60-7)	Yes	No	1

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into water, this material is not expected to biodegrade.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Kieselguhr, Soda Ash Flux-calcined (68855-54-9)	Yes	Yes	No	Yes
Cristobalite (14464-46-1)	Yes	Yes	Yes	Yes
Quartz (14808-60-7)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Kieselguhr, Soda Ash Flux-calcined (68855-54-9)	Yes	Yes	No	Yes
Cristobalite (14464-46-1)	Yes	Yes	No	Yes
Quartz (14808-60-7)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Kieselguhr, Soda Ash Flux-calcined (68855-54-9)	No	No	No	No
Cristobalite (14464-46-1)	No	No	No	No
Quartz (14808-60-7)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)

Kieselguhr, Soda Ash Flux-calcined (68855-54-9)	No	No	No
Cristobalite (14464-46-1)	No	No	No
Quartz (14808-60-7)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY AFFECT LUNGS. CANCER HAZARD. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE CANCER. Risk of cancer depends upon duration and level of exposure.
Label Precautions:
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Do not get in eyes, on skin, or on clothing.
Wash thoroughly after handling.
Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Attachment 22 '4

The Lancer dishwasher has two programs that we use. Program 5 uses deionized water and program 4 uses tap water.

Functions	Possibility	Our Program
PREWASH 1 PERIOD	0-30 MINUTES	1 MINUTE
FILLING	HOT/COLD	HOT
PREWASH 1 TEMPERATURE	0-95°C	50°C
PREWASH 1 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 1 ADDITIVE 2 (ACID)	0-6 MINUTES	0
PREWASH 2 PERIOD	0-30 MINUTES	2 MINUTES
FILLING	HOT/COLD	HOT
PREWASH 2 TEMPERATURE	0-95°C	65°C
PREWASH 2 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 2 ADDITIVE 2	0-6 MINUTES	0
PREWASH 3 PERIOD	0-30 MINUTES	0
FILLING	HOT/COLD	0
PREWASH 3 TEMPERATURE	0-95°C	0
PREWASH 3 DETERGENT	0-6 MINUTES	0
PREWASH 3 ADDITIVE 2	0-6 MINUTES	0
WASH PERIOD	0-30 MINUTES	4 MINUTES
FILLING	HOT/COLD	HOT
WASH TEMPERATURE	0-95°C	80°C
WASH DETERGENT	0-6 MINUTES	1 MINUTE 6 SECONDS
WASH ADDITIVE 2	0-6 MINUTES	0
RUNNING WATER RINSE 1	0-9 MINUTES	2 MINUTES
ACID RINSE PERIOD	0-30 MINUTES	2 MINUTES
ACID	0-6 MINUTES	2 MINUTES
RUNNING WATER RINSE 2	0-9 MINUTES	7 MINUTES
COLD DEMI WATER RINSE 1	0-30 MINUTES	0
COLD DEMI WATER RINSE 2	0-30 MINUTES	0
COLD DEMI WATER RINSE 3	0-30 MINUTES	0
COLD DEMI WATER RINSE 4	0-3 MINUTES	0
HOT DEMI WATER RINSE	0-30 MINUTES	2 MINUTES
HOT DEMI TEMPERATURE	0-95°C	75°C
HOT DEMI ADDITIVE	0-6 MINUTES	0
DRYING	0-90 MINUTES	25 MINUTES

MATERIAL SAFETY DATA SHEET (MSDS) VARIAN

Section 1 - Introduction

Effective Date: May 22, 1995

Manufacturer's Name: VARIAN SAMPLE PREPARATION PRODUCTS

Address: 25200 Commercentre Dr
Lake Forest, California 92630

Emergency Telephone: (800) 424-9300

Information Telephone: (949) 770-9381

Trade Name: CHEM ELUT ™ Hydromatrix

Chemical Name: FLUX CALCINED DIATOMACEOUS EARTH

Varian Reference No.: 12198001, 12198002, 12198003, 12198004, 12198005, 12198006, 12198007, 12198008, 12198009, 12198010, and 12198011

Section 2 - Hazardous Ingredients

CAS No.	Chemical Name	Percent	ACGIH TLV	OSHA PEL
68855-54-9	Diatomaceous Earth	65%	10 mg/m3	6 mg/m3
14464-46-1	Cristobalite** (crystalline silica)	35%	0.05 mg/m3	0.05 mg/m3

n.e = none established * = Sara Title III Section 313 Chemical ** = California Proposition 65 Chemical

Section 3 - Physical Description

Appearance and Odor:

Fine white powder, no odor

Melting Point:	1710 ° C	**Specific Gravity:**	2.35
Boiling Point @ 1 atm:	2,230 ° C	**Solubility in Water:**	Practically Insoluble
Flash Point:	None	**Vapor Pressure:**	None

Upper Explosive Limit (UEL) in Air, % by volume: None

Lower Explosive Limit (LEL) in Air, % by volume: None

n/a = not available

Section 4 - Fire and Emergency Handling Data

Extinguishing Media:

Diatomaceous Earth is non-combustible

Personal Protective Equipment:

Use NIOSH/MSHA approved Self Contained Breathing Apparatus (SCBA) under extremely dusty conditions.

Fire and Explosion Hazard Precautions:

When heated to extreme temperature, diatomaceous earth can crystallize or melt into glass

MATERIAL SAFETY DATA SHEET (MSDS)

VARIAN

Section 5 - Health Hazard Data and Emergency First Aid Procedures

Routes of Entry into the Body:

Inhalation Eye Contact Skin

Symptoms:

Irritation and some soreness in the throat and nose. In extreme exposures some congestion may occur

Long Term Effects:

Crystalline silica has been classified as probably carcinogenic for human by IAC. Crystalline silica is also a known cause of silicosis, a non-cancerous lung disease

Listed as a Carcinogen or Potential Carcinogen:

NTP [N] IARC [Y] OSHA [N]

FIRST AID:

Skin Contact:

N/A

Eye Contact:

Immediately flush with water for 15 minutes

Inhalation:

Remove to fresh air. Drink water to clear throat and blow nose to remove dust

Ingestion:

N/A

Section 6 - Reactivity Data

Stability: [ ] Unstable [x] Stable

Hazardous Polymerization: [ ] May Occur [x] Will not occur

Incompatible Materials:

Hydrofluoric Acid

Hazardous Decomposition Products:

None determined

Storage:

Store in a sealed container at room temperature

MATERIAL SAFETY DATA SHEET (MSDS) VARIAN

Section 7 - Spill, Leak and Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled:

Vacuum dust with equipment fitted with a HEPA filter. If sweeping is necessary use a dust suppressant

Waste Disposal Method:

Wastes are not hazardous as defined by RCRA (40 CFR Part 261.) Comply with federal, state, and local hazardous waste regulations.

Section 8 - Special Protection Information

Respiratory Protection:

Use a NIOSH-approved HEPA filter respirator is airborne levels are expected to exceed PEL or TLV limits

Ventilation:

As needed to reduce worker exposure below PEL and TLV exposure limits

Protective Gloves:

Not normally required

Eye Protection:

Not normally required

Other Protective Equipment:

Protective clothing should be worn where skin irritation or other effects may occur.

Section 9 - Product Warning Label Statement

These data are offered in good faith as typical values and not as a product specification. No warranty, either expressed or implied is hereby made. The recommended Industrial Hygiene and safety procedures are believed to be generally applicable. However, each user should review these recommendations in the specific context of the intended use and determine whether they are appropriate.

Section 10 - Other Product Warning Statements

[X] **California State Proposition 65**

This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm

[X] **SARA Title III**

This product **does not contain** a chemical listed in Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
EQUIPMENT MONITORING RECORD
CALENDAR YEAR _____

Refrigerator/Freezer/Oven (Circle one)

Room # _____

Equipment # _____

Thermometer Serial # _____

Thermometer Correction Factor _____

Acceptance Range (C or F) _____

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		
Day	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Temperature	Initials	Day
1																									1
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Recorded temperature must be observed temperature plus the thermometer correction factor.

Comments, corrective actions & date: _____

ATTACHMENT 22.15

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

Date:

TO: (Name of your Unit Manager)
Albert Lee, QA Officer
Bob Avery, Chief, Laboratory Services Section
File, QA Officer

FROM:

SUBJECT: Quality Assurance Corrective Action

Please indicate the type of Quality Assurance failure/deviation:

_____ PT Study _____ Quality Assurance Data Trend _____ Other

1. Date of failure:

2. Parameter(s)/Method(s) name:

3. Instrument:

4. Sample(s)/Batch(s) affected:
   a. Identify the sample or batch of samples affected.
   b. Describe if any other samples were affected by this problem and why or why not.

5. Detailed description of the failure/deviation:

6. Describe investigation of the failure/deviation.
   a. How was it detected, what steps did you take to resolve the problem, how was it finally resolved?
   b. Write a description about the QC acceptance, instrument failure, sample interference, or any other issues that affected the quality of data.

7. Corrective action taken:
   a. Describe the action you took to resolve the problem: what did you do?
   b. Provide appropriate supporting documentation showing that the problem has been resolved: ie new calibration curve, corrected report, batch sheet with corrections, or any other document showing the corrective action.
   c. Describe any impact to other samples: were other samples affected, what was done to correct these sample results, were clients notified, etc.?

Comments (as necessary):

1)_____	_____	3)_____	_____
Analyst	Date	Laboratory QA Officer	Date
2)_____	_____	4)_____	_____
Unit Supervisor	Date	Laboratory Director	Date

(Routing Instruction: 1) Analyst(s) 2) Unit Supervisor 3) QA Officer 4) Laboratory Director

5) QA Office File (send additional copy to Unit Manager)

MDEQ-Environmental Lab
Weekly Balance Calibration Check

A minimum of 3 weights must be checked

Date	Balance #	Analyst	1 g weight	2 g weight	5 g weight	10 g weight	20 g weight	50 g weight	100 g weight	Acceptable (yes/no)	Comments
Acceptance Criteria			+/- 0.05 g +/- 0.005 g +/- 0.0005 g	+/- 0.05 g +/- 0.005 g +/- 0.0005 g	+/- 0.05 g +/- 0.005 g +/- 0.0005 g	+/- 0.05 g +/- 0.005 g +/- 0.0005 g	+/- 0.05 g +/- 0.005 g +/- 0.0005 g	+/- 0.05 g +/- 0.010 g +/- 0.0010 g	+/- 0.05 g +/- 0.010 g +/- 0.0010 g		

COMMENTS

Acceptance criteria is dependent upon significant figures of balance

ABSOLUTE STANDARDS, INC • 44 Rossotto Drive • Hamden, CT • (800) 368-1131

ISO 9001:2000 Quality System Registered
ISO/IEC Guide 17025, ANSI Z540 Compliant
DLS ANSI-RAB Accredited

EL 2310 1-4 JA 3/2/06

Attachment 22.19

CERTIFIED WEIGHT REPORT

Part Number: 94206
Lot Number: 022306
Description: EPA Method 625 LCS Spike
67 components
Expiration Date: 022311

Lot #: CF114
Solvent(s): Methanol

Nominal Concentration (µg/mL): Varied

Formulated By	Justin Dippold	022306 DATE
Reviewed By	Pedro L. Rentas	022306 DATE

Volume(s) shown below were combined and diluted to: 500.0 — 5E-05 Balance Uncertainty — 0.042 Flask Uncertainty

MSDS Information (Solvent Safety Info. On Attached pg.)

	Compound	Part Number	Lot Number	Dil Factor	Initial Vol (mL)	Uncertainty Pipette	Initial Conc (µg/mL)	Final Conc (µg/mL)	Expanded Uncertainty (+/-) (µg/mL)	CAS#	OSHA PEL (TWA)	LD50
1.	Acenaphthene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00083-32-9	N/A	ipr-rat 600mg/kg
2.	Acenaphthylene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00450	00208-96-8	N/A	N/A
3.	Anthracene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00120-12-7	0.2mg/m3 (8H)	ipr-mus 430mg/kg
4.	Benzo(a)anthracene	92987	072805	0.50	250.0	0.013	100.0	50.0	0.00450	00056-55-3	N/A	N/A
5.	Benzo(b)fluoranthene	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00205-99-2	N/A	N/A
6.	Benzo(k)fluoranthene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00207-08-9	N/A	orl-rat 2820mg/kg
7.	Benzo(g,h,i)perylene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00450	00191-24-2	N/A	N/A
8.	Benzo(a)pyrene	92987	072805	0.50	250.0	0.013	100.3	50.2	0.00453	00050-32-8	0.2mg/m3 (8H)	scu-rat 50mg/kg
9.	4-Bromophenyl phenyl ether	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00101-55-3	N/A	N/A
10.	Benzyl butyl phthalate	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00085-68-7	N/A	orl-rat 2330mg/kg
11.	bis(2-Chloroethoxy) methane	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	00111-91-1	N/A	N/A
12.	bis(2-Chloroethyl) ether	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00450	00111-44-4	15 ppm (90mg/m3/8H)(sk	orl-rat 75mg/kg
13.	bis(2-Chloroisopropyl) ether	92987	072805	0.50	250.0	0.013	100.0	50.0	0.01043	00108-60-1	N/A	orl-rat 240mg/kg
14.	2-Chloronaphthalene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00091-58-7	N/A	orl-rat 2078mg/kg
15.	4-Chlorophenyl phenyl ether	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	07005-72-3	N/A	N/A
16.	Chrysene	92987	072805	0.50	250.0	0.013	100.4	50.2	0.00450	00218-01-9	0.2mg/m3	N/A
17.	Di-n-butyl phthalate	92987	072805	0.50	250.0	0.013	100.4	50.2	0.00450	00084-74-2	5mg/m3/8H	orl-rat 8000mg/kg
18.	Di-n-octyl phthalate	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	00117-84-0	N/A	ipr-mus 65g/kg
19.	Dibenzo(a,h)anthracene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00053-70-3	0.2mg/m3	N/A
20.	1,2-Dichlorobenzene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00450	00095-50-1	50 ppm (300mg/m3) (CL)	orl-rat 500mg/kg
21.	1,3-Dichlorobenzene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00453	00541-73-1	N/A	ipr-mus 1062mg/kg
22.	1,4-Dichlorobenzene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00450	00106-46-7	75 ppm (450mg/m3/8H)	orl-rat 500mg/kg
23.	2,4-Dinitrotoluene	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00456	00121-14-2	1.5mg/m3/8H (skin)	orl-rat 268mg/kg
24.	2,6-Dinitrotoluene	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00606-20-2	1.5mg/m3/8H (skin)	orl-rat 177mg/kg
25.	Diethyl phthalate	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00084-66-2	5mg/m3/8H	orl-rat 8600mg/kg
26.	Dimethyl phthalate	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00131-11-3	5mg/m3/8H	orl-rat 6800mg/kg
27.	bis(2-Ethylhexyl) phthalate	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00117-81-7	5mg/m3/8H	orl-rat 30600mg/kg
28.	Fluoranthene	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00453	00206-44-0	N/A	orl-rat 2000mg/kg
29.	Fluorene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00453	00086-73-7	N/A	ipr-mus 2 g/kg
30.	Hexachlorobenzene	92987	072805	0.50	250.0	0.013	100.0	50.0	0.00450	0011[illegible]-74-1	N/A	orl-rat 10g/kg
31.	Hexachlorobutadiene	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00453	0008[illegible]-68-3	0.02 ppm (0.24mg/m3/8H	orl-rat 90mg/kg
32.	Hexachlorocyclopentadiene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00453	00077-47-4	0.01 ppm (0.1mg/m3/8H)	orl-rat 1300mg/kg
33.	Hexachloroethane	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00067-72-1	1 ppm (10mg/m3/8H)(skin	orl-rat 4460mg/kg
34.	Indeno(1,2,3-cd)pyrene	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	00193-39-5	N/A	N/A
35.	Isophorone	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00456	00078-59-1	25 ppm	orl-rat 2330mg/kg
36.	Naphthalene	92987	072805	0.50	250.0	0.013	100.3	50.1	0.00450	00091-20-3	10 ppm (50mg/m3/8H)	orl-rat 490mg/kg
37.	Nitrobenzene	92987	072805	0.50	250.0	0.013	100.0	50.0	0.00450	00098-95-3	1 ppm (5mg/m3/8H)(skin)	orl-rat 780mg/kg
38.	N-Nitrosodimethylamine	92987	072805	0.50	250.0	0.013	100.0	50.0	0.00453	00062-75-9	N/A	orl-rat 58mg/kg
39.	N-Nitrosodi-n-propylamine	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	00621-64-7	N/A	orl-rat 480mg/kg
40.	N-Nitrosodiphenylamine	92987	072805	0.50	250.0	0.013	100.1	50.1	0.00453	00086-30-6	N/A	orl-rat 2140mg/kg
41.	Phenanthrene	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00450	00085-01-8	0.2mg/m3/8H	orl-mus 700mg/kg
42.	Pyrene	92987	072805	0.50	250.0	0.013	100.2	50.1	0.00453	00129-00-0	0.2mg/m3/8H	orl-rat 2700mg/kg
43.	1,2,4-Trichlorobenzene	92987	072805	0.50	250.0	0.013	100.1	50.0	0.00450	00120-82-1	5 ppm (CL) (40mg/m3)	orl-rat 756mg/kg
44.	Aniline	94208	022306	0.05	25.0	0.011	1001.1	50.1	0.00417	00062-53-3	5 ppm (8H)	orl-rat 250mg/kg
45.	Azobenzene	94208	022306	0.05	25.0	0.011	1002.4	50.1	0.00428	00103-33-3	N/A	orl-rat 1000mg/kg
46.	Carbazole	94208	022306	0.05	25.0	0.011	1003.0	50.1	0.00416	00086-74-8	N/A	ipr-mus 200mg/kg
47.	Dibenzofuran	94208	022306	0.05	25.0	0.011	1002.5	50.1	0.00417	00132-64-9	N/A	N/A
48.	2-Methylnaphthalene	94208	022306	0.05	25.0	0.011	1002.2	50.1	0.00428	00091-57-6	N/A	orl-rat 1630mg/kg
49.	2-Nitroaniline	94208	022306	0.05	25.0	0.011	1001.0	50.0	0.00420	00088-74-4	N/A	orl-rat 1600mg/kg
50.	3-Nitroaniline	94208	022306	0.05	25.0	0.011	1002.6	50.1	0.00420	00099-09-2	N/A	orl-rat 535mg/kg
51.	4-Nitroaniline	94208	022306	0.05	25.0	0.011	1001.4	50.1	0.00420	00100-01-6	1 ppm (6mg/m3/8H)(skin)	orl-rat 750mg/kg
52.	Pyridine	94208	022306	0.05	25.0	0.011	1003.1	50.2	0.00414	00110-86-1	5 ppm (15mg/m3/8H)	orl-rat 891mg/kg
53.	4-Chloro-3-methylphenol	94196	021306	0.05	25.0	0.011	2002.3	100.1	0.00435	000[illegible]-50-7	N/A	orl-rat 1830mg/kg
54.	2-Chlorophenol	94196	021306	0.05	25.0	0.011	2000.6	100.0	0.00435	0009[illegible]-57-8	N/A	orl-rat 670mg/kg
55.	2,4-Dichlorophenol	94196	021306	0.05	25.0	0.011	2001.8	100.1	0.00435	0012[illegible]-83-2	N/A	orl-rat 580mg/kg
56.	2,4-Dimethylphenol	94196	021306	0.05	25.0	0.011	2001.9	100.1	0.00443	001[illegible]-67-9	N/A	orl-rat 3200mg/kg
57.	2,4-Dinitrophenol	94196	021306	0.05	25.0	0.011	2000.6	100.0	0.00439	000[illegible]-28-5	N/A	orl-rat 30mg/kg
58.	4,6-Dinitro-2-methylphenol	94196	021306	0.05	25.0	0.011	2001.1	100.0	0.00439	005[illegible]-52-1	0.2mg/m3/8H (skin)	orl-rat 10mg/kg
59.	2-Nitrophenol	94196	021306	0.05	25.0	0.011	2003.4	100.2	0.00439	00088-75-5	N/A	orl-rat 334mg/kg
60.	4-Nitrophenol	94196	021306	0.05	25.0	0.011	2002.4	100.1	0.00439	00100-02-7	N/A	orl-rat 250mg/kg
61.	Pentachlorophenol	94196	021306	0.05	25.0	0.011	2002.4	100.1	0.00439	000[illegible]-86-5	0.5mg/m3/8H (skin)	orl-rat 27mg/kg
62.	Phenol	94196	021306	0.05	25.0	0.011	2001.3	100.1	0.00435	001[illegible]-95-2	5 ppm (19mg/m3/8H)(skin	orl-rat 317mg/kg
63.	2,4,6-Trichlorophenol	94196	021306	0.05	25.0	0.011	2002.0	100.1	0.00435	000[illegible]-06-2	N/A	orl-rat 820mg/kg
64.	Benzyl alcohol	94207	022306	0.05	25.0	0.011	2001.2	100.0	0.00408	00100-51-6	N/A	orl-rat 1230mg/kg
65.	o-Cresol (2-Methylphenol)	94207	022306	0.05	25.0	0.011	2001.6	100.1	0.00408	00095-48-7	5 ppm (22mg/m3/8H)(skin	orl-rat 121mg/kg
66.	p-Cresol (4-Methylphenol)	94207	022306	0.05	25.0	0.011	2000.7	100.0	0.00408	00106-44-5	5 ppm (22mg/m3/8H)(skin	orl-rat 207mg/kg
67.	2,4,5-Trichlorophenol	94207	022306	0.05	25.0	0.011	2002.1	100.1	0.00408	00095-95-4	N/A	orl-rat 820mg/kg

Michigan Department of Environmental Quality

Laboratory Services Standard Operating Procedure Document

EFFECTIVE DATE: 05/2006 SOP# 402 REVISION # 1

SILICA GEL CLEANUP OF PCBs (AS AROCLORS) AND ORGANOCHLORINE PESTICIDES

Table of Contents

1.0 Applicable Analytical Methods 1
2.0 Matrix or Matrices 2
3.0 Method Detection Limits (MDLs) 2
4.0 Scope and Application 2
5.0 Method Summary 2
6.0 Definitions 3
7.0 Interferences 3
8.0 Safety 4
9.0 Equipment and Supplies 4
10.0 Reagents and Standards 5
11.0 Sample Collection, Preservation, Shipment and Storage 7
12.0 Quality Control (QC) 8
13.0 Calibration and Standardization 8
14.0 Procedure 9
15.0 Calculations 12
16.0 Method Performance 12
17.0 Pollution Prevention 12
18.0 Data Assessment 12
19.0 Corrective Actions 12
20.0 Waste Management 12
21.0 References 13
22.0 Attachments 13
Signature Page 14

SILICA

1.0 Applicable Analytical Methods

1.1 Silica Gel Cleanup, U.S. Environmental Protection Agency, Method 3630C, SW846, Revision 3, December 1996.

1.2 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.3 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996.

1.4 Cleanup, U.S. Environmental Protection Agency, Method 3600C, SW846, Revision 3, December 1996.

2.0 Matrix or Matrices

2.1 Aqueous.

2.2 Soil.

2.3 Sediment.

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Solid or liquid waste.

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 MDLs are extracted according to SOP 401, SOP 404, or SOP 405 and cleaned by following SOP 400 and/or SOP 403 prior to silica gel cleanup. The extract must be in hexane.

4.0 Scope and Application

4.1 This method provides for the column or cartridge cleanup of organochlorine pesticides and PCBs (as aroclors) from other interfering compounds.

4.2 This method separates most single component organochlorine pesticides from the aroclors. See Attachment 22.9 for compound distribution in each fraction.

4.3 Silica gel is an adsorbent with weakly acidic properties and can separate compounds of different chemical polarity.

4.4 Silica gel columns, with 5 grams of silica gel, are used when the pesticide (2nd fraction) needs to be collected and silica gel cartridges, with 1 gram of silica gel, are used when only the PCB fraction (1st fraction) needs to be collected.

4.5 All oil samples and sediment low level PCBs are cleaned by silica gel.

5.0 Method Summary

5.1 Water samples are extracted by following SOP 405 and cleaned up as in SOP 400 and SOP 403. Solid samples are extracted by following SOP 401 and cleaned by following SOP 400. Oil samples are prepared by following SOP 404 and cleaned by following SOP 400. The sample extracts are then solvent exchanged to hexane.

5.2 Activated silica gel is weighed and packed into a chromatography column with a small layer of sodium sulfate on the top. The column is rinsed with appropriate solvents. If SPE cartridges are used, they are place on the Supelco SPE vacuum manifold and rinsed with appropriate solvents.

5.3 Sample extracts are introduced onto the top of the prepared column along with azulene. Or samples are introduced onto SPE cartridges without azulene as only the first fraction is collected. Azulene is used to help visually identify the end of the fraction I. Collection tubes are replaced with new ones to collect fraction II. Both fractions are concentrated to 1 mL in hexane and analyzed by gas chromatography with electron capture detection (GC-ECD)(SOP 502).

6.0 Definitions

6.1 Method Preparation Blank (MPB) - An aliquot of a blank matrix that is treated exactly as a sample, including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.2 Laboratory Control Sample (LCS) - An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample, including extraction, cleanup, and analysis.

6.3 Matrix Spike (MS) - An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is treated exactly as a sample, including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.4 Matrix Spike Duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample, including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

7.0 Interferences

7.1 Interferences from contaminants can occur from solvents, glassware, and other sample processing equipment. Pesticide quality solvents (or better) and solvent rinsing of all glassware should help minimize contaminants.

7.2 The use of plastic must be minimized to prevent phthalate contamination.

7.3 Soap residue must be thoroughly rinsed from all glassware to avoid degradation of some pesticide compounds.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (SOP 100).

8.4 Hexane, toluene, azulene, silica gel, and sodium sulfate material safety data sheets (MSDSs) are attached.

8.5 Nitrile or other solvent resistant gloves must be worn when handling solvents.

9.0 Equipment and Supplies

9.1 Chromatographic columns – 9 mm x 200 mm, with a 50 mL reservoir.

9.2 Vials - 2 mL crimp cap with caps.

9.2.1 Place 1 mL of hexane into each vial from calibrated bottle-top dispenser
9.2.2 Mark the meniscus on each vial with a lab marker.
9.2.3 Dispose of the hexane. Let vial air dry.

9.3 Turbovap tubes from Caliper 250 mL and 50 mL capacity and suitable racks.

9.4 Turbovap concentration workstation from Caliper - with temperature control up to 95°C and nitrogen pressure from zero to 20 psi (settings: temperature = 35°C and pressure = 15 psi).

9.5 Glass wool - Pyrex brand or equivalent.

9.6 Pasteur pipets.

9.7 Muffle furnace - capable of attaining 400°C.

9.8 Oven - capable of maintaining 130°C.

9.9 Aluminum weigh boats.

9.10 Balance - capable of weighing to 0.01g.

9.11 Bottle top dispensers - 1 to 10 mL.

9.12 Graduated cylinders - various sizes.

9.13 Syringes - various sizes.

9.14 Volumetric flasks - various sizes.

9.15 Amber bottles - 125 mL, with teflon lined caps.

9.16 Beakers – 100 mL, pyrex brand.

9.17 Screw cap test tubes – 13 X 100

9.17.1 Place 2 mL of hexane into each tube from calibrated bottle-top dispenser
9.17.2 Mark the meniscus with a lab marker.
9.17.3 Dispose of the hexane. Let tube air dry.

9.18 Glass test tubes – 16 X 100mm

9.19 Supelco SPE Vacuum Manifold – 8 port or larger or equivalent

9.20 Solid phase extraction cartridges – Strata SI-1, part #8B-SO12-JCH with silica 55um, 70A from Phenomenex or equivalent

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with the date received, the date opened, the expiration date, the tracking number, and the receiver's initials.

10.3 All prepared reagents and standards must be labeled with the date prepared, the expiration date, the preparer's initials, the tracking number, the diluent, and the description.

10.4 All standard logbooks must be completely filled out.

10.5 Hexane (95% n-Hexane) - pesticide grade, demonstrated to be free of target analytes.

10.6 Toluene - Nanograde, demonstrated to be free of target analytes.

10.7 Azulene (cyclopentacycloheptene) - Sigma-Aldrich, part # 4273 (99%).

10.7.1 Weigh 500 mg of azulene into a 100 mL volumetric flask.
10.7.2 Dilute to the mark with hexane (Section 10.5). Mix.
10.7.3 Transfer to an amber bottle with a teflon lined cap. Label.
10.7.4 Fill out the semivolatile standard logbook. See Attachment 22.2.
10.7.5 Store in a refrigerator. There is no expiration date for azulene.

10.8 Silica gel - 60, 70-230 mesh, Mallinckrodt part #V153, special for column chromatography or equivalent.

10.8.1 Place silica gel in beaker (Section 9.16).
10.8.2 Place the beaker in a muffle furnace at 400°C for 12 hours.
10.8.3 Cool in the muffle furnace. Transfer to a glass jar.
10.8.4 Store in an oven at 130°C.

10.9 Sodium sulfate - ACS grade, granular, anhydrous.

10.9.1 Transfer to a glass beaker.
10.9.2 Place in an oven at 130°C for at least 12 hours.

10.10 Stock Standards (SS) – All standards must be certified reference materials. Manufacturer's certificates of analysis are retained by the laboratory and kept as part of the overall QA/QC requirements. All SSs must be given a unique lab tracking number and logged into the SS (EL) tracking logbook. (Attachment 22.1) Store SSs in amber sealed ampules. Protect the standards from light. All standards are received in hexane unless otherwise noted.

10.10.1 SSs – SSs are purchased as mixes in sealed ampules and stored in a freezer at a temperature lower than 0°C.

10.10.1.1 Toxaphene (1000 ug/mL) in hexane– Absolute Stds, part #20021 or equivalent.

10.10.1.2 PCB mix Aroclors 1016 and 1260 (1000 ug/mL) in hexane – Absolute Standards, part #20064 or equivalent.

10.10.1.3 Custom pesticide standard (1000 ug/mL) in hexane:toluene - Accustandard Inc., part #S-7179-R1 or equivalent.

Aldrin	Endosulfan Sulfate
alpha-BHC	Endrin
beta-BHC	Endrin Aldehyde
delta-BHC	Endrin Ketone
gamma-BHC (Lindane)	Heptaclor
alpha-Chlordane	Heptaclor Epoxide
gamma-Chlordane	Methoxyclor
4,4'-DDD	Mirex
4,4'-DDE	Hexabromobenzene
4,4'-DDT	PBB (BP-6)
Dieldrin	TCMX (surrogate)
Endosulfan I	DCB (surrogate)
Endosulfan II	

10.10.1.4 Custom VOC Standard (1000 ug/mL) in Acetone - Accustandard Inc., part #S-8258 or equivalent.

Pentachlorobenzene	Hexachlorobenzene
Pentachloronitrobenzene	Hexachlorobutadiene
1,2,3,4-Tetrachlorobenzene	Hexachlorocyclopentadiene
1,2,4,5-Tetrachlorobenzene	

10.10.1.5 Surrogate mix (200ug/mL) in acetone – Absolute Standards, part #20023 or equivalent – 2,4,5,6-Tetrachloro-m-xylene and Decachlorobiphenyl

10.11 Intermediate and working standards (WS) – All prepared standards must be given a unique laboratory tracking number and logged into the semivolatile standards logbook (Attachment 22.2). Store prepared standards in labeled amber bottles in a freezer. Prepared standards are good for up to six months.

10.11.1 Intermediate toxaphene standard (4000 ug/L) – Place hexane into a 25 mL volumetric flask. Inject 100 uL of toxaphene SS (Section 10.10.1.1) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.2 Toxaphene WS (500 ug/L) – Place hexane into a 50 mL volumetric flask. Pipet or inject 6.25 mL of intermediate toxaphene standard (Section 10.11.1) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.3 Intermediate aroclor standard (2000 ug/L) – Place hexane into a 500 mL volumetric flask. Inject 1mL of aroclor 1016 and 1260 mixture SS (Section 10.10.1.2) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.4 Aroclor WS (500 ug/L) – Place hexane into a 200 mL volumetric flask. Pipet or inject 50 mL of intermediate aroclor standard (Section 10.11.3) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.5 Pesticide WS (250 ug/L) – Place hexane into a 500 mL volumetric flask. Inject 125 uL of custom pesticide SS (Section 10.10.1.3) and 125 uL of custom VOC pesticide SS (Section 10.10.1.4) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.6 Aroclor cartridge check standard (100ug/L) – Place hexane into a 200 mL volumetric flask. Inject 10mL of intermediate aroclor standard (Section 10.11.3) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.7 Pesticide cartridge check standard (125ug/L) – Place hexane into a 200 mL volumetric flask. Inject 100 mL of pesticide WS (Section 10.11.5) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.8 Surrogate mix (200ug/L) – Place hexane into 500mL volumetric flask. Inject 0.5mL of surrogate mix (Section 10.10.1.5) directly into hexane in flask. Bring to volume with hexane. Cap. Mix.

11.0 Sample Collection, Preservation, Shipment and Storage

11.1 Aqueous samples – see SOP 405.

11.2 Solid samples – see SOP 401.

11.3 Waste samples – see SOP 404.

11.4 Holding times – Sample extracts may be analyzed for up to 40 days from the extraction date.

11.5 Storage – Sample extracts must be stored in a freezer and protected from light in crimp cap vials until analysis.

12.0 Quality Control (QC)

12.1 All associated QC samples must be processed through this cleaning method along with the sample extracts.

NOTE: *The MS/MSDs do not need to go through this cleaning procedure if the sample they are associated with does not need this cleaning.*

12.2 Extracted sample batches.

12.2.1 Extracted sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS (if a MS/MSD is not available, a laboratory control sample duplicate [LCSD] must be analyzed).

12.2.2 MSs and MSDs are actual samples that are selected at random from within the batch of 20.

12.2.3 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction or during cleanup of individual samples.

12.2.4 The MS, MSD, LCS, and LCSD are spiked at a known concentration with target analyte compounds. The replicate MSs or LCSs are used to evaluate the entire batch for precision and accuracy.

12.3 Initial demonstration of capability (IDOC) - Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for the target analytes. This is accomplished by extraction and cleanup of four aliquots of a reference sample.

12.3.1 Five aliquots of reagent water or sand are extracted using SOP 401 or SOP 405. One is a MPB, and the other four are spiked with a mid-range concentration of all the pesticide analytes of interest (10.11.5).

12.3.2 Sample extracts are taken through all the normal sample cleaning methods.

12.3.3 Extracts are then analyzed by GC-ECD. See SOP 502 for further details.

13.0 Calibration and Standardization

13.1 Each new lot of silica gel is tested to determine the separation point between fraction I and fraction II. The procedure is as follows:

13.1.1 Prepare ten columns with the new silica gel (Section 14.1.6).

13.1.2 Premark three columns at 1 cm above the glass wool.

13.1.3 Premark four columns at 1.5 cm above the glass wool.

13.1.4 Premark three columns at 2 cm above the glass wool.

13.1.5 Place ten screw cap tubes in a rack. Add 2 mL of hexane (Section 10.5) to each tube. Label one tube as blank. Label three tubes as toxaphene. Label three tubes as aroclors. Label three tubes as pesticides.

NOTE: *The blank is fractionated at the 1.5 cm mark. One of each of the other solutions is fractionated at the 1 cm mark, the 1.5 cm, and the 2 cm mark.*

13.1.6 Inject 200 uL of toxaphene standard (Section 10.11.2) into the test tubes labeled toxaphene.
13.1.7 Inject 200 uL of aroclor standard (Section 10.11.4) into the test tubes labeled aroclors.
13.1.8 Inject 200 uL of pesticide standard (Section 10.11.5) into the test tubes labeled pesticides.
13.1.9 Add 200 uL of azulene (Section 10.7.3) to all 10 test tubes.
13.1.10 Add 500ul of surrogate(Section10.11.8) to the test tube labeled blank.
13.1.11 Proceed to Section 14.3.6.
13.1.12 See Attachment 22.9 for desired fractionation. If fractionation is not optimum, repeat above fractionation at other markings. Repeat until optimum fractionation is achieved.
13.1.13 Total recovery is determined by adding the results of both fractions together. Total recovery must be >85% for every compound. The lot is rejected if total recovery is not >85% for every compound.
13.1.14 Record results of these lot tests in the silica gel run logbook. The optimum cm column markings for the lot must be indicated.
13.1.15 The predetermined mark for this lot of silica gel is good until replaced with a new lot.

13.2 Each new lot number of SPE cartridges is tested to determine sufficient recovery of the PCBs and 1st fraction pesticides. Because azulene moves through too rapidly in the cartridge, the cartridges are not used for separating the 2nd fraction pesticides.

13.2.1 Five cartridges are placed on the SPE vacuum manifold.
13.2.2 Add 2 mL of a mix of standards (5 mL of Section 10.11.6 and 5 mL of Section 10.11.7) to each of four cartridges and 500uL of surrogate (Section 10.11.8) in 2 ml of hexane to the fifth cartridge for the MPB. Use procedure specified for cartridges (Section 14.2.3).
13.2.3 Recoveries of analytes must be at least 85% of spiked amount and free of interferences for cartridge lot to be accepted.

14.0 Procedure

14.1 Procedure for Silica Gel Columns.

14.1.1 This procedure must be performed in an area where the temperature and humidity can be controlled.
14.1.2 The optimum humidity is 25-35%.
14.1.3 The optimum temperature is 20-26°C (68–79°F).
14.1.4 Cold drafts must be avoided as they cause channeling within the column.
14.1.5 Sample preparation.

14.1.5.1 Extracts must be in hexane.
14.1.5.2 Extracts are transferred to 13X100 screw top tubes (section 9.17.3) and brought up to 2 mL with hexane.

NOTE: *If the extract is less than 1 mL, the exact volume must be measured using a syringe prior to transfer. Record the initial extract volume in the silica gel logbook (Attachment 22.3). Alternately, the extract level may be marked on the vial and the vial reused to collect the new extract.*

14.1.5.3 Allow extracts to reach room temperature.
14.1.5.4 Add 200 uL of azulene (Section 10.7.3) to every extract requiring cleanup.

14.1.6 Column Preparation.

14.1.6.1 Place some glass wool in the end of a chromatographic column.
14.1.6.2 Measure and mark the column at the predetermined level for the current lot number above the glass wool (Section13.1).
14.1.6.3 Weigh 5 g (± 0.01 g) of hot silica gel (Section 10.8.4) into an aluminum weigh boat.
14.1.6.4 Transfer the weighed silica gel to the column. Tap vigorously against wooden stand to pack the silica gel.
14.1.6.5 Add approximately 1 cm of hot sodium sulfate (Section 10.9.2) to the top of the column.

NOTE: *Pack three to four columns to allow the silica gel to cool slightly. Do not pack more than four columns or channeling could result.*

14.1.6.6 Rinse the column with 10 mL of hexane (Section 10.5). The column is ready when it appears clear with no sign of channeling. Let elute until just above level of sodium sulfate.

NOTE: *Do not let the columns go dry.*

14.1.6.7 Immediately proceed to Section 14.1.7.

14.1.7 Procedure.

14.1.7.1 Pour extract (Section 14.1.5.4) onto the column.
14.1.7.2 Rinse extract vial with 2 mL of hexane. Add this to the column just prior to the column going dry.
14.1.7.3 Repeat Section 14.1.7.2.
14.1.7.4 Prior to exposure of the column to air, discard eluate. Add 35 mL of hexane. Place a 250 mL turbovap tube under the column to collect fraction I.
14.1.7.5 Collect fraction I until the bottom of the azulene reaches the predetermined mark (Section 14.1.6.2).

NOTE: *Add additional hexane if necessary.*

14.1.7.6 Change turbovap tubes to collect fraction II. If any hexane remains in the reservoir, let it drain into fraction II or pipet it off the column and dispose.
14.1.7.7 Prior to exposure of the column to air, add 45 mL of toluene (Section 10.6).

NOTE: *Toluene causes the column to become clear, allowing the observance of the migration of the solvent through the column. Note any channeling.*

14.1.7.8 The column may be allowed to go to dryness at this point.
14.1.7.9 Concentrate each fraction on the turbovap workstation to less than 1 mL.
14.1.7.10 Transfer each fraction to 1 mL premarked crimp cap vials (Section 9.2) using pasteur pipets. Dilute to 1 mL with hexane. Cap.
14.1.7.11 Label each vial with sample number and fraction I or II.
14.1.7.12 Copy the silica gel logbook page onto blue colored paper.
14.1.7.13 Store extracts in the pesticide/PCB sample storage freezer. Staple the blue logbook copy to the batch sheets. Give this and the extracts to the analyst.

14.2 Procedure for Silica Gel Cartridges

14.2.1 Sample preparation will be the same as in Section 14.1.5. (Skip step 14.1.5.4)
14.2.2 Cartridge preparation.

14.2.2.1 Attach cartridges to flow control valves on top of SPE vacuum manifold.
14.2.2.2 Put test tubes under each cartridge in manifold to collect waste.
14.2.2.3 Set vacuum to ten inches of Hg and add 6 mL of hexane to each cartridge.
14.2.2.4 Open valve to allow a few drops to flow out, then close and let sit for at least 5 minutes.

14.2.3 Procedure

14.2.3.1 Open valves and let hexane elute at about 2 mL per minute until level is about 1 mm above the silica gel in the cartridge.
14.2.3.2 Transfer 2 mL of sample extract (Section 14.1.5.3) to cartridge. Let sample elute at about 2 mL per minute until just above silica gel. Do not let it go dry. Close control valves.
14.2.3.3 Rinse sample vial with about 0.5 mL hexane and add to cartridge.
14.2.3.4 Turn off vacuum, remove waste tubes and replace with labeled 16x100 test tubes.
14.2.3.5 Turn on vacuum and open valves to let solvent through, but do not let them go dry.
14.2.3.6 Close valves, add 5 mL hexane to cartridges and let stand for 1 minute.
14.2.3.7 Open valves and let elute until hexane just reaches top of silica gel in cartridge.
14.2.3.8 Turn off vacuum, remove collection tubes, and pour each sample into a labeled 50 mL capacity turbovap tube.
14.2.3.9 Rinse each collection tube with 5 mL hexane and add to turbovap tubes.
14.2.3.10 Concentrate on the turbovap workstation to less than 1 mL.
14.2.3.11 Transfer each fraction to 1 mL pre-marked crimp cap vials (Section 9.2) using Pasteur pipets. (Section 9.6) 'Dilute to 1mL with hexane. Cap vial.
14.2.3.12 Label each vial with sample number.
14.2.3.13 Copy the silica gel logbook page onto blue colored paper.
14.2.3.14 Store extracts in the pesticide/PCB sample storage freezer. Staple the blue logbook copy to the batch sheets. Give this and the extracts to the analyst.

14.3 Glassware cleaning

14.3.1 Use house air line to blow used silica gel from columns.
14.3.2 Put columns and turbovap tubes in dishwasher.
14.3.3 Run dishwasher as directed (Attachment 22.10).
14.3.4 Rinse all glassware with hexane prior to use.

15.0 Calculations

15.1 Divide the recovered concentration by the spiked amount and multiply by 100 to find the % recovery of each compound.

15.2 IDOC – The average and SD are determined and the % RSD is calculated by dividing the SD by the average and multiplying by 100.

16.0 Method Performance

16.1 Each MDL study must be labeled with the analyst's name and the date.

16.2 Each IDOC study must be labeled with the analyst's name and the date. A copy must be placed into the analyst's training file.

17.0 Pollution Prevention

17.1 This method uses small quantities of organic solvents. The waste that is produced is collected for disposal. (See SOP 111)

17.2 For information concerning pollution prevention that may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 See SOP 502.

19.0 Corrective Actions

19.1 QA/QC failure – If the QA/QC in SOP 502 is not met and it is determined to be attributed to the extraction or clean up, samples may be repeated through this cleaning process.

20.0 Waste Management

20.1 The Laboratory Safety Officer arranges for proper waste disposal.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Appendix A and B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition 1986, Final Update III, December 1996.

22.0 Attachments

22.1 Stock standard logbook page.

22.2 Semivolatile standard logbook page.

22.3 Silica gel runlog page.

22.4 Hexane MSDS.

22.5 Azulene MSDS.

22.6 Toluene MSDS.

22.7 Silica gel MSDS.

22.8 Sodium sulfate MSDS.

22.9 Distribution of organochlorine pesticides and PCBs (as aroclors) in silica gel column fractions.

22.10 Dishwasher program.

Signature Page

APPROVED BY _____ DATE 5/4/06
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 5/4/06
COMPLIANCE OFFICER

APPROVED BY _____ DATE 3/28/06
QA OFFICER

APPROVED BY _____ DATE 3-22-06
UNIT MANAGER

APPROVED BY _____ DATE 3/23/06
ANALYST

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									

FILE:ST-STD
12/30/98

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											

ATTACHMENT 22.2

FILE:SV-STD
12/30/98

Scan:_____
Method: 3620
Date:_____
Analyst:_____
Batch #_____

MDEQ-Environmental Lab
Silica Gel Cleanup Logbook-Organics

Humidity _____
Temperature_____

ATTACHMENT 22.3

	Silica Gel #	Hexane #			Toluene #		Azulene #
#	Sample #	Fraction #	Extraction Batch #	Volume of Toluene (mL)	Volume of Extract Cleaned (uL)	Final Volume (uL)	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							

COMMENTS

ATTACHMENT 22.4

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANES

MSDS Number: H2379 --- *Effective Date: 04/15/99*

1. Product Identification

Synonyms: Normal Hexane; Hexyl Hydride
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9277, 9306, 9309, N169

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	> 95%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
2-Methylpentane	107-83-5	1 - 2%	No
3-Methylpentane	96-14-0	1 - 2%	No
Pentane	109-66-0	0 - 2%	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

ATTACHMENT 22.4

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation;
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention

immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

5. Fire Fighting Measures

Fire:
Flash point: -21C (-6F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.1; uel: 7.5
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel

attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

ATTACHMENT 22.4

9. Physical and Chemical Properties

The following properties are for n-hexane, the major component.
Appearance:
Clear, colorless liquid.
Odor:
Gasoline-like odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
150 @ 25C (77F)
Evaporation Rate (BuAc=1):
9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

ATTACHMENT 22.4

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
2-Methylpentane (107-83-5)	No	No	None
3-Methylpentane (96-14-0)	No	No	None
Pentane (109-66-0)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

ATTACHMENT 22.4

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3.1
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	Yes	Yes
3-Methylpentane (96-14-0)	Yes	Yes	Yes	Yes
Pentane (109-66-0)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	No	Yes
3-Methylpentane (96-14-0)	Yes	Yes	No	Yes
Pentane (109-66-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
2-Methylpentane (107-83-5)	No	No	No	No
3-Methylpentane (96-14-0)	No	No	No	No
Pentane (109-66-0)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
2-Methylpentane (107-83-5)	No	No	No
3-Methylpentane (96-14-0)	No	No	No
Pentane (109-66-0)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8. Updated the ACGIH part of the Airborne section of TAB 8.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY,

ATTACHMENT 22.4

MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

ATTACHMENT 22.5

**** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Azulene, 99%
Catalog Numbers:
AC105180000, AC105180010, AC105181000
Synonyms:
Bicyclo[5.3.0]decapentaene; Cyclopentacycloheptene.
Company Identification (Europe): Acros Organics BVBA
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium
Company Identification (USA): Acros Organics
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies in Europe, call: 0032(0) 14575299

**** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

CAS#	Chemical Name	%	EINECS#
275-51-4	Azulene	99.0	205-993-6

Hazard Symbols: XI
Risk Phrases: 36/37/38

**** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW
Irritating to eyes, respiratory system and skin.

Potential Health Effects
Eye:
Causes eye irritation. May cause chemical conjunctivitis.
Skin:
Causes skin irritation.
Ingestion:
May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation:
Causes respiratory tract irritation. Can produce delayed pulmonary edema.
Chronic:
Effects may be delayed.

**** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin:
Get medical aid. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion:
Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician:
Treat symptomatically and supportively.

**** SECTION 5 - FIRE FIGHTING MEASURES ****

ATTACHMENT 22.5

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media:
In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam. Use water spray, dry chemical, carbon dioxide, or appropriate foam.

**** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks:
Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up or absorb material, then place into a suitable clean, dry, closed container for disposal. Provide ventilation.

**** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation. Use with adequate ventilation. Wash clothing before reuse.
Storage:
Keep container closed when not in use. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

**** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Personal Protective Equipment

Eyes:
Wear safety glasses and chemical goggles if splashing is possible.
Skin:
Wear appropriate protective gloves and clothing to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
A respiratory protection program that meets OSHA's 29 CFR :1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use. Wear a NIOSH/MSHA or European Standard EN 149 approved full-facepiece airline respirator in the positive pressure mode with emergency escape provisions.

**** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State:	Flakes
Appearance:	dark blue
Odor:	None reported.
pH:	Not available.
Vapor Pressure:	Not available.
Vapor Density:	Not available.
Evaporation Rate:	Not available.
Viscosity:	Not available.
Boiling Point:	242 deg C @ 760.00mmHg
Freezing/Melting Point:	99.00 - 100.50 deg C
Autoignition Temperature:	Not available.

ATTACHMENT 22.5

Flash Point	270 deg C (518.00 deg F)
Explosion Limits, lower:	Not available.
Explosion Limits, upper:	Not available.
Decomposition Temperature:	270 deg C
Solubility:	insoluble
Specific Gravity/Density:	
Molecular Formula:	C10H8
Molecular Weight:	128.17

**** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid:
Incompatible materials, dust generation, excess heat, strong oxidants.
Incompatibilities with Other Materials:
Strong oxidizing agents.
Hazardous Decomposition Products:
Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported.

**** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 275-51-4: CO4570000
LD50/LC50:
CAS# 275-51-4: Oral, mouse: LD50 = >3 gm/kg; Oral, rat: LD50 = >4 gm/kg.
Carcinogenicity:
Azulene -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No information available.
Teratogenicity:
No information available.
Reproductive Effects:
No information available.
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
No data available.

**** SECTION 12 - ECOLOGICAL INFORMATION ****

Other
No information available.

**** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.

**** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
Canadian TDG
No information available.

**** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 275-51-4 is listed on the TSCA inventory.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:

ATTACHMENT 22.5

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.

STATE
Azulene is not present on state lists from CA, PA, MN, MA, FL, or NJ.
California No Significant Risk Level:
None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: XI
Risk Phrases:
R 36/37/38 Irritating to eyes, respiratory system and skin.
Safety Phrases:
S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)
CAS# 275-51-4: No information available.
United Kingdom Occupational Exposure Limits

Canada
CAS# 275-51-4 is listed on Canada's DSL List.
CAS# 275-51-4 is not listed on Canada's Ingredient Disclosure List.
Exposure Limits

**** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 9/02/1997 Revision #3 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

ATTACHMENT 22.6

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

TOLUENE

MSDS Number: T3913 --- ***Effective Date: 11/17/99***

1. Product Identification

Synonyms: Methylbenzene; Toluol; Phenylmethane
CAS No.: 108-88-3
Molecular Weight: 92.14
Chemical Formula: C6H5-CH3
Product Codes:
J.T. Baker: 5375, 5584, 5809, 5812, 9336, 9351, 9364, 9456, 9457, 9459, 9460, 9462, 9466, 9472, 9476
Mallinckrodt: 4483, 8091, 8092, 8604, 8608, 8610, 8611, V560

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Toluene	108-88-3	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION

ATTACHMENT 22.6

TO SKIN, EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Very high concentrations may cause unconsciousness and death.
Ingestion:
Swallowing may cause abdominal spasms and other symptoms that parallel over-exposure from inhalation. Aspiration of material into the lungs can cause chemical pneumonitis, which may be fatal.
Skin Contact:
Causes irritation. May be absorbed through skin.
Eye Contact:
Causes severe eye irritation with redness and pain.
Chronic Exposure:
Reports of chronic poisoning describe anemia, decreased blood cell count and bone marrow hypoplasia. Liver and kidney damage may occur. Repeated or prolonged contact has a defatting action, causing drying, redness, dermatitis. Exposure to toluene may affect the developing fetus.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver or kidney function may be more susceptible to the effects of this substance. Alcoholic beverage consumption can enhance the toxic effects of this substance.

---

4. First Aid Measures

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. CALL A PHYSICIAN IMMEDIATELY.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities

of water. Never give anything by mouth to an unconscious person. Get medical attention immediately. If vomiting occurs, keep head below hips to prevent aspiration into lungs.
Skin Contact:
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 7C (45F) CC
Autoignition temperature: 422C (792F)
Flammable limits in air % by volume:
lel: 3.3; uel: 19
Flammable liquid and vapor!
Dangerous fire hazard when exposed to heat or flame. Vapors can flow along surfaces to distant ignition source and flash back.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Toluene:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA); 300 ppm (acceptable ceiling conc.); 500 ppm (maximum conc.).
- ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) skin, A4 - Not Classifiable as a Human Carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Aromatic benzene-like.
Solubility:
0.05 gm/100gm water @ 20C (68F).
Specific Gravity:
0.86 @ 20C / 4 C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
111C (232F)
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
3.14
Vapor Pressure (mm Hg):
22 @ 20C (68F)
Evaporation Rate (BuAc=1):
2.24

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Oral rat LD50: 636 mg/kg; skin rabbit LD50: 14100 uL/kg; inhalation rat LC50: 49 gm/m3/4H; Irritation data: skin rabbit, 500 mg, Moderate; eye rabbit, 2 mg/24H, Severe. Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Has shown some evidence of reproductive effects in laboratory animals.

ATTACHMENT 22.6

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Toluene (108-88-3)	No	No	3

12. Ecological Information

Environmental Fate:
When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. This material has a log octanol-water partition coefficient of less than 3.0. Bioconcentration factor = 13.2 (eels).
Environmental Toxicity:
This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TOLUENE
Hazard Class: 3
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

International (Water, I.M.O.)

Proper Shipping Name: TOLUENE

ATTACHMENT 22.6

Hazard Class: 3.2
UN/NA: UN1294
Packing Group: II
Information reported for product/size: 390LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Toluene (108-88-3)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Toluene (108-88-3)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

Ingredient	-SARA 302- RQ	TPQ	List	------SARA 313------ Chemical Catg.
Toluene (108-88-3)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Toluene (108-88-3)	1000	U220	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: 3[Y]E
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 2 Flammability: 3 Reactivity: 0
Label Hazard Warning:
POISON! DANGER! HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF

INHALED OR ABSORBED THROUGH SKIN. VAPOR HARMFUL. FLAMMABLE LIQUID AND VAPOR. MAY AFFECT LIVER, KIDNEYS, BLOOD SYSTEM, OR CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT.

Label Precautions:

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If vomiting occurs, keep head below hips to prevent aspiration into lungs. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician immediately.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

ATTACHMENT 22.7

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

All non-emergency questions should be directed to Customer Service (1-800-582 2537) for assistance

Silica Gel

MSDS Number: S1610 --- *Effective Date: 08/20/98*

1. Product Identification

Synonyms: Kieselgel; Daiso Gel; Silica, Amorphous
CAS No.: 63231-67-4
Molecular Weight: Not available.
Chemical Formula: Not Available.
Product Codes: 3404, 3405, 3406

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Silica Gel	63231-67-4	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

ATTACHMENT 22.7

Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Orange (General Storage)

Potential Health Effects

This product contains synthetic amorphous silica, not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

Inhalation:
May cause dryness and irritation to mucous membranes, nose, and throat. Symptoms may include coughing, sore throat, and wheezing.
Ingestion:
No adverse effects expected.
Skin Contact:
May cause irritation with dryness and abrasion.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
Repeated exposure may cause symptoms similar to those listed for acute effects. Synthetic amorphous silica does not produce silicosis.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. When pouring into a container of flammable liquid, ground both containers electrically to prevent a static electric spark. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Silica (synthetic, amorphous):
- OSHA Permissible Exposure Limit (PEL) -
80/(%SiO2) mg/m3 (TWA) for amorphous silica, including natural diatomaceous earth.
- ACGIH Threshold Limit Value (TLV) -
10 mg/m3 (TWA) for amorphous precipitated silica and amorphous silica gel.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator

supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White granular powder.
Odor:
Odorless.
Solubility:
Negligible (< 0.1%)
Specific Gravity:
2.10
pH:
3 - 8 (in 5% slurry)
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
2230C (4046F)
Melting Point:
1610C (2930F)
Vapor Density (Air=1):
Not applicable.
Vapor Pressure (mm Hg):
Not applicable.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Oxides of carbon and silicon may be formed when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Reacts with hydrogen fluoride, fluorine, oxygen difluoride, chlorine trifluoride, strong acids, strong bases, and oxidizers.

Conditions to Avoid:
Moisture, extreme heat, and incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Silica Gel (63231-67-4)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into water, this material is not expected to biodegrade.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Silica Gel (63231-67-4)	Yes	No	No	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.

ATTACHMENT 22.7

Silica Gel (63231-67-4)	Yes	Yes	No	Yes

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Silica Gel (63231-67-4)	No	No	No	No

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Silica Gel (63231-67-4)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312 Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If inhaled, remove to fresh air. Get medical attention for any breathing difficulty. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 16.
Disclaimer:
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ATTACHMENT 22.7

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

ATTACHMENT 22.8

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

SODIUM SULFATE

MSDS Number: S5022 --- ***Effective Date: 11/17/99***

1. Product Identification

Synonyms: Sodium sulfate decahydrate; disodium sulfate decahydrate; glauber's salt; sulfuric acid, sodium salt, decahydrate; sodium sulfate, 10-hydrate
CAS No.: 7757-82-6 (Anhydrous)
Molecular Weight: 322.19
Chemical Formula: Na2SO4.10H2O
Product Codes:
J.T. Baker: 3889, 3890
Mallinckrodt: 8012, 8027

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Sulfate	7757-82-6	98 - 100%	Yes

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
Not expected to be a health hazard.
Ingestion:
Mildly toxic by ingestion. Systemic toxicity is unlikely unless massive amounts have been swallowed. Drinking water with > 500 mg/L may result in gastrointestinal irritation.
Skin Contact:
No adverse effects expected.
Eye Contact:
No adverse effects expected but dust may cause mechanical irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Not expected to require first aid measures.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered an explosion hazard, but violent explosions occur when potassium sulfate and sodium sulfate are melted with aluminum.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the dust or mist is apparent, a half-face dust/mist respirator may be worn. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White efflorescent crystals or granules.
Odor:
Odorless.
Solubility:
Soluble in 1.5 parts of water @ 25C (77F).
Specific Gravity:
1.46
pH:
Aqueous solution is neutral.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
32C (90F) Loses water at 100C (212F). Anhydrous melts ca. 844C (1551F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability
Stable under ordinary conditions of use and storage. Effloresces in dry air.
Hazardous Decomposition Products:
Oxides of sulfur and sodium may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
In combination with sodium sulfate, aluminum and magnesium will explode @ 800C (1472F); strong mineral acids and bases.
Conditions to Avoid:
Air, incompatibles.

11. Toxicological Information

Investigated as a tumorigen, mutagen, reproductive effector. No LD50/LC50 information found relating to normal routes of occupational exposure.

--------OSHA Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category

ATTACHMENT 22.8

Sodium Sulfate (7757-82-6)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to leach into groundwater. This material is not expected to significantly bioaccumulate.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l. The EC50/48-hour values for daphnia are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

\Chemical Inventory Status - Part 1\

Ingredient	TSCA	EC	Japan	Australia
Sodium Sulfate (7757-82-6)	Yes	Yes	Yes	Yes

\Chemical Inventory Status - Part 2\

Ingredient	Korea	Canada DSL	Canada NDSL	Canada Phil.
Sodium Sulfate (7757-82-6)	Yes	Yes	No	Yes

\Federal, State & International Regulations - Part 1\

Ingredient	SARA 302 RQ	SARA 302 TPQ	SARA 313 List	SARA 313 Chemical Catg.
Sodium Sulfate (7757-82-6)	No	No	No	No

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	RCRA 261.33	TSCA 8(d)
Sodium Sulfate (7757-82-6)	No	No	No

ATTACHMENT 22.8

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Solid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
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ATTACHMENT 22.8

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

DISTRIBUTION OF ORGANOCHLORINE PESTICIDES AND PCBs (AS AROCLORS) IN SILICA GEL COLUMN FRACTIONS

Compound	Fraction I	Fraction II
Hexachlorobutadiene	X	
1,2,4,5-Tetrachlorobenzene	X	
Hexachlorocyclopentadiene	X	
1,2,3,4-Tetrachlorobenzene	X	
Pentachlorobenzene	X	
alpha-BHC		X
Hexachlorobenzene	X	
beta-BHC		X
gamma-BHC (Lindane)		X
Pentachloronitrobenzene	<30%	>70%
delta-BHC		X
Heptachlor	X	
Aldrin	X	
Heptachlor Epoxide		X
gamma-Chlordane		X
alpha-Chlordane		X
Endosulfan I		X
Dieldrin		X
4-4'-DDE	>70%	<30%
Endrin		X
Endosulfan II		X
4,4,'-DDD		X
Endrin Aldehyde		X
Endosulfan Sulfate		X
4,4'-DDT	<20%	>80%
Endrin Ketone		X
Hexabromobenzene	X	
Methoxychlor		X
Mirex	X	
PBB (BP-6)	X	
Toxaphene		X
PCBS (as Aroclors)	X	
TCMX (surrogate)	X	
DCB (surrogate)	X	

Attachment 22.10

The Lancer dishwasher has two programs that we use. Program 5 uses deionized water and program 4 uses tap water.

Functions	Possibility	Our Program
PREWASH 1 PERIOD	0-30 MINUTES	1 MINUTE
FILLING	HOT/COLD	HOT
PREWASH 1 TEMPERATURE	0-95°C	50°C
PREWASH 1 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 1 ADDITIVE 2 (ACID)	0-6 MINUTES	0
PREWASH 2 PERIOD	0-30 MINUTES	2 MINUTES
FILLING	HOT/COLD	HOT
PREWASH 2 TEMPERATURE	0-95°C	65°C
PREWASH 2 DETERGENT	0-6 MINUTES	24 SECONDS
PREWASH 2 ADDITIVE 2	0-6 MINUTES	0
PREWASH 3 PERIOD	0-30 MINUTES	0
FILLING	HOT/COLD	0
PREWASH 3 TEMPERATURE	0-95°C	0
PREWASH 3 DETERGENT	0-6 MINUTES	0
PREWASH 3 ADDITIVE 2	0-6 MINUTES	0
WASH PERIOD	0-30 MINUTES	4 MINUTES
FILLING	HOT/COLD	HOT
WASH TEMPERATURE	0-95°C	80°C
WASH DETERGENT	0-6 MINUTES	1 MINUTE. 6 SECONDS
WASH ADDITIVE 2	0-6 MINUTES	0
RUNNING WATER RINSE 1	0-9 MINUTES	2 MINUTES
ACID RINSE PERIOD	0-30 MINUTES	2 MINUTES
ACID	0-6 MINUTES	2 MINUTES
RUNNING WATER RINSE 2	0-9 MINUTES	7 MINUTES
COLD DEMI. WATER RINSE 1	0-30 MINUTES	0
COLD DEMI. WATER RINSE 2	0-30 MINUTES	0
COLD DEMI. WATER RINSE 3	0-30 MINUTES	0
COLD DEMI. WATER RINSE 4	0-3 MINUTES	0
HOT DEMI. WATER RINSE	0-30 MINUTES	2 MINUTES
HOT DEMI. TEMPERATURE	0-95°C	75°C
HOT DEMI. ADDITIVE	0-6 MINUTES	0
DRYING	0-90 MINUTES	25 MINUTES

DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 403 REVISION # ____

EFFECTIVE DATE 04/02

PAGE 1 OF 11 COPY ____

RELEASED BY _____ DATE 6/13/02
COMPLIANCE OFFICER

FLORISIL CLEANUP

1.0 Applicable Analytical Methods

1.1 Florisil Cleanup, U.S. Environmental Protection Agency, Method 3620B, SW846, Revision 2, December 1996.

1.2 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.3 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996.

1.4 Cleanup, U.S. Environmental Protection Agency, Method 3600C, SW846, Revision 3, December 1996.

2.0 Matrix or Matrices

2.1 Aqueous.

2.2 Soil.

2.3 Sediment.

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Solid or liquid waste.

FLGK

3.0 Method Detection Limits (MDLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 MDLs are extracted according to internal procedure SOP 405 and cleaned up according to internal procedure SOP 400 prior to florisil cleanup. The extract must be in hexane.

4.0 Scope and Application

4.1 This method provides for the cartridge cleanup of pesticide residues and other chlorinated hydrocarbons, the separation of nitrogen compounds from hydrocarbons, the separation of aromatic compounds from aliphatic-aromatic mixtures, and similar applications for use with fats, oils, ketones, glycerides, alkaloids, and some carbohydrates.

4.2 Florisil is a magnesium silicate with basic properties and can be used to separate analytes from interfering compounds prior to sample analysis by chromatographic methods.

4.3 This method includes procedures for cleanup of sample extracts containing the following analyte groups:

Phthalate esters	Chlorinated hydrocarbons
Nitrosamines	Organochlorine pesticides
Nitroaromatics	Organophosphates
Haloethers	Organophosphorus pesticides
Aniline and aniline derivatives	PCBs

5.0 Method Summary

5.1 Water samples are extracted by following internal procedure SOP 405 and are cleaned up as in internal procedure SOP 400. Solid samples are extracted by following internal procedure SOP 401 and are cleaned up as in internal procedure SOP 400. Oil samples are prepared as defined in internal procedure SOP 404 and are cleaned up as in internal procedure SOP 400. The sample extracts are then solvent exchanged to hexane.

5.2 Solid-phase extraction cartridges containing 40 µm particles of florisil (60 Å pores) are rinsed with appropriate solvents.

5.3 Sample extracts are introduced onto the top of the pre-packed column and eluted with suitable solvent(s). The eluate is concentrated to 1 mL in hexane and analyzed

by gas chromatography with electron capture detection (GC-ECD)(internal procedure SOP 502).

6.0 Definitions

6.1 Method Preparation Blank (MPB) - An aliquot of a blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.2 Laboratory Control Sample (LCS) - An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction, cleanup, and analysis.

6.3 Matrix Spike (MS) - An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.4 Matrix Spike Duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

7.0 *Interferences*

7.1 Interferences from contaminants can occur from solvents, glassware, and other sample processing equipment. Pesticide quality solvents (or better) and solvent rinsing of all glassware should help minimize contaminants.

7.2 The use of plastic must be minimized to prevent phthalate contamination.

7.3 Soap residue must be thoroughly rinsed from all glassware to avoid degradation of some pesticide compounds.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (internal procedure SOP 100).

8.4 Hexane, acetone, florisil and sodium sulfate material safety data sheets (MSDSs) are attached.

8.5 Nitrile or other solvent resistant gloves must be worn when handling solvents.

9.0 Equipment and Supplies

9.1 SPE PTFE manifold turn valves - Burdick & Jackson, part #9433T or equivalent.

9.2 SPE PTFE manifold port - Burdick & Jackson, part #9431 or equivalent.

9.3 Vials - 2 mL crimp vial with cap, Agilent, part #5181-3375 (vials), part #5181-1217 (caps) or equivalent.

9.3.1 Place 1 mL of hexane into each vial.
9.3.2 Mark the meniscus with a lab marker.
9.3.3 Dispose of the hexane. Let vial air dry.

9.4 Turbovap tubes - 50 mL capacity, Zymark, part #ZA2039 or equivalent.

9.5 Turbovap trays - Capacity of twelve 50 mL tubes.

9.6 Turbovap concentration workstation - With temperature control up to 95°C and nitrogen pressure from zero to 20 psi (settings: temperature = 35°C and pressure = 15 psi).

9.7 Pasteur pipets.

9.8 Bottle top dispensers - 1 to 10 mL.

9.9 Florisil manifold.

9.10 Graduated cylinders – 1000 mL.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 Nitrogen – Liquid.

10.6 Hexane (95% n-hexane) - Pesticide grade, demonstrated to be free of target analytes.

10.7 Acetone - HPLC grade, demonstrated to be free of target analytes.

10.8 Hexane/acetone (80/20).

10.8.1 Label an empty 4 L amber solvent bottle (Section 10.3).
10.8.2 Using a graduated cylinder, measure 3200 mL of hexane. Pour into a labeled amber bottle.
10.8.3 Using a graduated cylinder, measure 800 mL of acetone. Pour into a labeled amber bottle.
10.8.4 Mix by inverting the bottle several times. Vent.
10.8.5 Fill out the semivolatile standard logbook (Attachment 22.2).
10.8.6 Store the mixture in the water extractions florisil hood.

10.9 Florisil cartridges (2000 mg,15 mL) – Alltech, part #207962SP or equivalent.

10.10 Stock standards (SSs) – All standards must be certified reference materials. Manufacturer's certificates of analysis are retained by the DEQ laboratory and are kept as part of the overall quality assurance/quality control (QA/QC) requirements. All SSs must be given a unique lab tracking number and logged into the SS (Environmental Laboratory) tracking logbook (Attachment 22.1). Store the SSs in amber sealed ampules. Protect the standards from light. All standards are received in hexane unless otherwise noted.

10.10.1 SSs – SSs are purchased as mixes in sealed ampules and stored in a freezer at a temperature lower than 0°C.

10.10.1.1 Custom pesticide standard (1000 µg/mL) in hexane:toluene - Accustandard Inc., part #S-7179-R1 or equivalent.

Aldrin	Endosulfan Sulfate
alpha-BHC	*Endrin*
beta-BHC	Endrin Aldehyde
delta-BHC	Endrin Ketone
gamma-BHC (Lindane)	Heptaclor
alpha-Chlordane	Heptaclor Epoxide
gamma-Chlordane	Methoxyclor
4,4'-DDD	Mirex
4,4'-DDE	*Hexabromobenzene*
4,4'-DDT	PBB (BP-6)
Dieldrin	TCMX (surrogate)
Endosulfan I	DCB (surrogate)
Endosulfan II	

10.10.1.2 Custom volatile organic compound (VOC) standard (1000 µg/mL) in Acetone - Accustandard Inc., part #S-8258 or equivalent.

Pentachlorobenzene	Hexachlorobenzene
Pentachloronitrobenzene	Hexachlorobutadiene
1,2,3,4-Tetrachlorobenzene	Hexachlorocyclopentadiene
1,2,4,5-Tetrachlorobenzene	

10.11 Intermediate and working standards (WSs) – All prepared standards must be given a unique laboratory tracking number and logged into the semivolatile standards logbook (Attachment 22.2). Store prepared standards in labeled amber bottles in a freezer. Prepared standards are good for up to six months.

10.11.1 Pesticide WS (250 µg/L) – Place hexane in a 500 mL volumetric flask. Inject 125 µL of custom pesticide standard (Section 10.10.1.1) and 125 µL of custom VOC standard (Section 10.10.1.2) directly into the hexane in the flask. Bring to volume with hexane. Cap. Mix.

10.11.2 For a 125 ppb standard, make a 1:2 dilution of the 250 ppb standard in hexane.

11.0 Sample Collection, Preservation, and Handling

11.1 Aqueous samples – See internal procedure SOP 405.

11.2 Solid samples – See internal procedure SOP 401.

11.3 Waste samples – See internal procedure SOP 404.

11.4 Holding times – Sample extracts may be analyzed for up to 40 days from the extraction date.

11.5 Storage – Sample extracts must be stored in a freezer and protected from light in crimp cap vials until analysis.

12.0 Quality Control (QC)

12.1 All associated QC samples must be processed through this cleanup method along with the sample extracts.

12.2 Extracted sample batches

12.2.1 Extracted sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS (if a MS/MSD is not available, a laboratory control sample duplicate [LCSD] must be analyzed).

12.2.2 MSs and MSDs are actual samples that are selected at random from within the batch of 20.

12.2.3 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction or during cleanup of individual samples.

12.2.4 The MS, MSD, LCS, and LCSD are spiked at a known concentration with target analyte compounds. The replicate MSs or LCSs are used to evaluate the entire batch for precision and accuracy.

12.3 Initial demonstration of ability (IDOA) - Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for the target analytes. This is accomplished by extraction and cleanup of four aliquots of a reference sample.

12.3.1 Five aliquots of reagent water or sand are extracted using internal procedure SOP 401 or internal procedure SOP 405. One of these is a MPB, and the other four are spiked at a mid-range concentration with all the analytes of interest.

12.3.2 Sample extracts are taken through all the normal sample cleanup methods.

12.3.3 Extracts are then analyzed by GC-ECD. See internal procedure SOP 502 for further details.

13.0 Calibration and Standardization

13.1 Each new lot of florisil is tested to determine if compound recoveries are sufficient and if cartridges are free of interferences. The procedure is as follows:

13.1.1 Prepare hexane/acetone mix (Section 10.8).

13.1.2 Attach turn valves and manifold ports to three cartridges. Place the assembled cartridges on the manifold.

13.1.3 Add 5 mL of 80/20 hexane/acetone to each cartridge. Place waste containers under the cartridges.

13.1.4 Open the valves enough to allow several drops to pass through each column. Close the valves. Allow the cartridges to soak for at least five minutes.

13.1.5 Open the valves. Drain. Do net let the cartridges go dry. Close the valves.

13.1.6 Add 5 mL of hexane to each cartridge.

13.1.7 Open the valves. Drain. Do not let the cartridges go dry. Close the valves.

13.1.8 Label the cartridges (MPB, LCS1, and LCS2).

13.1.9 Add 1 mL of hexane to the cartridge labeled MPB. Add 1 mL of 125 ppb pesticide WS (Section 10.11.2) to each LCS cartridge.

13.1.10 Open the valve to drain into the waste container. When the entire extract has passed through, but before it goes dry, close the valve.

13.1.11 Place a labeled turbovap tube under each cartridge

13.1.12 Elute each cartridge with 9 mL of hexane/acetone (80/20). Open the valves. Let the cartridges go dry.

13.1.13 Concentrate each sample on the turbovap workstation to less than 1 mL.

13.1.14 Transfer each sample to a 1 mL pre-marked crimp cap vial (Section 9.3) using pasteur pipets. Dilute to 1 mL with hexane. Cap.

13.1.15 Label each vial (MPB, LCS1, and LCS2).

13.1.16 Fill out the solvent/reagent checking logbook (Attachment 22.7).

13.1.17 Fill out the florisil logbook. Copy onto yellow colored paper (Attachment 22.6).

13.1.18 Give the yellow copy of the florisil logbook page and the samples to the analyst.

14.0 Procedure

14.1 Sample preparation

14.1.1 Extracts must be in hexane.
14.1.2 Extracts must be taken off the GPC. The solvent must be exchanged prior to being florisilied.
14.1.3 Concentrate extracts to approximately 1 mL in hexane in a turbovap tube.

14.2 Cartridge preparation

14.2.1 Attach a SPE PTFE turn valve to the tip of each florisil cartridge.
14.2.2 Attach a SPE PTFE manifold port to the tip of each turn valve.
14.2.3 Place assembled florisil cartridges in the manifold apparatus. Place waste containers under the cartridges.
14.2.4 Add 5 mL of 80/20 hexane/acetone (Section 10.8) to each cartridge. Open the valves. Allow several drops of solvent to pass through each column. Close the valves. Allow the cartridges to soak for at least five minutes.
14.2.5 Open the valves. Drain. Do not let the cartridges go dry. Close the valves.
14.2.6 Add 5 mL of hexane to each cartridge.
14.2.7 Open the valves. Drain. Do not let the cartridges go dry. Close the valves.
14.2.8 Label the cartridges.
14.2.9 Immediately proceed to Section 14.3.1.

14.3 Procedure

14.3.1 Transfer the sample from the turbovap tube with a pasteur pipet to the appropriately labeled cartridge.
14.3.2 Open the valve to drain into the waste container. When the entire extract has passed through, but before it goes dry, close the valves.
14.3.3 Rinse the turbovap tube with 1 mL of hexane. Transfer the rinsate to the cartridge.
14.3.4 Place the same turbovap tube under the cartridge. Drain. Do not allow it to go dry.
14.3.5 Elute each cartridge with 9 mL of hexane/acetone (80/20). Let the cartridge go dry.
14.3.6 Concentrate each sample on the turbovap workstation to less than 1 mL.
14.3.7 Transfer each sample to a 1 mL pre-marked crimp cap vial (Section 9.3) using pasteur pipets. Dilute to 1 mL with hexane. Cap.
14.3.8 Label each vial with the sample number.
14.3.9 Fill out the florisil logbook. Copy onto yellow colored paper (Attachment 22.6).
14.3.10 Staple the yellow logbook copy to the batch sheets. Give this and the extracts to the analyst.

15.0 Calculations

15.1 See internal procedure SOP 502.

16.0 Method Performance

16.1 Each MDL study must be labeled with the analyst's name and the date.

16.2 Each IDOA study must be labeled with the analyst's name and the date. A copy must be placed into the analyst's training file.

17.0 Pollution Prevention

17.1 This method uses small quantities of organic solvents. The waste that is produced is collected for disposal.

17.2 For information concerning pollution prevention that may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Florisil lot check (Section 13.1) – All recoveries must be 80 – 110% with no interfering peaks.

19.0 Corrective Actions

19.1 QA/QC failure – If the QA/QC in internal procedure SOP 502 is not met and if it is determined to be attributed to the extraction or cleanup, the samples may be repeated through this cleanup process.

20.0 Waste Management

20.1 The Laboratory Safety Officer arranges for proper waste disposal.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, Part 136, Appendix A and B, U.S. Government Printing Office, Washington, DC.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition 1986, Final Update III, December 1996.

22.0 Attachments

22.1 Stock standard logbook page.

22.2 Semivolatile standard logbook page.

22.3 Hexane MSDS.

22.4 Acetone MSDS.

22.5 Florisil MSDS.

22.6 Florisil logbook page.

22.7 Solvent/reagent checking logbook page.

DEQ

ENVIRONMENTAL LAB
PAGE 11 of 11

MDEQ SOP# 403 REVISION #____

APPROVED BY Bob H Avery DATE 5/17/02
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY [signature] DATE 5/16/02
COMPLIANCE OFFICER

APPROVED BY [signature] DATE 4/23/02
QA OFFICER

APPROVED BY Carol Smith DATE 4-18-02
UNIT MANAGER

APPROVED BY Katt Dw DATE 4/17/02
ANALYST

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
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EL-									
EL-									

ATTACHMENT 22.1

FILE:ST-STD
12/30/98

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
SE-											
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SE-											
SE-											
SE-											
SE-											

ATTACHMENT 22.2

FILE:SV-STD
12/30/98

*INCLUDE UNITS

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1 800-582-2537) for assistance.

HEXANES

MSDS Number: H2379 --- *Effective Date: 11/02/01*

1. Product Identification

Synonyms: Normal Hexane; Hexyl Hydride
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
9277, 9306, 9309, N169

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	> 95%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
2-Methylpentane	107-83-5	1 - 2%	No
3-Methylpentane	96-14-0	1 - 2%	No
Pentane	109-66-0	0 - 2%	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF

INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:

Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

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5. Fire Fighting Measures

Fire:
Flash point: -21C (-6F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.1; uel: 7.5
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

The following properties are for n-hexane, the major component.

Appearance:
Clear, colorless liquid.
Odor:
Gasoline-like odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
150 @ 25C (77F)
Evaporation Rate (BuAc=1):
9

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category

Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
2-Methylpentane (107-83-5)	No	No	None
3-Methylpentane (96-14-0)	No	No	None
Pentane (109-66-0)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	Yes	Yes
3-Methylpentane (96-14-0)	Yes	Yes	Yes	Yes
Pentane (109-66-0)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	No	Yes
3-Methylpentane (96-14-0)	Yes	Yes	No	Yes
Pentane (109-66-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
2-Methylpentane (107-83-5)	No	No	No	No
3-Methylpentane (96-14-0)	No	No	No	No
Pentane (109-66-0)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
2-Methylpentane (107-83-5)	No	No	No
3-Methylpentane (96-14-0)	No	No	No
Pentane (109-66-0)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]E

Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ACETONE

MSDS Number: A0446 — *Effective Date: 04/10/01*

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5356, 5580, 5805, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9036, 9125, 9254, 9271, A134, V655
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES

IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.
Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.
Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.
Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Aggravation of Pre-existing Conditions:
Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

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5. Fire Fighting Measures

Fire:

Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.

Fire Extinguishing Media:

Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless, volatile liquid.

Odor:
Fragrant, mint-like
Solubility:
Miscible in all proportions in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
56.5C (133F) @ 760 mm Hg
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
2.0
Vapor Pressure (mm Hg):
400 @ 39.5C (104F)
Evaporation Rate (BuAc=1):
ca. 7.7

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: Yes
SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.

Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

No changes.

Disclaimer:

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS | J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

FLORISIL®

MSDS Number: F2546 — *Effective Date: 11/02/01*

1. Product Identification

Synonyms: Synthetic magnesia-silica gel; Activated magnesium silicate; Florisil® 60-100 mesh; Florisil® 100-200 mesh; Florisil® 60-100 suitable for pesticide residue analysis; Magnesia-Silica Gel; Magnesium Silicate; Silicic Acid, Magnesium Salt
CAS No.: 1343-88-0
Molecular Weight: Not applicable to mixtures.
Chemical Formula: MgO 3.75 SiO2.xH2O
Product Codes: J.T. Baker: 3372, M368, M369
Mallinckrodt: 6875, 6876, 6877

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Synthetic Magnesia-silica gel	1343-88-0	90 - 100%	Yes

Florisil® is a registered trademark of U.S. Silica Company

3. Hazards Identification

Emergency Overview

CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY

TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause dryness and irritation to mucous membranes, nose, and throat.
Ingestion:
No adverse effects expected.
Skin Contact:
May cause irritation with dryness and abrasion.
Eye Contact:
No adverse effects expected but dust may cause mechanical irritation.
Chronic Exposure:
Grossly excessive and chronic inhalation of the dust may cause a progressive chemical pneumonitis, cyanosis, and pulmonary edema. Repeated or prolonged ingestion may contribute to the production of urinary calculi.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
15 mg/m3 total dust, 5 mg/m3 respirable fraction for nuisance dusts.
- ACGIH Threshold Limit Value (TLV):
10 mg/m3 total dust containing no asbestos and < 1% crystalline silica for Particulates Not Otherwise Classified (PNOC).
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half facepiece particulate respirator (NIOSH type N95 or better filters) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest.. A full-face piece particulate respirator (NIOSH type N100 filters) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure

levels are not known, use a full-facepiece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
White powder or granules.
Odor:
Odorless.
Solubility:
Insoluble in water.
Specific Gravity:
2.51
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No information found.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Hydrofluoric acid will dissolve substance and produce corrosive silicon tetrafluoride.
Conditions to Avoid:
Dusting and incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Synthetic Magnesia-silica gel (1343-88-0)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Synthetic Magnesia-silica gel (1343-88-0)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

	--Canada--

Ingredient	Korea	DSL	NDSL	Phil.
Synthetic Magnesia-silica gel (1343-88-0)	Yes	Yes	No	Yes

Federal, State & International Regulations - Part 1

Ingredient	-SARA 302- RQ	TPQ	-SARA 313- List	Chemical Catg.
Synthetic Magnesia-silica gel (1343-88-0)	No	No	No	No

Federal, State & International Regulations - Part 2

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Synthetic Magnesia-silica gel (1343-88-0)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.
Label Precautions:
Avoid breathing dust.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If inhaled, remove to fresh air. Get medical attention for any breathing difficulty. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MDEQ-Environmental Lab
Florisil Cleanup Logbook-Organics

Scan:_____
Method: 3620
Date:_____
Analyst:_____
Batch #_____

ATTACHMENT 22.6

	Florsil Cartridge EL#		Hexane EL#		Hexane/Acetone SE#	
#	Sample #	Fraction #	Extraction Batch #	Volume of Extract Cleaned (uL)	Final Volume (uL)	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						

COMMENTS

MDEQ-ENVIRONMENTAL LAB
SOLVENT CHECKING LOG

Solvent	Manufacturer	Lot #	Date Checked	Analyst	Comments/ Results	Acceptable Yes/No

ATTACHMENT 22.7

FILE:SOL
01/09/99

DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 405 REVISION # 2

EFFECTIVE DATE 01/05

PAGE 1 OF 21 COPY

RELEASED BY _____ DATE 1/24/05
COMPLIANCE OFFICER

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION

1.0 Applicable Analytical Methods

1.1 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revised, December 1996.

1.2 Separatory Funnel Liquid-Liquid Extraction, U.S. Environmental Protection Agency, Method 3510C, SW846, Revision 3, December 1996.

1.3 Organochlorine Pesticides and PCBs, U.S. Environmental Protection Agency, Method 608, 40 CFR, Part 136, Appendix A.

1.4 Chlorinated Hydrocarbons, U.S. Environmental Protection Agency, Method 612, 40 CFR, Part 136, Appendix A.

1.5 Base Neutrals and Acids, U.S. Environmental Protection Agency, Method 625, 40 CFR, Part 136, Appendix A.

1.6 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

2.0 Matrix or Matrices

2.1 Aqueous.

3.0 Method Detection Limits

3.1 All method detection limits (MDLs) shall be performed according to the Code of Federal Regulations, 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. MDLs are analyzed annually or whenever major instrument maintenance occurs. MDLs should be calculated as in 40 CFR, Part 136, Appendix B.

3.3 A minimum of seven replicate extractions are performed using reagent water spiked with the analytes of interest at a level which meets the criteria in SOP 103.

3.3.1 One method preparation blank (MPB) is extracted with every set of MDLs.

3.3.2 The MPB and all the replicates must be extracted as if they were samples and must undergo the same cleanups as a sample.

4.0 Scope and Application

4.1 The method is used in the extraction of semi-volatile organic compounds from municipal and industrial discharges, surface waters, and groundwaters.

4.2 This method is designated to meet the monitoring requirements of the National Pollutant Discharge Elimination System and similar environmental programs.

4.3 This method is applicable to the extraction of semi-volatile organic compounds, halogenated hydrocarbons, polychlorinated biphenyls (PCBs), and certain organochlorine pesticides. See DEQ Laboratory SOP # 500 and SOP #502 for complete lists of compounds covered by this method.

5.0 Method Summary

5.1 A 1 L sample is serially extracted with methylene chloride (MeCl) using separatory funnel techniques. The extract is dried with sodium sulfate and concentrated.

5.1.1 Gel permeation chromatography (GPC) cleanup is required for PCB or pesticide analysis unless the sample matrix is expected to be clean. After GPC, the sample is concentrated and further cleaned with florisil.

5.1.2 For base neutral acids (BNAs), base neutrals (BNs), acids or polynuclear aromatic hydrocarbons (PNAs), the sample extract is diluted to 1.0 mL in methylene chloride. No further cleanup is required.

5.2 Extracts are then analyzed by gas chromatography (GC) or GC/mass spectrometry (MS) for the requested parameters. See DEQ Laboratory SOP# 500 and SOP #502.

6.0 Definitions

6.1 MDL – The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

SEE F

6.2 Surrogate analyte (SA) - A pure analyte which is extremely unlikely to be found in any sample and which is added to a sample aliquot in known amounts before extraction or other processing and is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

6.3 MPB - An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.4 Laboratory control sample (LCS) - An aliquot of reagent water to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction and analysis.

6.5 Lab control sample duplicate (LCSD) – A second aliquot of reagent water to which known quantities of the method analytes are added in the laboratory. The LCSD is treated exactly as a sample including extraction and analysis.

6.6 Matrix spike (MS) - An aliquot of a sample to which known quantities of the method analytes are added in the laboratory. The MS is treated exactly as a sample including extraction and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.7 Matrix spike duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

7.0 Interferences

7.1 Interferences may be from solvents, reagents, glassware, and other sample processing equipment and may cause misinterpretation of GCs and/or elevated reporting limits. All of these materials must be demonstrated to be virtually free from interferences under the conditions of the analysis by running method preparation blanks. The use of pesticide grade or better reagents will reduce the occurrence of interferences.

7.2 Interferences coextracted from samples will vary considerably from source to source depending upon the diversity of the samples. While general cleanup techniques are referenced in this method, unique samples may require additional cleanup approaches.

7.3 Plastics must be avoided due to phthalate ester contamination.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (SOP 100).

8.4 Gas tanks must be secured to a wall or counter top.

8.5 MeCl, hexane, sulfuric acid, methanol, acetone, sodium hydroxide, and sodium sulfate material safety data sheets (MSDSs) are attached.

8.6 Protective gloves must be worn when handling solvents.

8.7 Samples containing cyanide need special care if acid is added to them. Because acid releases cyanide, it must be added in a hood with the sash pulled as far down as possible. Shake the sample and acid. Vent it in a hood. Cyanide smells similar to almonds or bread baking.

8.8 Solvent spill kits are located near the refrigerator in Room 301.

9.0 Equipment and Supplies

9.1 Extraction equipment

9.1.1 Separatory funnel – 2000 mL with teflon (Nalgene part #4301-2000 or equivalent).
9.1.2 FEP teflon filling funnel, 450mL – Big Science, Inc. part #P00007
9.1.3 Glass wool – Pyrex brand or equivalent.
9.1.4 Turbovap tubes – Zymark, 250 mL, 50 mL and suitable racks.
9.1.5 Turbovap workstation – Zymark, model ZW640-3.
9.1.6 Rotomixer – Associated Design and Manufacturing Co.
9.1.7 pH paper – EM-Reagents, colorfast, pH 0-14, or equivalent.
9.1.8 Crimp cap vials and caps – 2 mL.

9.1.8.1 Fill each vial with one mL of MeCl from a calibrated bottle top dispenser. Check the dispenser prior to use with a volumetric flask.
9.1.8.2 Mark the meniscus on each vial.
9.1.8.3 Discard the solvent. Turn the vial upside down in a rack to dry.

9.1.9 Pipettes – Pasteur.
9.1.10 Volumetric pipets – Class A, various sizes.

9.1.11 Volumetric flasks – Class A, various sizes with ground glass stoppers.
9.1.12 Syringes – 50 µl or 100 µl.
9.1.13 Stir bars and stir plate.
9.1.14 Beakers – 1 L.
9.1.15 Graduated cylinders – 2000 mL and 500 mL.
9.1.16 Oven – Capable of maintaining 130°C.
9.1.17 Bottle top dispensers – 10 mL and 50 mL, solvent resistant.
9.1.18 Bottles – Amber glass, Teflon lined screw-cap, glass, 250 mL and 1000 mL.
9.1.19 Centrifuge – Dupont Sorvall GLC-2B or equivalent.
9.1.20 Centrifuge tubes – Glass, must fit into Section 9.1.19.
9.1.21 Pipet bulbs – For pasteur and volumetric pipets.
9.1.22 Tweezers – Long.
9.1.23 Flasks – Erlenmeyer, glass, 250 mL.
9.1.24 Foil.
9.1.25 Culture tubes – VWR #60825-618 or equivalent, glass, 16 x 100 mm.

9.1.25.1 Fill each tube with 10 mL of MeCl or hexane from a calibrated bottle top dispenser. Check the dispenser prior to use with a volumetric flask.
9.1.25.2 Mark the meniscus on each tube.
9.1.25.3 Discard the solvent. Turn the tubes upside down in a rack to dry.

9.1.26 Caps – Plug tite, large, VWR part #15070-176, 1000 per pack.
9.1.27 Nitrile gloves – various sizes.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: expiration date (if applicable) and tracking number.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard and given to the Quality Control (QC) Officer.

10.6 Sodium sulfate (ACS) – Granular, anhydrous, stored in glass containers at 130°C for a minimum of 12 hours prior to use.

10.7 Solvents – Pesticide residue analysis grade, n-hexane, acetone, technical grade acetone, MeCl, and methanol.

10.8 Reagent water – Organic free.

10.9 Nitrogen – High purity.

10.10 Sulfuric acid (1:1 V/V) H_2SO_4 – Measure 250 mL of reagent water into a 1 L beaker. Add a stir bar. While stirring, slowly add 250 mL of concentrated sulfuric acid. Cool. Pour into a glass reagent bottle. Label. Complete the SE standard logbook.

NOTE: *Never add water to acid.*

10.11 Sodium hydroxide (10 N) NaOH – Measure 400 mL of reagent water into a 1 L beaker. Add a stir bar. While stirring, slowly add 200 g of sodium hydroxide pellets. Cool. Pour into a 500 mL volumetric bottle and dilute to the mark. Mix Well. Label. Complete the SE standard logbook.

NOTE: *Purchased 50% (W/W) NaOH solution may be substituted.*

10.12 Stock standards (SSs) – All standards must be certified reference materials. Manufacturer's certificates of analysis are retained by the DEQ Laboratory and kept as part of the overall quality assurance QA/QC requirements. All SSs must be given a unique lab tracking number and logged into the SS tracking logbook. Store SSs in amber sealed ampules at 10°C to 20°C. Protect the standards from light.

10.13 Surrogate solutions

10.13.1 BN surrogate - Absolute Standards #24016 or equivalent, 5000 ug/mL in MeCl.
2-Fluorobiphenyl
Nitrobenzene-d5
p-Terphenyl-d14

10.13.2 Acid surrogate - Absolute Standards #24015 or equivalent, 10,000 ug/mL in methanol.
2-Fluorophenol
Phenol-d6
2,4,6-Tribromphenol

10.13.3 BNA surrogate solution (BN = 25 ppm, A = 50 ppm)

10.13.3.1 Partially fill a 1000 mL volumetric flask with methanol.
10.13.3.2 Pipette 5 mL of BN surrogate (Section 10.13.1) into the flask.
10.13.3.3 Pipette 5 mL of acid surrogate (Section 10.13.2) into the flask. Mix.
10.13.3.4 Dilute the flask to the mark with methanol. Mix.
10.13.3.5 Transfer to amber screw cap bottles. Label.
10.13.3.6 Store current bottle of solution in a refrigerator and store extra bottles of solution in a freezer. Replace every six months or sooner as needed.

10.13.4 Pesticide/PCB surrogate solution (200 ug/L)

10.13.4.1 Absolute Standards #20023 or equivalent, 200 ppm in acetone.
Decachlorobiphenyl
2,4,5,6-Tetrachloro-m-xylene

10.13.4.2 Partially fill a 1000 mL volumetric flask with methanol.

10.13.4.3 Pipet 1 mL of stock surrogate solution (Section 10.13.4.1) directly into the methanol in the flask. Mix.

10.13.4.4 Dilute the flask to the mark with methanol. Mix.

10.13.4.5 Transfer to amber screw cap bottles. Label.

10.13.4.6 Store current bottle of solution in a refrigerator and store extra bottles of solution in a freezer. Replace every six months or sooner as needed.

10.14 Spike Solutions

10.14.1 BNA spike solution (BN = 50 ug/mL; A = 100 ug/mL)

10.14.1.1 Absolute Standards part #93009, Method 625 with 54 components. Solution is purchased complete and ready to use. See attachment #22.11 for complete compound list.

10.14.1.2 Store current bottle of solution in a refrigerator and store extra bottles of solution in a freezer. Replace every six months or sooner as needed.

10.14.2 Pesticide spike solution

10.14.2.1 Accustandard #S-7179 or equivalent, 10,000 mg/L in methanol.

Aldrin	Endosulfan I
a-BHC	Endosulfan II
b-BHC	Endosulfan sulfate
d-BHC	Endrin
g-BHC (lindane)	Endrin aldehyde
BP-6 (PPB)	Endrine ketone
a-Chlordane	Heptachlor
g-Chlrodane	Heptaclor epoxide
4,4'-DDD	Hexabromobenzene
4,4'-DDE	Methoxyclor
4,4'-DDT	Mirex
Dieldrin	

10.14.2.2 Pesticide spike solution for water samples, 200 ug/L

10.14.2.2.1 Partially fill a 100 mL volumetric flask with methanol.

10.14.2.2.2 Pipet 20 mL from sediment pesticide spike into volumetric (Section 10.14.2.3). Mix.

10.14.2.2.3 Dilute to the mark with methanol. Mix.
10.14.2.2.4 Transfer to a 100 mL amber screw cap bottle. Label.
10.14.2.2.5 Store in a refrigerator. Replace every six months or sooner as needed.

10.14.2.3 Pesticide spike solution for soil samples, 10,000ug/L

10.14.2.3.1 Partially fill a 200 mL volumetric flask with methanol.
10.14.2.3.2 Inject 200 uL of stock pesticide (Section 10.14.2.1) directly into the methanol in the flask.
10.14.2.3.3 Dilute to the mark with methanol. Mix.
10.14.2.3.4 Transfer to a 250 mL amber screw cap bottle. Label.
10.14.2.3.5 Store in a refrigerator. Replace every six months or sooner as needed.

10.14.3 PCB spike solution (Aroclors 1016 and 1260)

10.14.3.1 Aroclor 1016 – Absolute Standards #70015, 1000 ppm in methanol.
10.14.3.2 Aroclor 1260 – Absolute Standards #70021, 1000 ppm in methanol.
10.14.3.3 PCB spike solution (Aroclor 1016, 1ppm and Aroclor 1260, 1 ppm)

10.14.3.3.1 Partially fill a 100 mL volumetric flask with methanol.
10.14.3.3.2 Inject 100 µL of PCB spike (Section 10.14.3.1) directly into the methanol in the flask.
10.14.3.3.3 Inject 100 µL of PCB spike (Section 10.14.3.2) directly into the methanol in the flask. Mix.
10.14.3.3.4 Dilute to the mark with methanol. Mix.
10.14.3.3.5 Transfer to a 100 mL amber screw cap bottle. Label.
10.14.3.3.6 Store solution in a refrigerator. Replace every six months or sooner as needed.

11.0 Sample Collection, Preservation, Shipment, and Storage

11.1 Samples must be collected in 1 L amber glass bottles with teflon or foil lined caps.

11.2 Samples should be stored in ice until the laboratory receives them. They are then refrigerated at 4°C until extraction.

11.3 The U.S. Environmental Protection Agency maximum holding time is seven days from sample collection to extraction.

11.4 Sample extracts should be stored in a freezer and must be analyzed within 40 days of extraction.

12.0 QC

12.1 Sample batches consist of a maximum of 20 samples, 1 method preparation blank, 1 MS, 1 MSD, and 1 LCS. If MS/MSD are not available, an LCSD is also included in the batch.

12.2 A batch may stay open for up to one week, with a maximum or 20 samples. Any additional samples must be accompanied by one MPB, per day extracted. Additional MPBs are not included in the 20 samples.

12.3 MSs and MSDs are actual samples that are selected at random from within the batch of 20 unless requested by field staff.

12.4 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction and cleanup of individual samples.

12.5 The MSs, MSDs, LCSs, and LCSDs are spiked at a known concentration with the analyte compounds. The replicate spikes are used to evaluate the entire batch for precision and accuracy.

12.6 Initial demonstration of ability – Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for target analytes.

12.6.1 Prepare five sets of glassware for extraction.
12.6.2 Add 1 L of DI water into each of the five separatory funnels.
12.6.3 Adjust pH if applicable and add 1 mL of BNA surrogate (Section 10.13.3) or 1 mL of pesticide/PCB surrogate (Section 10.13.4) to each separatory funnel depending upon the analytes to be extracted.
12.6.4 Spike four of the separatory funnels with 1 mL of BNA spike (see SVOC chemist to obtain a full list spike), or 1 mL of pesticide spike (Section 10.14.2.2) or 1 mL of PCB spike (Section 10.14.3.3) depending upon the analytes to be extracted. Label these as LCS1, LCS2, LCS3, and LCS4.
12.6.5 Label the remaining separatory funnel as MPB.
12.6.6 Extract as in Section 14.2 or Section 14.5 as appropriate.
12.6.7 Follow all cleanup procedures used for routine samples.
12.6.8 Analyze, calculate, and evaluate results by the same procedures used to analyze samples (SOP 500 or SOP 502).

12.7 MDLs

12.7.1 Prepare MDLs at levels specified by the analyst and with the spike solutions they provide.
12.7.2 Prepare nine sets of glassware for extraction.
12.7.3 Add 1 L of DI water to each separatory funnel.

12.7.4 Adjust pH if applicable and add 1 mL of BNA surrogate (Section 10.13.3) or 1 mL of pesticide/PCB surrogate (Section 10.13.4) to each separatory funnel depending upon the analytes to be extracted.

12.7.5 Spike eight of the separatory funnels with 1 mL of the spike provided by the analyst. Label the 8 separatory funnels as MDL1, MDL2, MDL3, MDL4, MDL5, MDL6, MDL7, and MDL8. Label the remaining separatory funnel as MPB.

12.7.6 Extract as in Section 14.2 or Section 14.5 as appropriate.

12.7.7 Follow all cleanup procedures used for routine samples.

12.7.8 Analyze and evaluate results by the same procedures used to analyze samples (SOP 500 or SOP 502).

13.0 Calibration and Standardization

13.1 This section is not applicable to this method.

14.0 Procedure

14.1 Glassware cleaning

14.1.1 Dishwasher

14.1.1.1 Rinse separatory funnels with warm tap water. Wash separatory funnels in sets of four or six.

14.1.1.2 Close the stopcock. Add approximately 100 mL of tap water to one separatory funnel.

14.1.1.3 Add several mLs of concentrated sulfuric acid (H_2SO_4) to the separatory funnel with the water. Swirl to rinse entire funnel. Drain solution through the stopcock into the next separatory funnel. Repeat. Rinse with tap water after acid rinse.

14.1.1.4 Rinse other glassware with H_2SO_4 if necessary.

14.1.1.5 Remove the stopcocks for hand washing. Caps are run through the dishwasher.

14.1.1.6 Load separatory funnels onto the top rack of the dishwasher. They may also be placed on the bottom rack if there is room.

14.1.1.7 Other glassware goes on the bottom rack and must be secured with a rack or screen.

14.1.2 Hand washing

14.1.2.1 Remove felt tip marks from glassware with acetone on a paper towel.

14.1.2.2 Rinse with warm tap water.

14.1.2.3 Wash with hot soapy water (Liqui-Nox dish soap).

14.1.2.4 Rinse with hot tap water.

14.1.2.5 Rinse separatory funnels with H_2SO_4 as in Section 14.1.1.3 through Section 14.1.1.4.

14.1.2.6 Rinse with tap water several times.

14.1.2.7 Remove the stopcocks.

14.1.2.8 Rinse with acetone (technical grade from five gallon can).

14.1.2.9 Drain dry.

14.1.3 Solvent rinsing

14.1.3.1 Rinse all glassware with MeCl or hexane prior to use.

14.2 Organic neutral (pesticides, PCBs, or Scan 3)

14.2.1 Fill in the extraction logbook.
14.2.2 Label separatory funnels and turbovap tubes with the sample ID or QC ID.
14.2.3 Close stopcocks on separatory funnels.
14.2.4 Pour 1 L of deionized (DI) water into each of the separatory funnels labeled MPB, LCS, and LCSD (if applicable).

NOTE: *All samples, surrogates, and spikes must be at room temperature prior to use.*

14.2.5 Pour each sample into the appropriate separatory funnel.

NOTE: *Make sure the meniscus has been marked on each sample bottle.*

14.2.6 Check to make sure that the pH of the samples is between five and seven. Add acid (Section 10.10) or base (Section 10.11) to adjust the pH to five to seven if necessary. Record in logbook.
14.2.7 Add 1 mL (by class A pipette) of pesticide/PCB surrogate (Section 10.13.4) to every separatory funnel.

NOTE: *Make sure it is surrogate that is added.*

14.2.8 Add 1 mL (by class A pipette) of pesticide (Section 10.14.2.2) or PCB spike solution (Section 10.14.3.3) to the LCS, LCSD, MS, and MSD. The choice of spike depends on the parameters being tested. Spike with pesticide spike if pesticides or Scan 3 are requested. Otherwise, spike with PCBs.
14.2.9 Add 60 mL of MeCl to the MPB, LCS, and LCSD separatory funnels.
14.2.10 Add 60 mL of MeCl to each sample bottle. Replace top. Swirl, being careful not to let pressure build up. Pour the MeCl into the respective separatory funnel.
14.2.11 Place caps on each separatory funnel. Remove from stand. Invert. Release pressure into a hood. Shake once. Vent. Shake. Vent until pressure is minimized. Place on rotary extractor. Bungee it down. When extractor is full, rotate several turns. Vent. Turn on extractor. Set timer for five minutes.

Note: *Watch for leaking from separatory funnels. Change caps or stopcocks if necessary. Make a note in the extraction logbook.*

14.2.12 After five minutes have passed, vent each separatory funnel. Replace in stand. Remove tops. Let sit for 15 minutes.
14.2.13 Place glass wool in bottom of each drying funnel. Pour approximately two inches of cooled sodium sulfate into the funnels. Rinse each funnel with MeCl until the solvent runs through. When drained, place a funnel over each turbovap tube.

14.2.14 Drain MeCl layer from separatory funnel into the respective drying funnel. See emulsion section (Section 14.6) if an emulsion is present.

14.2.15 Extract each separatory funnel two more times with 60 mL of MeCl each time. Rinse sample bottles with MeCl as before. Vent. Rotate as before. These last two extractions only need to sit for five minutes each.

14.2.16 Full DEQ amber bottles have an initial volume of 1000 mL. All other sample bottles will need to be filled with tap water to the marked level and then poured into a graduated cylinder for measurement. Record initial volume in the extraction logbook. Rinse all sample bottles with water. Place in boxes for recycling of amber glass.

14.2.17 Rinse each drying funnel with 30 mL of MeCl after the sample has completed draining.

14.2.18 Place foil over each turbovap tube. Use a rubber band to secure.

14.2.19 Place each tube on the turbovap. Check that nitrogen flow is turned on at the wall inlet and minimized at the turbovap. Poke a hole in the foil on each tube. Check that the temperature for the turbovap water bath is set at 35°C.

14.2.20 Turn on each turbovap. Slowly turn on the nitrogen until samples are swirling. Turn up the nitrogen flow as the sample volume decreases. The nitrogen flow rate should not be allowed to exceed 15/1.0 (seen in the Condition display).

14.2.21 Remove the tubes when the turbovap beeps.

14.2.22 If the samples are not going to be cleaned up by GP C, rinse the walls of the turbovap with 10 mL of hexane (for solvent exchange). Replace the samples on the turbovap. Remove the samples when the turbovap beeps. Transfer them to 1 mL marked vials (Section 9.1.8) with hexane using a pasteur pipet. Place crimp caps on the vials. Label the vial rack with the batch number. Proceed to Section 14.2.24. Place the tray in the freezer located in the pesticide/PCB area.

14.2.23 If the samples are going to be cleaned up by GPC, transfer the turbovap tube contents to a premarked culture tube (Section 9.1.25) using a pasteur pipette. Add MeCl to the turbovap tube. Squirt and rinse the walls of the tube. Transfer to the culture tube, being careful not to go over the 10 mL mark. Dilute to the 10 mL mark. Place a cap (Section 9.1.26) on the culture tube. Remove the label from the turbovap tube. Place on the culture tube. Label the tube rack with the batch number. Place in the refrigerator for GPC cleanup. Proceed to Section 14.2.24, then place the goldenrod sheet in the tray by the GPC computer.

14.2.24 Complete the extraction logbook for the batch. Include all information pertaining to lab accidents, spillage, missed holding times, emulsions, etc. Make a copy on goldenrod paper.

14.3 Acid extractables (phenols)

14.3.1 Fill in the extraction logbook.

14.3.2 Label separatory funnels and turbovap tubes with the sample ID or QC ID.

14.3.3 Close stopcocks on separatory funnels.

14.3.4 Pour 1 L of DI water into each of the separatory funnels labeled MPB, LCS, and LCSD (if applicable).

NOTE: *All samples, surrogates, and spikes must be at room temperature prior to use.*

14.3.5 Pour each sample into the appropriate separatory funnel.

NOTE: *Make sure the volume level has been marked on each sample bottle.*

14.3.6 Add 1 mL of 1:1 H_2SO_4 (Section 10.10) to each separatory funnel. Swirl to mix while keeping the separatory funnel in the hood. Check the pH of each separatory funnel with pH paper to ensure a pH<2. Add more acid if necessary. Note this in the logbook.

14.3.7 Add 1 mL (by class A pipette) of BNA surrogate (Section 10.13.3) to every separatory funnel. Make sure it is surrogate that is added.

14.3.8 Add 1 mL (by class A pipette) of BNA spike solution (Section 10.14.1) to the LCS, LCSD, MS, and MSD.

14.3.9 Add 60 mL of MeCl to the MPB, LCS, and LCSD separatory funnels.

14.3.10 Add 60 mL of MeCl to each sample bottle. Replace top. Swirl, being careful not to let pressure build up. Pour the MeCl into the respective separatory funnel.

14.3.11 Place caps on each separatory funnel. Remove from stand. Invert. Release pressure into a hood. Shake once. Vent. Shake. Vent until pressure is minimized. Place on rotary extractor. Bungee it down. When extractor is full, rotate several turns. Vent. Turn on extractor. Set timer for five minutes.

Note: *Watch for leaking from separatory funnels. Change caps or stopcocks if necessary. Make a note in the extraction logbook.*

14.3.12 After five minutes have passed, vent each separatory funnel. Replace in stand. Remove caps. Let sit for 15 minutes.

14.3.13 Place glass wool in bottom of each drying funnel. Pour approximately two inches of cooled sodium sulfate into the funnels. Rinse each funnel with MeCl until the solvent runs through. When drained, place a funnel over each turbovap tube.

14.3.14 Drain MeCl layer from separatory funnel into the respective drying funnel. See emulsion section (Section 14.6) if an emulsion is present.

14.3.15 Extract each separatory funnel two more times with 60 mL of MeCl each time. Rinse sample bottles with MeCl as before. Vent. Rotate as before. These last two extractions only need to sit for five minutes each.

14.3.16 Label crimp cap glass vials (Section 9.1.8) with sample ID.

14.3.17 Full DEQ amber bottles have an initial volume of 1000 mL. All other sample bottles will need to be filled with tap water to the marked level and then poured into a graduated cylinder for measurement. Record initial volume in the extraction logbook. Rinse all sample bottles with water. Place in boxes for recycling of amber glass.

14.3.18 Rinse each drying funnel with 30 mL of MeCl after the sample has completed draining.

14.3.19 Place foil over each turbovap tube. Use a rubber band to secure.

14.3.20 Place each tube on the turbovap. Check that nitrogen flow is turned on at the wall inlet and minimized at the turbovap. Poke a hole in the foil on each tube. Check that the temperature for the turbovap water bath is set at 35°C.

14.3.21 Turn on each turbovap. Slowly turn on the nitrogen until samples are swirling. Turn up the nitrogen flow as the sample volume decreases. The nitrogen flow rate should not be allowed to exceed 15/1.0 (seen in the Condition display).

14.3.22 Remove the tubes when the turbovap beeps.

14.3.23 Transfer the turbovap tube contents to the appropr iately labeled vial (Section 14.3.16) using a pasteur pipette. Add a small amount (1/2 mL) of MeCl to the turbovap tube. Squirt and rinse the walls of the tube. Transfer to the vial, being careful not to go over the 1 mL mark. Dilute to the 1 mL mark. Place a crimp cap on the vial and crimp.

14.3.24 Complete the extraction logbook for the batch. Include all information pertaining to lab accidents, spillage, missed holding times, emulsions, etc. Make a copy on blue paper.

14.3.25 Label the vial rack with the batch number. Place in the semi-volatile sample freezer. Place the blue sheet in the bin to the ri ght of the other freezer.

14.4 Base neutral-extractables or PNAs only

14.4.1 Fill in the extraction logbook.

14.4.2 Label separatory funnels and turbovap tubes with the sam ple ID or QC ID.

14.4.3 Close stopcocks on separatory funnels.

14.4.4 Pour 1 L of DI water into each of the separatory funnels labeled MPB, LCS, and LCSD (if applicable).

NOTE: *All samples, surrogates, and spikes must be at room temperature prior to use.*

14.4.5 Pour each sample into the appropriate separatory funnel.

NOTE: *Make sure the volume level has been marked on each sample bottle.*

14.4.6 Add 1 mL of 1:1 H_2SO_4 (Section 10.10) to each separatory funnel. Swirl to mix. Check the pH of each separatory funnel with pH paper to ensure a pH<2. Add more acid if necessary. Note this in the logbook.

14.4.7 Add 1 mL (by class A pipette) of BNA surrogate (Section 10.13.3) to every separatory funnel. Make sure it is surrogate that is added.

14.4.8 Add 1 mL (by class A pipette) of BNA spike solution (Section 10.14.1) to the LCS, LCSD, MS, and MSD.

14.4.9 Add 60 mL of MeCl to the MPB, LCS, and LCSD separatory funnels.

14.4.10 Add 60 mL of MeCl to each sample bottle. Replace top. Swirl, being careful not to let pressure build up. Pour the MeCl into the respective separatory funnel.

14.4.11 Place caps on each separatory funnel. Remove from stand. Invert. Release pressure into a hood. Shake once. Vent. Shake. Vent until pressure is minimized. Place on rotary extractor. Bungee it down. When extractor is full, rotate several turns. Vent. Turn on extractor. Set timer for five minutes.

Note: *Watch for leaking from separatory funnels. Change caps or stopcocks if necessary. Make a note in the extraction logbook.*

14.4.12 After five minutes have passed, vent each separatory funnel. Replace in stand. Remove tops. Let sit for 15 minutes.

14.4.13 Place glass wool in bottom of each drying funnel. Pour approximately two inches of cooled sodium sulfate into the funnels. Rinse each funnel with MeCl until solvent runs through. When drained, place a funnel over each turbovap tube.

14.4.14 Drain MeCl layer from separatory funnel into the respective funnel. See emulsion section (Section 14.6) if an emulsion is present.

14.4.15 Extract each separatory funnel one more time with 60 mL of MeCl. Rinse sample bottles with MeCl as before. Vent. Rotate as before. The second extraction only needs to sit for five minutes. Drain samples.

14.4.16 Add two to three mLs of 10 N NaOH (Section 10.11) to each separatory funnel. Swirl to mix. Check the pH of each separatory funnel with pH paper to ensure a pH>11. Add more base if necessary. Note this in the logbook.

14.4.17 Proceed with third extraction. Repeat steps 14.4.9 through 14.4.12. After the samples have been rotated, allow to sit for 15 minutes before draining extract.

14.4.18 Label crimp cap glass vials (Section 9.1.8) with sample ID.

14.4.19 Full DEQ amber bottles have an initial volume of 1000 mL. All other sample bottles will need to be filled with tap water to the marked level and then poured into a graduated cylinder for measurement. Record initial volume in the extraction logbook. Rinse all sample bottles with water. Place in boxes for recycling of amber glass.

14.4.20 Rinse each drying funnel with 30 mL of MeCl after the sample has completed draining.

14.4.21 Place foil over each turbovap tube. Use a rubber band to secure.

14.4.22 Place each tube on the turbovap. Check that nitrogen flow is turned on at the wall inlet and minimized at the turbovap. Poke a hole in the foil on each tube. Check that the temperature for the turbovap water bath is set at 35°C.

14.4.23 Turn on each turbovap. Slowly turn on the nitrogen until samples are swirling. Turn up the nitrogen flow as the sample volume decreases. The nitrogen flow rate should not be allowed to exceed 15/1.0 (seen in the Condition display).

14.4.24 Remove the tubes when the turbovap beeps.

14.4.25 Transfer the turbovap tube contents to an appropriately labeled vial (Section 14.4.18) using a pasteur pipette. Add a small amount (1/2 mL) of MeCl to the turbovap tube. Squirt and rinse the walls of the tube. Transfer to the vial, being careful not to go over the 1 mL mark. Dilute to the 1 mL mark. Place a crimp cap on the vial and crimp.

14.4.26 Complete the extraction logbook for the batch. Include all information pertaining to lab accidents, spillage, missed holding times, emulsions, etc. Make a copy on blue paper.

14.4.27 Label the vial rack with the batch number. Place in the semi-volatile sample freezer. Place the blue sheet in the bin to the right of the other freezer.

14.5 BNA extractables

14.5.1 Follow the acid extractables procedure.(Section 14.3) After the third MeCl drain (Section 14.3.15), add two to three mLs of NaOH (Section 10.11) to the separatory funnel. Remove turbovap tubes containing the acid extract and place on the turbovap to concentrate. Proceed as in the BN procedure (Section 14.4), except in the BNA procedure the last 3 extractions will all be basic.

14.5.2 Collect the BN fraction in a 250 mL rinsed and labeled erlenmeyer flask.

14.5.3 Add the BN fraction to the acid fraction in the turbovap tubes when the acid fraction volume is low.

14.5.4 Evaporate the combined extract as in the acid or BN sections.

14.6 Emulsions

14.6.1 An emulsion occurs when there is not complete separation of the MeCl layer from the water layer.

14.6.2 Try swirling the separatory funnel to break up the emulsion.

14.6.3 Draw off the MeCl layer into a centrifuge tube. Sometimes this action will break the emulsion up, and the MeCl layer can be transferred to the drying funnel with a disposable pipette, and the water can be returned to the separatory funnel.

14.6.4 If the emulsion still persists, centrifuge for five minutes at approximately 3000 rev/minute. Remove the MeCl layer with a disposable pipette. Return the water layer to the separatory funnel.

14.6.5 If the emulsion still persists, add extra MeCl to the tube. Shake. Vent. Make sure the cap does not leak. Centrifuge again. This information must be recorded in the extraction logbook. Remove the MeCl layer to the drying funnel. Return the water layer to the separatory funnel.

14.6.6 For more difficult emulsions, sodium sulfate can be added to the centrifuge tube to separate the water from the MeCl layer.

14.7 Low level PCB extraction

14.7.1 Three 1 L amber glass bottles are required per sample for low level PCB extraction.

14.7.2 Fill in the extraction logbook.

14.7.3 Label separatory funnels and turbovap tubes with the QC ID. Label two separatory funnels and two turbovap tubes per sample with the sample number. Add an "A" to one and add a "B" to the other.

14.7.4 Close stopcocks on separatory funnels.

14.7.5 Pour 1 L of DI water into each of the separatory funnels labeled MPB, LCS, and LCSD (if applicable).

NOTE: *All samples, surrogates, and spikes must be at room temperature prior to use.*

14.7.6 Divide the three ambers of sample between the two labeled separatory funnels.

NOTE: *Make sure the meniscus has been marked on each sample bottle.*

14.7.7 Check that the pH of all the samples is between five and seven. Add acid (Section 10.10) or base (Section 10.11) to adjust the pH to five to seven if necessary. Note in the extraction logbook.

14.7.8 Add 1 mL (by class A pipette) of pesticide/PCB surrogate (Section 10.13.4) to the QC separatory funnels. (MPB, LCS, LCSD, MS, MSD) Add ½ mL of surrogate (Section 10.13.4) to each sample separatory funnel.

NOTE: *Make sure it is surrogate that is added.*

14.7.9 Add 1 mL (by class A pipette) of PCB spike solution (Section 10.14.3.3) to the LCS, LCSD, MS, and MSD.

14.7.10 Add 60 mL of MeCl to the MPB, LCS, and LCSD separatory funnels.

14.7.11 Add 120 mL of MeCl to each sample bottle. Replace tops. Swirl, being careful not to let pressure build up. Use the MeCl of one amber per rotation and divide between the two separatory funnels, giving each of the three ambers one rinse.

14.7.12 Place caps on each separatory funnel. Remove from stand. Invert. Release pressure into a hood. Shake once. Vent. Shake. Vent until pressure is minimized. Place on rotary extractor. Bungee it down. When extractor is full, rotate several turns. Vent. Turn on extractor. Set timer for five minutes.

Note: *Watch for leaking from separatory funnels. Change caps or stopcocks if necessary. Make a note in the extraction logbook.*

14.7.13 After five minutes have passed, vent each separatory funnel. Replace in stand. Remove caps. Let sit for 15 minutes.

14.7.14 Place glass wool in bottom of each drying funnel. Pour approximately two inches of cooled sodium sulfate into the funnels. Rinse each column with MeCl until solvent runs through. When drained, place a funnel over each turbovap tube.

14.7.15 Drain MeCl layer from separatory funnel into the respective funnel. See emulsion section (Section 14.6) if an emulsion is present.

14.7.16 Extract each separatory funnel two more times with 60 mL of MeCl each time. Vent. Rotate as before. These last two extractions only need to sit for five minutes each.

14.7.17 Full DEQ amber bottles have an initial volume of 1000 mL. All other sample bottles will need to be filled with tap water to the marked level and then poured into a graduated cylinder for measurement. Record initial volume in the extraction logbook. Rinse all sample bottles with water. Place in boxes for recycling of amber glass.

14.7.18 Rinse each drying funnel with 30 mL of MeCl after the sample has completed draining.

14.7.19 Place foil over each turbovap tube. Use a rubber band to secure.

14.7.20 Place each tube on the turbovap. Check that nitrogen flow is turned on at the wall inlet and minimized at the turbovap. Poke a hole in the foil on each tube. Check that the temperature for the turbovap water bath is set at 35°C.

14.7.21 Turn on each turbovap. Slowly turn on the nitrogen until samples are swirling. Turn up the nitrogen flow as the sample volume decreases. The nitrogen flow rate should not be allowed to exceed 15/1.0 (seen in the Condition display).

14.7.22 Remove the tubes when the turbovap beeps.

14.7.23 Combine the two extracts for each sample (Section 14.7.3) into one extract by transferring both extracts into the same premarked culture tube (Section 9.1.25) using a Pasteur pipette. Add MeCl to the turbovap tubes. Squirt and rinse the walls of the tube. Transfer to the culture tube, being careful not to go over the 10 mL mark. Dilute to the 10 mL mark. Place a cap (Section 9.1.26) on the culture tube. Remove the label from the turbovap tube. Place on the culture tube.

14.7.24 Complete the extraction logbook for the batch. Include all information pertaining to lab accidents, spillage, missed holding times, emulsions, etc. Make a copy on goldenrod paper.

14.7.25 Label the tube rack with the batch number. Place in the refrigerator for GPC cleanup. Place the goldenrod sheet in the basket next to the GPC computer.

15.0 Calculations

15.1 This section is not applicable to this method.

16.0 Method Performance

16.1 This section is not applicable to this method.

17.0 Pollution Prevention

17.1 For information concerning pollution prevention which may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Samples must be extracted within seven days of collection. If samples are extracted past the holding time, it must be noted on the paperwork.

18.2 LIMS entry: Creating a batch.

18.2.1 Select the Labworks CITRIX icon on the desktop.
18.2.2 Enter your User ID and password. Select the ENV PRD database. Click "OK".
18.2.3 Click on "QA Batch".
18.2.4 Select "New Batches", then "Batch by Analysis".
18.2.5 Enter analysis in white box. Either E_WBA or E_PPW. Click "OK".
18.2.6 Select "OK" again. At this point, a list of possible samples for that analysis will appear. The samples included in the batch need to be marked with a red check. Uncheck those samples that are not with the batch.
18.2.7 Select "OK".
18.2.8 Make sure that the batch size matches or is greater than the number of samples. Select "OK".
18.2.9 Change the default batch name to match the extractions batch number by changing the last four numbers only. Example: from default number E_PPW-5111 to actual batch number E_PPW-4577.
18.2.10 Click on the sample that is being used for QC. Change QA Group and QA Tests as needed.
18.2.11 Select "OK".
18.2.12 Select "Exit".

18.3 LIMS entry: Entering results.

18.3.1 Select the Labworks CITRIX icon on the desktop.

18.3.2 Enter your User ID and password. Select the ENV_PRD database. Select "OK".
18.3.3 Select "Results".
18.3.4 Results entry template should read "Extract". Select "QA/QC Batch".
18.3.5 Select appropriate analysis code. Either E_WBA or E_PPW. Click "OK".
18.3.6 Select appropriate batch. Click on "OK" twice.
18.3.7 Enter the samples initial volume under "Results", check that the dates and initials are correct. Make any changes on the first sample; all following samples will be the same. Add any Qualifier Codes to the "Qualify" line. Find the QC sample. Scroll down and enter MS/MSD volumes, if applicable, and surrogate and spike tracking numbers. Select "Save".
18.3.8 Select "Exit".

18.4 Backlog Reports

18.4.1 Select the Labworks CITRIX icon on the desktop.
18.4.2 Enter your User ID and password. Select the ENV_PRD database. Select "OK".
18.4.3 Select "Backlog".
18.4.4 Search backlog by "Department Code". Select "OK".
18.4.5 Enter O_WA into the white bar. Select "OK".
18.4.6 Select "Display Report".
18.4.7 Select "Close" then "Exit" when done.

19.0 Corrective Actions

19.1 If surrogate recoveries fall outside the acceptance limits and the sample is within the seven-day hold time, reextraction is performed if another amber bottle is available.

19.2 All data reported for samples extracted outside the hold time receive a hold time code.

20.0 Waste Management

20.1 The Laboratory Safety Officer arranges for proper waste disposal.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, D.C., Appendix A & B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition, 1986, Final Update III, December 1996.

21.3 Methods for Chemical Analysis of Water and Wastes, U.S. Environmental Protection Agency, EPA-600/4-79-020, March 1983.

22.0 Attachments

22.1 MeCl MSDS.

22.2 Hexane MSDS.

22.3 Sulfuric acid MSDS.

22.4 Sodium hydroxide MSDS.

22.5 Sodium sulfate MSDS.

22.6 Methanol MSDS.

22.7 Acetone MSDS.

22.8 Semi-volatile standard logbook.

22.9 Stock chemical logbook.

22.10 Water extraction logbook.

22.11 BNA spike compound list.

MDEQ SOP# 405 REVISION # 2

APPROVED BY _____ DATE 1/12/2005
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 1/24/05
COMPLIANCE OFFICER

APPROVED BY _____ DATE 12/27/04
QA OFFICER

APPROVED BY _____ DATE 12-20-04
UNIT MANAGER

APPROVED BY _____ DATE 8/27/04
ANALYST

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYLENE CHLORIDE

MSDS Number: M4420 --- *Effective Date: 06/30/98*

1. Product Identification

Synonyms: MC; Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride
CAS No.: 75-09-2
Molecular Weight: 84.93
Chemical Formula: CH2Cl2
Product Codes: 9264, 9266, 9295, 9315, 9324, 9329, 9330, 9341, 9348, 9350, 9965, Q480

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methylene Chloride	75-09-2	> 99%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

ATTACHMENT 22.1

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes formation of carbon monoxide in blood which affects cardiovascular system and central nervous system. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. Exposure may make the symptoms of angina (chest pains) worse.

Ingestion:
May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.

Skin Contact:
Causes irritation, redness and pain. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

Eye Contact:
Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.

Chronic Exposure:
Can cause headache, mental confusion, depression, liver effects, kidney effects, bronchitis, loss of appetite, nausea, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact. Methylene chloride may cause cancer in humans.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Autoignition temperature: 556C (1033F)
Flammable limits in air % by volume:
lel: 12; uel: 23

Forms flammable vapor-air mixtures above 100C (212F).
Explosion:
Concentrated can be ignited by a high intensity ignition source. Vapor may form flammable mixture in atmosphere that contains a high percentage of oxygen. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste

container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. This material may corrode plastic and rubber. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Odor Threshold: 205 - 307 ppm. The odor threshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Methylene Chloride (Dichloromethane):
- OSHA Permissible Exposure Limit (PEL) -
25 ppm (TWA), 125 ppm (STEL), 12.5 ppm (8-hour TWA - Action Level)
- ACGIH Threshold Limit Value (TLV) -
50 ppm (TWA), A2 - suspected human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. The cartridges recommended for this material have a predicted service of less than 30 minutes at concentrations of ten times (10x) the exposure limits. Actual service life will vary considerbly, depending on concentration levels, temperature, humidity, and work rate. This substance has poor warning properties.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material

for personal protective equipment. Natural rubber and polyvinyl chloride ARE NOT recommended materials for personal protective equipment.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:
Do not use closed circuit rebreathing system employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. See OSHA Standard for medical surveillance, record keeping, and reporting requirements for methylene chloride (29 CFR 1910.1052).

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Chloroform-like odor.

Solubility:
1.32 gm/100 gm water @ 20C.

Specific Gravity:
1.33 @ 15C/4C

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
39.8C (104F)

Melting Point:
-97C (-143F)

Vapor Density (Air=1):
2.9

Vapor Pressure (mm Hg):
350 @ 20C (68F)

Evaporation Rate (BuAc=1):
27.5

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid. Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Strong oxidizers, strong caustics, plastics, rubber, nitric acid, water + heat, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs. Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Toxicological Data:
Dichloromethane: Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 52 gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Dichloromethane has been linked to spontaneous abortions in humans.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methylene Chloride (75-09-2)	No	Yes	2B

---

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of greater than 30 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

International (Air, I.C.A.O.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methylene Chloride (75-09-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methylene Chloride (75-09-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methylene Chloride (75-09-2)	1000	U080	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2Z
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Do not get in eyes, on skin, or on clothing.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2.
Disclaimer:
****

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****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

ATTACHMENT 22.2

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANES

MSDS Number: H2379 --- *Effective Date: 04/15/99*

1. Product Identification

Synonyms: Normal Hexane; Hexyl Hydride
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9277, 9306, 9309, N169

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	> 95%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
2-Methylpentane	107-83-5	1 - 2%	No
3-Methylpentane	96-14-0	1 - 2%	No
Pentane	109-66-0	0 - 2%	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention

immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

---

5. Fire Fighting Measures

Fire:
Flash point: -21C (-6F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.1; uel: 7.5
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel

attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

The following properties are for n-hexane, the major component.
Appearance:
Clear, colorless liquid.
Odor:
Gasoline-like odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
150 @ 25C (77F)
Evaporation Rate (BuAc=1):
9

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

ATTACHMENT 22.2

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
2-Methylpentane (107-83-5)	No	No	None
3-Methylpentane (96-14-0)	No	No	None
Pentane (109-66-0)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3.1
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	Yes	Yes
3-Methylpentane (96-14-0)	Yes	Yes	Yes	Yes
Pentane (109-66-0)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	No	Yes
3-Methylpentane (96-14-0)	Yes	Yes	No	Yes
Pentane (109-66-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
2-Methylpentane (107-83-5)	No	No	No	No
3-Methylpentane (96-14-0)	No	No	No	No
Pentane (109-66-0)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
2-Methylpentane (107-83-5)	No	No	No
3-Methylpentane (96-14-0)	No	No	No
Pentane (109-66-0)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8. Updated the ACGIH part of the Airborne section of TAB 8.
Disclaimer:
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****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SULFURIC ACID, 52 - 100 %

MSDS Number: S8234 --- *Effective Date: 09/14/00*

1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid
CAS No.: 7664-93-9
Molecular Weight: 98.08
Chemical Formula: H2SO4 in H2O
Product Codes:
J.T. Baker: 5030, 5137, 5374, 5802, 5815, 5889, 5960, 5961, 5971, 6902, 9673, 9674, 9675, 9676, 9679, 9680, 9681, 9682, 9684, 9687, 9691, 9693, 9694
Mallinckrodt: 2468, 2876, 2878, 2900, 2904, 3780, 4222, 5524, 5557, H644, H976, H996, V344, V651

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	52 - 100%	Yes
Water	7732-18-5	0 - 48%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR

ATTACHMENT 22.3

CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Water Reactive)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical emergency.
Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.
Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.

Eye Contact:
Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion:

DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.

Eye Contact:

Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

---

5. Fire Fighting Measures

Fire:

Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.

Explosion:

Contact with most metals causes formation of flammable and explosive hydrogen gas.

Fire Extinguishing Media:

Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB(R) or TEAM(R) 'Low Na+' acid neutralizers are recommended for spills of this product.

---

7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Sulfuric Acid:
- OSHA Permissible Exposure Limit (PEL) -
1 mg/m3 (TWA)
- ACGIH Threshold Limit Value (TLV) -
1 mg/m3(TWA), 3 mg/m3 (STEL), A2 - suspected human carcinogen for sulfuric acid contained in strong inorganic acid mists.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge and particulate filter (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P particulate filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear oily liquid.
Odor:
Odorless.
Solubility:
Miscible with water, liberates much heat.
Specific Gravity:
1.84 (98%), 1.40 (50%), 1.07 (10%)
pH:
1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
ca. 290C (ca. 554F) (decomposes at 340C)
Melting Point:
3C (100%), -32C (93%), -38C (78%), -64C (65%).
Vapor Density (Air=1):
3.4
Vapor Pressure (mm Hg):
1 @ 145.8C (295F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Concentrated solutions react violently with water, spattering and liberating heat.
Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.
Conditions to Avoid:
Heat, moisture, incompatibles.

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11. Toxicological Information

Toxicological Data:
Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.
Carcinogenicity:
Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sulfuric Acid (7664-93-9)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.
Environmental Toxicity:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified. This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

ATTACHMENT 22.3

Proper Shipping Name: SULFURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN1830
Packing Group: II
Information reported for product/size: 440LB

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Sulfuric Acid (7664-93-9)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sulfuric Acid (7664-93-9)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sulfuric Acid (7664-93-9)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sulfuric Acid (7664-93-9)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: Yes (Pure / Liquid)

Australian Hazchem Code: 2P
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled

Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 2 Other: **Water reactive**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Do not contact with water.
Label First Aid:
In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
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INFORMATION.
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

ATTACHMENT 22.4

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYDROXIDE

MSDS Number: S4034 --- *Effective Date: 08/20/98*

1. Product Identification

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate
CAS No.: 1310-73-2
Molecular Weight: 40.00
Chemical Formula: NaOH
Product Codes:
J.T. Baker: 3718, 3721, 3722, 3723, 3728, 3734, 3736, 5045, 5565
Mallinckrodt: 7001, 7680, 7708, 7712, 7772, 7798

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.
Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appears days after exposure.
Skin Contact:
Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.
Eye Contact:
Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before reuse.
Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water. Can react with certain metals, such as aluminum, to generate flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
2 mg/m3 Ceiling
- ACGIH Threshold Limit Value (TLV):
2 mg/m3 Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White, deliquescent pellets or flakes.

Odor:
Odorless.

Solubility:
111 g/100 g of water.

Specific Gravity:
2.13

pH:
13 - 14 (0.5% soln.)

% Volatiles by volume @ 21C (70F):
0

Boiling Point:
1390C (2534F)
Melting Point:
318C (604F)
Vapor Density (Air=1):
> 1.0
Vapor Pressure (mm Hg):
Negligible.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.
Hazardous Decomposition Products:
Sodium oxide. Decomposition by reaction with certain metals releases flammable and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Sodium hydroxide in contact with acids and organic halogen compounds, especially trichloroethylene, may causes violent reactions. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, magnesium, tin, and zinc cause formation of flammable hydrogen gas. Sodium hydroxide, even in fairly dilute solution, reacts readily with various sugars to produce carbon monoxide. Precautions should be taken including monitoring the tank atmosphere for carbon monoxide to ensure safety of personnel before vessel entry.
Conditions to Avoid:
Moisture; dusting and incompatibles.

11. Toxicological Information

Irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe; investigated as a mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Hydroxide (1310-73-2)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

International (Water, I.M.O.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Sodium Hydroxide (1310-73-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Hydroxide (1310-73-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

-SARA 302- ------SARA 313------

Ingredient	RQ	TPQ	List	Chemical Catg.
Sodium Hydroxide (1310-73-2)	No	No	Yes	No

\-------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Hydroxide (1310-73-2)	1000	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: Yes (Pure / Solid)

Australian Hazchem Code: 2R
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 1
Label Hazard Warning:
POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 10.
Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

ATTACHMENT 22.5

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM SULFATE ANHYDROUS

MSDS Number: S5018 --- *Effective Date: 03/01/00*

1. Product Identification

Synonyms: Disodium sulfate; sodium sulfate anhydrous; sulfuric acid, disodium salt; sodium sulfate
CAS No.: 7757-82-6
Molecular Weight: 142.04
Chemical Formula: Na2 SO4
Product Codes:
J.T. Baker: 3375, 3887, 3891, 3898, 3902
Mallinckrodt: 6775, 7803, 8016, 8020, 8022, 8024, 8025, 8026, 8028, 9675

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Sulfate	7757-82-6	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
Not expected to be a health hazard.
Ingestion:
Mildly toxic by ingestion. Slowly absorbed from the alimentary tract. Because of osmotic activity, it will draw water into the lumen of the bowel and may cause purging, fluid loss, blood in stools, fall of blood pressure, and high sodium levels in the blood.
Skin Contact:
No adverse effects expected.
Eye Contact:
No adverse effects expected but dust may cause mechanical irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Not expected to require first aid measures.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard, but violent explosions occur when potassium sulfate and sodium sulfate are melted with aluminum.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to the dust or mist is apparent, a half-face dust/mist respirator may be worn. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Fine white crystalline granules.
Odor:
Odorless.
Solubility:
Soluble in approx. 3.6 parts water, 1 in 2 parts maximum @ 33C (91F).
Density:
2.68
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
844C (1551F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

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10. Stability and Reactivity

Stability:
Stable in tightly closed containers under normal conditions of storage.
Hazardous Decomposition Products:
Oxides of sulfur and sodium may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
In combination with sodium sulfate, aluminum and magnesium will explode @ 800C (1472F); strong mineral acids and bases.
Conditions to Avoid:
Air, moisture, and incompatibles.

---

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.
Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category

Sodium Sulfate (7757-82-6)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to leach into groundwater. This material is not expected to significantly bioaccumulate.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l. The EC50/48-hour values for daphnia are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

\Chemical Inventory Status - Part 1\

Ingredient	TSCA	EC	Japan	Australia
Sodium Sulfate (7757-82-6)	Yes	Yes	Yes	Yes

\Chemical Inventory Status - Part 2\

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Sulfate (7757-82-6)	Yes	Yes	No	Yes

\Federal, State & International Regulations - Part 1\

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Sulfate (7757-82-6)	No	No	No	No

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Sulfate (7757-82-6)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: No information found.
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYL ALCOHOL

MSDS Number: M2015 --- *Effective Date: 12/14/00*

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5217, 5370, 5794, 5807, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9893
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE

ATTACHMENT 22.6

LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.
Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.
Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.
Eye Contact:
Irritant. Continued exposure may cause eye lesions.
Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may cause skin irritation.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by

mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:

Flash point: 12C (54F) CC

Autoignition temperature: 464C (867F)

Flammable limits in air % by volume:

lel: 6.0; uel: 36

Flammable Liquid and Vapor!

Explosion:

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.

Fire Extinguishing Media:

Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

---

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Characteristic odor.

Solubility:
Miscible in water.
Specific Gravity:
0.8
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
64.5C (147F)
Melting Point:
-98C (-144F)
Vapor Density (Air=1):
1.1
Vapor Pressure (mm Hg):
97 @ 20C (68F)
Evaporation Rate (BuAc=1):
5.9

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category

Methyl Alcohol (67-56-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3.2, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 350LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.
Label Precautions:
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.

Keep container closed.
Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 5.

Disclaimer:

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****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

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MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

MALLINCKRODT J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ACETONE

MSDS Number: A0446 --- *Effective Date: 04/09/98*

1. Product Identification

Synonyms: Dimethylketone; 2-propanone; dimethylketal
CAS No.: 67-64-1
Molecular Weight: 58.08
Chemical Formula: (CH3)2CO
Product Codes:
J.T. Baker: 5356, 5580, 5805, 9001, 9002, 9003, 9004, 9005, 9006, 9007, 9008, 9009, 9010, 9015, 9036, 9125, 9254, 9271, A134
Mallinckrodt: 0018, 2432, 2435, 2437, 2438, 2440, 2443, 2445, 2850, H451, H580, H981

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Acetone	67-64-1	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS

CENTRAL NERVOUS SYSTEM.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache. Higher concentrations can produce central nervous system depression, narcosis, and unconsciousness.
Ingestion:
Swallowing small amounts is not likely to produce harmful effects. Ingestion of larger amounts may produce abdominal pain, nausea and vomiting. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms are expected to parallel inhalation.
Skin Contact:
Irritating due to defatting action on skin. Causes redness, pain, drying and cracking of the skin.
Eye Contact:
Vapors are irritating to the eyes. Splashes may cause severe irritation, with stinging, tearing, redness and pain.
Chronic Exposure:
Prolonged or repeated skin contact may produce severe irritation or dermatitis.
Aggravation of Pre-existing Conditions:
Use of alcoholic beverages enhances toxic effects. Exposure may increase the toxic potential of chlorinated hydrocarbons, such as chloroform, trichloroethane.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention.

5. Fire Fighting Measures

Fire:
Flash point: -20C (-4F) CC
Autoignition temperature: 465C (869F)
Flammable limits in air % by volume:
lel: 2.5; uel: 12.8
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Vapors can flow along surfaces to distant ignition source and flash back. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. This material may produce a floating fire hazard. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, alcohol foam or carbon dioxide. Water may be ineffective. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Acetone:
-OSHA Permissible Exposure Limit (PEL):
1000 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
500 ppm (TWA), 750 ppm (STEL) A4 - not classifiable as a human carcinogen
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless, volatile liquid.
Odor:
Fragrant, mint-like
Solubility:
Miscible in all proportions in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
56.5C (133F) @ 760 mm Hg
Melting Point:
-95C (-139F)
Vapor Density (Air=1):
2.0
Vapor Pressure (mm Hg):
400 @ 39.5C (104F)
Evaporation Rate (BuAc=1):
ca. 7.7

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Concentrated nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis, chlorine compounds, acids, potassium t-butoxide.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Oral rat LD50: 5800 mg/kg; Inhalation rat LC50: 50,100mg/m3; Irritation eye rabbit, Standard Draize, 20 mg severe; investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

---NTP Carcinogen---

Ingredient	Known	Anticipated	IARC Category
Acetone (67-64-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material may be moderately degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is not expected to be toxic to aquatic life. The LC50/96-hour values for fish are over 100 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ACETONE
Hazard Class: 3
UN/NA: UN1090
Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: ACETONE
Hazard Class: 3.1
UN/NA: UN1090

Packing Group: II
Information reported for product/size: 350LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Acetone (67-64-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Acetone (67-64-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Acetone (67-64-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Acetone (67-64-1)	5000	U002	No

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: Yes
SARA 311/312: Acute: Yes Chronic: No Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

Australian Hazchem Code: 2[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM.
Label Precautions:
Keep away from heat, sparks and flame.

Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.

Label First Aid:

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
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ATTACHMENT 22.8

FILE:SV-STD
12/30/98

*INCLUDE UNITS

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
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ATTACHMENT 22.9

ATTACHMENT 22.10

Scan:_____
Method: 3510
Date:_____
Analyst:_____
Batch #_____

MDEQ-Environmental Lab
Water Extraction Logbook- Organics

Surrogate #_____
Spike #_____

	MeCl#		NaOH#		H2SO4#		Na2SO4#		Hexane#
#	Sample #	Collection Date	Adjusted pH	Initial Volume (mL)	Surrogate Volume (mL)	Spike Volume (mL)	Final Volume (mL)	Scan	Comments
1									
2									
3									
4									
5									
6									
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23									
24									

COMMENTS

ABSOLUTE STANDARDS, INC • 44 Rossotto Drive • Hamden, CT • (800)-368-1131

CL 16841-4
11/6/03KD

ISO 9001 Quality System Registered
DLS ANSI-RAB Accredited

ATTACHMENT 22.11

CERTIFIED WEIGHT REPORT

Part Number: 93009
Lot Number: 102903
Description: EPA Method 625 LCS Spike
54 components
Expiration Date: 102908

Nominal Concentration (µg/mL): Varied

Lot # CI561 Solvent(s): Methanol

Formulated By:	Vincent K. Criscio, Jr.	102903 DATE
Reviewed By:	Pedro L. Rentas	102903 DATE

5E-05 Balance Uncertainty

Volume(s) shown below were combined and diluted to : 400.0 0.050 Flask Uncertainty

Compound	Part Number	Lot Number	Dil Factor	Initial Vol. (mL)	Uncertainty Pipette	Initial Conc (ug/mL)	Final Conc (ug/mL)	Expanded Uncertainty (+/-) (µg/mL)	MSDS Information (Solvent Safety Info. On Attached pg.) CAS#	OSHA PEL (TWA)	LD50
1. Acenaphthene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00083-32-9	N/A	ipr-rat 800mg/kg
2. Acenaphthylene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00208-96-8	N/A	N/A
3. Anthracene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00120-12-7	0.2mg/m3 (8H)	ipr-mus 430mg/kg
4. Benzo(a)anthracene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00056-55-3	N/A	N/A
5. Benzo(b)fluoranthene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00205-99-2	N/A	N/A
6. Benzo(k)fluoranthene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00207-08-9	N/A	orl-rat 2820mg/kg
7. Benzo(g,h,i)perylene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00191-24-2	N/A	N/A
8. Benzo(a)pyrene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00453	00050-32-8	0.2mg/m3 (8H)	scu-rat 50mg/kg
9. 4-Bromophenyl phenyl ether	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00101-55-3	N/A	N/A
10. Benzyl butyl phthalate	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00085-68-7	N/A	orl-rat 2330mg/kg
11. bis(2-Chloroethoxy) methane	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00111-91-1	N/A	N/A
12. bis(2-Chloroethyl) ether	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00111-44-4	15 ppm (90mg/m3/8H)(skin	orl-rat 75mg/kg
13. bis(2-Chloroisopropyl) ether	92987	102903	0.50	200.0	0.013	100.2	50.1	0.01043	00108-60-1	N/A	orl-rat 240mg/kg
14. 2-Chloronaphthalene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00091-58-7	N/A	orl-rat 2078mg/kg
15. 4-Chlorophenyl phenyl ether	92987	102903	0.50	200.0	0.013	100.5	50.2	0.00450	07005-72-3	N/A	N/A
16. Chrysene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00218-01-9	0.2mg/m3	N/A
17. Di-n-butyl phthalate	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00450	00084-74-2	5mg/m3/8H	orl-rat 8000mg/kg
18. Di-n-octyl phthalate	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00117-84-0	N/A	ipr-mus 65g/kg
19. Dibenzo(a,h)anthracene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00053-70-3	0.2mg/m3	N/A
20. 1,2-Dichlorobenzene	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00095-50-1	50 ppm (300mg/m3) (CL)	orl-rat 500mg/kg
21. 1,3-Dichlorobenzene	92987	102903	0.50	200.0	0.013	100.3	50.2	0.00453	00541-73-1	N/A	ipr-mus 1062mg/kg
22. 1,4-Dichlorobenzene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00106-46-7	75 ppm (450mg/m3/8H)	orl-rat 500mg/kg
23. 2,4-Dinitrotoluene	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00456	00121-14-2	1.5mg/m3/8H (skin)	orl-rat 268mg/kg
24. 2,6-Dinitrotoluene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00606-20-2	1.5mg/m3/8H (skin)	orl-rat 177mg/kg
25. Diethyl phthalate	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00084-66-2	5mg/m3/8H	orl-rat 8600mg/kg
26. Dimethyl phthalate	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00131-11-3	5mg/m3/8H	orl-rat 6800mg/kg
27. bis(2-Ethylhexyl) phthalate	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00450	00117-81-7	5mg/m3/8H	orl-rat 30600mg/kg
28. Fluoranthene	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00453	00206-44-0	N/A	orl-rat 2000mg/kg
29. Fluorene	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00453	00086-73-7	N/A	ipr-mus 2 g/kg
30. Hexachlorobenzene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00118-74-1	N/A	orl-rat 10g/kg
31. Hexachlorobutadiene	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00453	00087-68-3	0.02 ppm (0.24mg/m3/8H)	orl-rat 90mg/kg
32. Hexachlorocyclopentadiene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00453	00077-47-4	0.01 ppm (0.1mg/m3/8H)	orl-rat 1300mg/kg
33. Hexachloroethane	92987	102903	0.50	200.0	0.013	100.0	50.0	0.00450	00067-72-1	1 ppm (10mg/m3/8H)(skin	orl-rat 4460mg/kg
34. Indeno(1,2,3-cd)pyrene	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00450	00193-39-5	N/A	N/A
35. Isophorone	92987	102903	0.50	200.0	0.013	100.2	50.1	0.00456	00078-59-1	25 ppm	orl-rat 2330mg/kg
36. Naphthalene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00091-20-3	10 ppm (50mg/m3/8H)	orl-rat 490mg/kg
37. Nitrobenzene	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00450	00098-95-3	1 ppm (5mg/m3/8H)(skin)	orl-rat 780mg/kg
38. N-Nitrosodimethylamine	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00453	00062-75-9	N/A	orl-rat 58mg/kg
39. N-Nitrosodi-n-propylamine	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00621-64-7	N/A	orl-rat 480mg/kg
40. N-Nitrosodiphenylamine	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00453	00086-30-6	N/A	orl-rat 2140mg/kg
41. Phenanthrene	92987	102903	0.50	200.0	0.013	100.1	50.1	0.00450	00085-01-8	0.2mg/m3/8H	orl-mus 700mg/kg
42. Pyrene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00453	00129-00-0	0.2mg/m3/8H	orl-rat 2700mg/kg
43. 1,2,4-Trichlorobenzene	92987	102903	0.50	200.0	0.013	100.1	50.0	0.00450	00120-82-1	5 ppm (CL) (40mg/m3)	orl-rat 756mg/kg
44. 4-Chloro-3-methylphenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00480	00059-50-7	N/A	orl-rat 1830mg/kg
45. 2-Chlorophenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00480	00095-57-8	N/A	orl-rat 670mg/kg
46. 2,4-Dichlorophenol	92988	102903	0.50	200.0	0.013	200.3	100.1	0.00480	00120-83-2	N/A	orl-rat 580mg/kg
47. 2,4-Dimethylphenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00484	00105-67-9	N/A	orl-rat 3200mg/kg
48. 2,4-Dinitrophenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00482	00051-28-5	N/A	orl-rat 30mg/kg
49. 4,6-Dinitro-2-methylphenol	92988	102903	0.50	200.0	0.013	200.2	100.1	0.00482	00534-52-1	0.2mg/m3/8H (skin)	orl-rat 10mg/kg
50. 2-Nitrophenol	92988	102903	0.50	200.0	0.013	200.2	100.1	0.00482	00088-75-5	N/A	orl-rat 334mg/kg
51. 4-Nitrophenol	92988	102903	0.50	200.0	0.013	200.2	100.1	0.00482	00100-02-7	N/A	orl-rat 250mg/kg
52. Pentachlorophenol	92988	102903	0.50	200.0	0.013	200.1	100.0	0.00482	00087-86-5	0.5mg/m3/8H (skin)	orl-rat 27mg/kg
53. Phenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00480	00108-95-2	5 ppm (19mg/m3/8H)(skin	orl-rat 317mg/kg
54. 2,4,6-Trichlorophenol	92988	102903	0.50	200.0	0.013	200.4	100.2	0.00480	00088-06-2	N/A	orl-rat 820mg/kg

DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 500 REVISION # ____

EFFECTIVE DATE 07/01

PAGE 1 OF 27 COPY ____

RELEASED BY _____ DATE 7/18/01

COMPLIANCE OFFICER

SEMIVOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

1.0 Applicable Analytical Methods

1.1 Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), U.S. Environmental Protection Agency, Method 8270C, SW846, Revision 3, December 1996.

1.2 Base/Neutrals and Acids, U.S. Environmental Protection Agency, Method 625, 40-CFR, Part 136, Appendix A.

1.3 Determinative Chromatographic Separations, U.S. Environmental Protection Agency, Method 8000B, SW846, Revision 2, December 1996.

1.4 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.5 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996.

1.6 Cleanup, U.S. Environmental Protection Agency, Method 3600C, SW846, Revision 3, December 1996.

2.0 Matrix or Matrices

2.1 Aqueous.

2.2 Soil.

2.3 Sediment.

SV0C

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Solid or liquid waste.

3.0 Method Detection Limits (MDLs) and Reporting Limits (RLs)

3.1 All MDLs are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 Every analyte to be quantitated by this method must have an MDL study performed. Results obtained for analytes that have not had an MDL calculated by this method must be considered estimated. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. MDLs are analyzed annually or whenever major instrument maintenance occurs. MDLs will be calculated as in 40 CFR, Part 136, Appendix B.

3.2.1 Water MDLs - A minimum of 7 replicate analyses are prepared in reagent water spiked with every analyte of interest at 1 ug/L concentration. MDLs are carried through all sample extraction and cleanup procedures that a sample would go through. See SOP 405 for details. Some compounds may need to be prepared at other levels.

3.2.2 Soil MDLs - A minimum of 7 replicate analyses are prepared in sand spiked with every analyte of interest at a concentration of 80 ug/Kg. See SOP 401, SOP 404, and SOP 400 for details. Some compounds may need to be prepared at other levels.

3.3 A RL will be used as the minimum quantification limit for all analytes reported unless otherwise specified. The RL will always be routinely achievable and greater than the MDL. See internal procedure SOP 103 for further details.

4.0 Scope and Application

4.1 This method provides for the GC/MS determination of semivolatile organic compounds in aqueous and solid matrices. This method is restricted to use by, or under the supervision of, analysts experienced in the use of GC/MS and skilled in the interpretation of mass spectra and their use as a quantitative tool. The RLs for solid samples are reported on a dry weight basis. See Attachment 22.12 for RLs and units. The following compounds are analyzed by this method:

Analyte	Chemical Abstract Services Registry Number
1,2,4-Trichlorobenzene	120-82-1
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7

2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2
2,4-Dichlorophenol	120-83-2
2,4-Dimethylphenol	105-67-9
2,4-Dinitrophenol	51-28-5
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
2-Chloronaphthalene	91-58-7
2-Chlorophenol	95-57-8
2-Methyl-4,6-Dinitrophenol	534-52-1
2-Methylnaphthalene	91-57-6
2-Methylphenol	95-48-7
2-Nitroaniline	88-74-4
2-Nitrophenol	88-75-5
3/4-Methylphenol	108-39-4 & 106-44-5
3-Nitroaniline	99-09-2
4-Bromophenyl phenylether	101-55-3
4-Chloro-3-methylphenol	59-50-7
4-Chlorophenyl phenylether	7005-72-3
4-Nitroaniline	100-01-6
4-Nitrophenol	100-02-7
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Azobenzene	103-33-3
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Bis(2-chloroethoxy)methane	111-91-1
Bis(2-chloroethyl)ether	111-44-4
Bis(2-chloroisopropyl)ether	108-60-1
Bis(2-ethylhexyl)phthalate	117-81-7
Butyl benzyl phthalate	85-68-7
Carbazole	86-74-8
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Dibenzofuran	132-64-9
Diethyl phthalate	84-66-2
Dimethyl Phthalate	131-11-3
Di-n-butyl phthalate	84-74-2
Di-n-octyl phthalate	117-84-0
Fluoranthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3

Hexachlorocyclopentadiene	77-47-4
Hexachloroethane	67-72-1
Indeno(1,2,3-cd)pyrene	193-39-5
Isophorone	78-59-1
Naphthalene	91-20-3
Nitrobenzene	98-95-3
N-Nitrosodimethylamine	62-75-9
N-Nitrosodi-n-propylamine	621-64-7
N-Nitrosodiphenylamine	86-30-6
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Phenol	108-95-2
Pyrene	129-00-0

5.0 Method Summary

5.1 Water samples are extracted by following SOP 405. Solid samples are extracted by following SOP 401 and cleaned up as in SOP 400. Oil samples are prepared as defined in SOP 404 and cleaned up as in SOP 400. The sample extracts are then injected onto a GC/MS. The gas chromatograph is temperature programmed to separate the analytes, which are then detected with a mass spectrometer detector. The capillary column is directly interfaced into the ion source.

5.2 Interpretations are performed by analyzing samples under the same conditions used for standards and comparing retention times (RTs), resultant mass spectra, and intensities of individual ions produced by that compound to the mass spectra response for a specific ion produced by an internal standard (IS). Quantitation is accomplished by comparing the response of a major ion relative to a major ion in an IS using the initial calibration curve.

6.0 Definitions

6.1 Surrogate Analyte (SA) - A pure analyte that is extremely unlikely to be found in any sample and is added to a sample aliquot in known amounts before extraction or other processing. The SA is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

6.2 Method Preparation Blank (MPB) - An aliquot of a blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.3 Laboratory Control Sample (LCS) - An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction, cleanup, and analysis.

6.4 Matrix Spike (MS) - An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.5 Matrix Spike Duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction, cleanup, and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

6.6 Initial Calibration Verification (ICV) – A second source standard used to check the accuracy of the calibration standards (CALs). This standard includes all target analytes and should be from a different vendor than the CALs.

6.7 Continuing Calibration Standard (CCS) – A mid-range standard to check the overall instrument performance. This includes all analytes that are to be reported.

6.8 IS - A pure analyte added to a sample, extract, or standard solution in known amounts and used to measure the relative responses of other method analytes and surrogates that are components of the sample or solution. The IS also monitors detector stability. The IS must be an analyte that is not a sample component.

6.9 Stock Standard (SS) – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

6.10 Working Standard (WS) – A solution of an analyte(s) prepared in the laboratory from SSs and diluted as needed to prepare calibration solutions and other needed analyte solutions.

6.11 System Blank (SB) – An aliquot of methylene chloride that has not undergone any preparation and is analyzed under the same analytical conditions as a sample. The purpose of the SB is to check for instrument contamination.

7.0 Interferences

7.1 Contamination by carryover can occur whenever high level and low level samples are sequentially analyzed. To reduce carryover the sample syringe is rinsed with solvent between sample analysis. Whenever an unusually concentrated sample is encountered, the sample following it must be evaluated to check for cross contamination.

7.2 Interferences from contaminants can occur from solvents, glassware, and other sample processing equipment. Pesticide quality solvents (or better) and solvent rinsing of all glassware should help minimize contaminants.

7.3 Compounds co-extracted with the analytes of interest can cause interferences. Whenever possible samples should be cleaned up to avoid interferences.

7.4 Oily sample matrices will often cause a raised baseline, IS, and/or surrogate failure. Samples will usually need a dilution performed to minimize this interference. RLs will then be elevated appropriately.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (SOP 100).

8.4 Gas cylinders must be secured to a wall or countertop.

8.5 Methylene chloride material safety data sheets (MSDS) are attached.

8.6 Protective gloves must be worn when handling solvents.

9.0 Equipment and Supplies

9.1 Microsyringes – various sizes.

9.2 Volumetric flasks - Class A with ground-glass stoppers.

9.3 Vials - 2 mL crimp cap.

9.4 Pipettes - Class A.

9.5 Injectors.

9.6 Autosamplers.

9.7 Gas chromatograph.

9.7.1 Hewlett Packard model 5890 series II or 6890 GC - Equipped with a split/splitless capillary injector and electronic pressure controller or APEX injector. The electronic pressure controller or APEX injector maintains constant flow as the GC temperature increases during programming.

9.7.2 Typical operating conditions can be found in Attachment 22.17. Changes or deviations can be found in their respective maintenance logbooks.

9.8 Mass spectrometer.

9.8.1 The mass spectrometer must be capable of scanning from 35 to 300 amu every second or less, utilizing 70 volts (nominal) of electron energy in the electron impact ionization mode. It produces a mass spectrum that meets all the instrument performance criteria when 50 ng of decafluorotriphenylphosphine (DFTPP) is directly injected via the injection port. To ensure sufficient precision of mass spectral data, the MS scan rate should allow acquisition of at least five spectra while a sample component elutes from the GC.

9.8.2 Hewlett Packard MSD model 5972.

9.8.3 Hewlett Packard MSD model 5973.

9.8.4 Typical operating conditions can be found in Attachment 22.18. Changes or deviations can be found in their respective maintenance logbooks.

9.9 *GC/MS interface*

9.9.1 The capillary column in the GC is directly interfaced into the ion source of the mass spectrometer via a heated transfer line.

NOTE: *The same GC conditions are used for the analysis of all standards, samples, blanks, MSs, and MSDs.*

9.10 Capillary column - J & W Scientific DB5MS narrow bore capillary column, 30 m long x 0.25 mm ID x 0.25-1.0 µm film thickness or equivalent.

9.11 Data system - A personal computer is interfaced to the GC/MS system. The computer system is equipped with an assortment of disk drives, a hard drive, and tape or CD back-up accessories. The software (HPCHEMPC with Enviroquant) is from Hewlett Packard and is multitasking and window driven. This software allows for searches of any GC/MS data file for ions of a specified mass, and it plots such ion abundance versus time or scan number. This type of plot is defined as an extracted ion current profile (EICP). The software also allows integration of the abundance of any EICP between specified time or scan number limits. In addition, it allows the tentative identification of non-target compounds by comparing the unknown mass spectra with that of a reference library.

9.12 Bottle top dispensers - 1 to 10 mL.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to that standard. Original certificates are kept by the Laboratory's Quality Assurance (QA) Officer.

10.6 Helium – Ultra-high purity.

10.7 Methylene chloride - Pesticide grade, demonstrated to be free of target analytes.

10.8 SSs - All standards must be certified reference materials. Manufacturer's certificates of analysis are retained by the Laboratory and kept as part of the overall QA/QC requirements. All SSs must be given a unique lab tracking number and logged into the SS tracking logbook. Store SSs in amber sealed ampules at 10°C to 20°C. Protect the standards from light. All standards are received in methylene chloride unless otherwise specified.

10.8.1 SSs - SSs are purchased as mixes in sealed ampules and are stored in a freezer at a temperature lower than 0°C.

10.8.2 CALs

10.8.2.1 Base/neutral mix (2000 ug/mL) - Absolute Standards, part #91759 or equivalent. See Attachment 22.2 for compound list.

10.8.2.2 Additional compounds mix (2000 ug/mL) - Absolute Standards, part #91760 or equivalent.

Aniline	Benzyl alcohol
Carbazole	4-Chloroaniline
Dibenzofuran	2-Methylnaphthalene
2-Nitroaniline	3-Nitroaniline
4-Nitroaniline	Pyridine

10.8.2.3 Acid mix (2000 ug/mL) - Absolute Standards, part #91761 or equivalent.

Benzoic acid	4-Chloro-3-methylphenol
2-Chlorophenol	2-Methylphenol
4-Methylphenol	2,4-Dichlorophenol
2,4-Dimethylphenol	2-Nitrophenol
4-Nitrophenol	Pentachlorophenol
Phenol	2,4,5-Trichlorophenol
2,4,6-Trichlorophenol	

10.8.2.4 Base/neutral surrogate mix (5000 ug/mL) - Absolute Standards, part #24016 or equivalent.

2-Fluorobiphenyl
p-Terphenyl-d_{14}
Nitrobenzene-d_5

10.8.2.5 Acid surrogate mix (10,000 ug/mL in methanol) - Absolute Standards, part #24015 or equivalent.
2-Fluorophenol
Phenol-d_6
2,4,6-Tribromophenol

10.8.3 ICV at 200 ug/mL - NSI Solutions, Inc., part #C-509 or equivalent. See Attachment 22.5 for compound list.

10.8.4 IS – Absolute Standards, part #10009 or equivalent. The IS is at a concentration of 4000 ug/mL and contains:

Acenaphthene-d_{10}	Naphthalene-d_8
Chrysene-d_{12}	Perylene-d_{12}
1,4-Dichlorobenzene-d_4	Phenanthrene-d_{10}

10.8.5 Tuning standard – Absolute Standards, part #43030 or equivalent. The tuning standard is at a concentration of 500 ug/mL and contains:

Benzidene	Pentachlorophenol
4,4'-DDT	DFTPP

10.9 Intermediate and WSs - All prepared standards must be given a unique laboratory tracking number and logged into the semivolatile standards logbook. Store intermediate and working solutions in 2 mL teflon-sealed crimp cap vials with minimal headspace at -10°C to -20°C. The intermediate standards must be checked frequently for signs of degradation or evaporation. Fresh standards should be prepared if a check exceeds a 20% drift. All standards are good for up to six months maximum. Recapping the vials at appropriate intervals after repeated usage will minimize loss of early eluting compounds in the standards.

10.9.1 Intermediate tune standard (50 ug/mL) - Place approximately 5 mL of methylene chloride into a 10 mL volumetric flask. Inject 1000 µL of the tune SS (Section 10.8.5) directly into the methylene chloride in the volumetric flask. Bring to volume with methylene chloride. Prepare fresh tune solution every six months or sooner if the solution has degraded or evaporated.

NOTE: *A 1 µL injection of this 50 ug/mL solution is 50 ng on column.*

10.9.2 IS solution (500 ug/mL) - Place approximately 10 mL of methylene chloride into a 25 mL volumetric flask. Inject 3125 µL of stock IS (Section 10.8.4) directly into the methylene chloride in the volumetric flask. Bring to volume with methylene chloride. Cap. Mix. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.9.3 Intermediate CALs - Place approximately 2 mL of methylene chloride into a 10 mL volumetric flask. Inject the amount of each SS directly into the methylene chloride in the volumetric flask according to the list below. Bring to volume with methylene chloride. Cap. Mix. Distribute this prepared intermediate CAL into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

SS	uL	Final Conc. (mg/L)
10.8.2.1	1000	200
10.8.2.2	1000	200
10.8.2.3	2500	500
10.8.2.4	400	200
10.8.2.5	500	500

NOTE: *Recap vials each time the septum on the cap is pierced by a syringe. This will keep the standard from concentrating by evaporation.*

10.9.4 WSs – Eight WSs are prepared primarily in crimp cap vials except for the mid range standard, which is prepared in a 10 mL volumetric flask. Using the intermediate standard prepared in Section 10.9.3, prepare each WS according to the list below. Cap. Mix. Label. Store in a freezer.

uL Intermediate Standard	uL MeCl	Final Conc. (mg/L) BN/A
400	600	80/200
300	700	60/150
200	800	40/100
1000	9000	20/50
50	950	10/25
20	980	4/10
10	990	2/5
5	995	1/2.5

Distribute the mid-range standard into 10 crimp cap vials with 1 mL in each vial. Add 20 uL of IS (Section 10.9.2) into every WS.

10.9.5 Intermediate ICV – The ICV is prepared at two concentration levels in crimp cap vials.

10.9.5.1 50 mg/L ICV – Place 250 uL of stock ICV (Section 10.8.3) into a crimp cap vial containing 750 uL of methylene chloride. Inject 20 uL of IS (Section 10.9.2). This ICV is typically used to verify the phenolic compounds.

10.9.5.2 20 mg/L ICV - Place 100 uL of stock ICV (Section 10.8.3) into a crimp cap vial containing 900 uL of methylene chloride. Inject 20 uL of IS (Section 10.9.2). This ICV is typically used to verify the base/neutral compounds.

11.0 Sample Collection, Preservation, and Handling

11.1 Aqueous samples -- see SOP 405.

11.2 Solid samples – see SOP 401.

11.3 Waste samples – see SOP 404.

11.4 Holding times – Sample extracts may be analyzed for up to 40 days from the extraction date.

11.5 Storage – Sample extracts must be stored in a freezer, and protected from light in crimp cap vials until analysis.

12.0 Quality Control (QC)

12.1 DFTPP performance criteria - The DFTPP must meet the criteria in Section 13.1 before any standards, blanks, or samples are analyzed. A DFTPP analysis must be performed every 12-hour shift.

12.2 Extracted sample batches

12.2.1 Extracted sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS (if a MS/MSD is not available a laboratory control sample duplicate [LCSD] must be analyzed).

12.2.2 MSs and MSDs are actual samples that are selected at random from within the batch of 20.

12.2.3 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction of individual samples.

12.2.4 The MS, MSD, LCS, and LCSD are spiked at a known concentration with target analyte compounds. The replicate MSs or LCSs are used to evaluate the entire batch for precision and accuracy.

12.3 Initial CALs

12.3.1 A set of 8 CALs are analyzed (Section 10.9.4). See Section 15.1 for response factor (RF) calculations and Section 18.2 for acceptance criteria. A minimum of five standards are used in the initial calibration curve. These are used to determined the average RF for each analyte.

12.3.2 Upon completion of the initial calibration, samples may be analyzed if time remains in the 12-hour time period.

12.4 CCS – A check of the calibration curve must be performed once every 12 hours. (It is not necessary to analyze a CCS within the 12-hour time period in which the initial calibration was performed.) Calculate the RFs for all analytes in the CCS. If the criteria in Section 18.3 is met, the initial calibration curve is considered to still be valid.

12.5 Blanks – A SB or MPB must be analyzed after the CCS. A blank must be analyzed every 12 hours to show that the analytical system is free from interferences and contamination. A blank will be run more frequently if contamination is a concern. If the criteria in Section 18.7 or Section 18.8 is met, the analysis of samples can begin.

12.6 Replicates

12.6.1 The laboratory analyzes a MS/MSD or LCS/LCSD pair at a minimum of once every extraction batch to assess precision and accuracy.

12.6.2 If the sample associated with the MS and MSD does not meet surrogate acceptance criteria, it should be reanalyzed only if the MS/MSD surrogate compound recoveries are within the limits. If the sample and associated MS/MSD show the same pattern (i.e., outside the limits), the sample does not require reanalysis.

12.7 LCS/LCSD

12.7.1 One LCS must be prepared for every batch of samples. An LCSD must be prepared if an MS/MSD is not prepared.

12.7.2 See Section 18.4 for acceptance criteria.

12.8 IS - IS responses and RTs in all standards must be evaluated after data acquisition. If the RT time for any IS changes by more than 0.50 minutes (30 seconds) from the most recent continuing (12-hour) CAL, the chromatographic system must be inspected for malfunctions, and corrections must be made as needed. The EICP of the ISs must be monitored and evaluated for each standard. The EICP area for ISs must be within 50% to 200%, or the mass spectrometric system must be inspected for malfunction, and corrections must be made as appropriate. When corrections are made, reanalysis of those samples analyzed while the system was malfunctioning is necessary.

12.9 ICV - This is analyzed after every initial calibration and at least once per quarter. The ICV may be analyzed in place of the CCS. See Section 18.3 for acceptance criteria.

12.10 The sample analyzed immediately after a contaminated sample must be evaluated for contamination. Reanalyze if contamination is suspected.

12.11 Initial demonstration of ability - Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for the target analytes. This is accomplished by preparing and analyzing four aliquots of a reference sample.

12.11.1 Reference sample preparation

12.11.1.1 Five aliquots of reagent water or sand are extracted using SOP 401 or SOP 405. One is an MPB, and the other four are spiked at a mid-range concentration with all the analytes listed in Section 4.1.

12.11.1.2 Sample extracts are taken through all the normal sample cleanup methods.

12.11.1.3 Inject 20 µL of the IS solution (Section 10.9.2) through the septum of the vial. This is equivalent to a concentration of 10 ug/mL.

12.11.2 Calculate the recovery of each compound (Section 15.8) and average the four results. Compare to laboratory generated limits.

12.11.3 Calculate the standard deviation (SD) of each compound (Section 15.3) and compare to laboratory generated limits.

12.12 Surrogate compounds are added to all samples, MPBs, and QC samples during extraction. Surrogate recovery data is compared to MDEQ Laboratory generated limits. (Section 18.10)

13.0 Calibration and Standardization

13.1 DFTPP tuning analysis - Prior to the analyses of any samples, blanks, CALs, or QA/QC samples, the GC/MS system must meet the mass spectral ion abundance criteria for the instrument performance check solution containing DFTPP.

13.1.1 Direct inject 1 µL of a 50 ug/mL solution of DFTPP (Section 10.9.1) into the GC/MS via the GC injection port.

13.1.2 The mass spectrum and ion abundance criteria of DFTPP are determined by averaging three scans (the scan at the apex, the scan preceding the apex, and the scan following the apex). Background subtraction is performed using a single scan no more than 20 scans prior to the elution of DFTPP.

13.1.3 The analysis of the instrument performance check solution (DFTPP) must meet the ion abundance criteria given below.

Mass	Ion abundance criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

13.1.4 The tuning standard (DFTPP) is analyzed once at the beginning of each 12-hour period in which samples, blanks, or standards are to be analyzed. The 12-hour time period starts with the injection of DFTPP. The time period ends after 12 hours have elapsed. If the analysis of a sample starts within the first 12-hour period but ends past the first 12-hour period, the last sample is considered to have been analyzed within the first 12-hour period.

13.1.5 The tuning standard solution is also used to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD should not exceed 20%. Benzidene and pentachlorophenol should be present at their normal responses, and no

peak tailing should be visible. Corrective action may include injection port cleaning and column clipping.

13.2 Initial calibration curve - Prior to the analysis of samples and after the tuning criteria has been met, the GC/MS system is calibrated. The WSs prepared in Section 10.9.4 are analyzed, and a minimum of five are used for the calibration curve. All standards, blanks, samples, and QC are injected at the same volume (usually 1 uL). ISs are in each standard and blank at a constant concentration of 10 ug/mL throughout the curve. The initial calibration is performed whenever the CCS (daily) fails to meet acceptance criteria or when major instrument repairs are made.

13.2.1 Calculate the RF for every analyte in each standard as in Section 15.1.
13.2.2 Calculate the average RF for each analyte as in Section 15.2.
13.2.3 Calculate the SD for each analyte as in Section 15.3.
13.2.4 Calculate the %RSD for each analyte as in Section 15.4.
13.2.5 Evaluate the initial calibration as in Section 18.2. If the criteria is met, analysis of the ICV may proceed.

13.3 SB – A SB is analyzed after every calibration curve to ensure that the system is contamination free.

13.3.1 Place 1 mL of methylene chloride into a crimp cap vial. Inject 20 uL of IS (Section 10.9.2). Cap. Mix.
13.3.2 Evaluate as in Section 18.7.

13.4 ICV - The ICV is analyzed after every acceptable initial calibration to verify the accuracy of the initial CALs. The ICV is prepared in Section 10.9.5.

13.4.1 Calculate the recovery of each analyte as in Section 15.8.
13.4.2 Evaluate the ICV as in Section 18.3. If the ICV meets the criteria, proceed with Section 14.

14.0 Procedure

14.1 Blank – An MPB or SB is analyzed once during every 12-hour shift in which samples are analyzed.

14.1.1 Evaluate as in Section 18.7 or Section 18.8.

14.2 CCS - The CCS verifies that the initial calibration curve is still valid. It is analyzed once during every 12-hour shift. The concentration is 20 ug/L for base neutrals (BNs) and 50 for acids and is prepared in Section 10.9.4.

NOTE: *An ICV (Section 13.4) may be analyzed in place of the CCS.*

14.2.1 Calculate the RF of each compound as in Section 15.1.
14.2.2 Evaluate the data as in Section 18.3. If the criteria is met, proceed with Section 14.3.

14.3 Sample analysis

14.3.1 Add 20 uL of IS solution (Section 10.9.2) to every sample, MPB, and QC sample in the extraction batch.
14.3.2 Load samples onto the autosampler and analyze.
14.3.3 Evaluate each target compound as in Section 18.1.
14.3.4 Evaluate all chromatograms as in Section 18.5.
14.3.5 Calculate target analyte concentrations as in Section 15.5.
14.3.6 Calculate recovery of each spiked compound as in Section 15.7.
14.3.7 Calculate the relative percent difference (RPD) as in Section 15.9.
14.3.8 Evaluate recovery and RPD as in Section 18.4.

14.4 Preventative maintenance

14.4.1 The septa, insert, and gold seal are changed or cleaned daily.
14.4.2 The pump oil is changed twice each year.
14.4.3 The injection end of the capillary column is clipped as needed.
14.4.4 The autosampler syringe is changed as needed.

15.0 Calculations

15.1 RF - Tabulate the area response of the characteristic ions in the EICP against concentration for each compound and IS. Calculate RFs for each compound as follows:

$$RF = \frac{A_x \times C_{is}}{A_{is} \times C_x}$$

A_x = area of the characteristic ion (EICP) for the analyte to be measured.
A_{is} = area of the characteristic ion (EICP) for the specific IS.
C_{is} = concentration of the IS.
C_x = concentration of the analyte to be measured.

***NOTE**: The m and p isomers of methylphenol coelute on the capillary column. However, only the p isomer is present in the standards.*

15.2 Average RF (aRF) - Calculate the aRF for each analyte in the initial calibration by adding up each RF and dividing by the number of RFs.

15.3 SD - Calculate the SD (population) of the RF for each analyte.

15.4 % RSD - Calculate the % RSD of the RF values over the working range of the curve. Record the % RSD for all compounds. The % RSD is calculated as follows:

$$\% RSD = (SD/aRF) * 100$$

RSD = relative standard deviation.
aRF = average RF for each analyte.
SD = standard deviation of mean RF for each analyte (population).

15.5 Target analytes - Identified target analytes must be calculated by the IS method and the average RF from the initial calibration curve.

15.5.1 Aqueous samples

$$\text{concentration (ug/L)} = \frac{(A_x)(Is)(Df)}{(A_{is})(aRF)(V)}$$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
aRF = average RF from the initial calibration curve.
V = volume of water sample extracted (mL).
Df = dilution factor (if any).

15.5.2 Solid samples

$$\text{concentration (ug/Kg dry)} = \frac{(A_x)(Is)(Vt)(1000)(Df)(2^*)}{(A_{is})(aRF)(W)(\%\ S)}$$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
aRF = average RF from the initial calibration curve.
Vt = total volume of final extract (mL).

NOTE: *This is usually 1 mL.*

Df = dilution factor (if any).
W = weight of solid sample extracted (g).
% S = % solids/100.
* Include a multiplication factor of 2 if gel permeation chromatography (GPC) cleanup was performed.

15.5.3 Oil or liquid waste samples

$$\text{concentration (mg/Kg)} = \frac{(A_x)(Is)(Vt)(Df)}{(A_{is})(aRF)(W)}$$

A_x = area of the characteristic ion for the analyte being

measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
aRF = average RF from the initial calibration curve.
Vt = total volume of final extract (mL).

NOTE: *This is usually 10 mL.*

Df = dilution factor (if any).
W = weight of sample extracted (g).

NOTE: *Oil or liquid waste samples are usually diluted 1g to 10 mL. If GPC is performed, 2 mL is removed and diluted to 10 mL by the GPC unit. Five mL of this is actually injected onto the GPC column. The final extract is concentrated to 1 mL. (The 2 to 10 dilution is canceled out by the 5 to 1 concentration).*

15.6 Surrogate compound recovery - Calculate the concentration of each surrogate compound as in Section 15.5. Calculate the recovery of each surrogate compound in all samples, blanks, MSs, MSDs, LCSs, LCSDs, CCSs, and ICVs as follows:

$$\% \text{ recovery} = \frac{\text{concentration found} \times 100}{\text{concentration spiked}}$$

15.7 % recovery - Calculate the concentration of each MS or MSD analyte as in Section 15.5. Calculate the recovery of each MS or MSD analyte as follows:

$$\text{MS or MSD recovery} = \frac{(SSR - SR) \times 100}{SA}$$

SSR = analyte concentration in spike.
SR = analyte concentration in unspiked sample.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.8 LCS, LCSD, CCS, reference sample, and ICV recovery - Calculate the concentration of each analyte as in Section 15.5. Calculate the recovery of each analyte as follows:

$$\% \text{ recovery} = \frac{SSR \times 100}{SA}$$

SSR = analyte concentration in spike.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.9 RPD - Calculate the RPD of the recoveries of each compound in the MS/MSD or LCS/LCSD as follows:

$$RPD = \frac{(MS - MSD) \times 100}{(1/2)(MS + MSD)} \quad \text{or} \quad RPD = \frac{(LCS - LCSD) \times 100}{(1/2)(LCS + LCSD)}$$

MS = matrix spike recovery.
MSD = matrix spike duplicate recovery.
LCS = laboratory control sample recovery.
LCSD = laboratory control samples duplicate recovery.

NOTE: *The formula above is the absolute value of the difference. Therefore, RPD is always expressed as a positive value.*

15.10 % difference

$$\% \text{ difference} = \frac{(RF - aRF) \times 100}{aRF}$$

RF = response factor of analyte.
aRF = average RF of analyte from initial calibration.

15.11 Least squares regression – Performed using a linear regression of the peak area response (y) versus the concentration of the standards (x).

y = ax + b.
a = slope.
b = intercept.

NOTE: *This line should not be forced through the origin, should include at least five points, and should not include a blank.*

15.12 Target analytes – Identified target analytes may be calculated by the IS method and a least squares regression of the initial calibration curve.

15.12.1 Aqueous sample target analytes (ug/L)

$$\text{Concentration (ug/L)} = [[(Ax)(Is)(Df)/(Ais)(V)] - b] \div a$$

Ax = area of characteristic ion for the analyte being measured.
Ais = area of the characteristic ion for IS (see Attachment 22.8).
Is = ng of IS
a = slope of the curve
b = intercept of curve
Df = dilution factor (if any)
V = volume of water sample extracted (mL).

15.12.2 Solid sample target analytes (ug/Kg)

Concentration (ug/Kg dry) = [[(Ax)(Is)(Df)(Vt)(1000)(2*)/(Ais)(W)(%S)] – b] ÷ a

Ax = area of characteristic ion for the analyte being measured.
Ais = area of the characteristic ion for IS (see Attachment 22.8).
Is = ng of IS.
a = slope of the curve.
b = intercept of curve.
Df = dilution factor (if any).
Vt = total volume of final extract (mL).

NOTE: *This is usually 1 mL.*

W = weight of solid sample extracted (g).
%S = % solids/100.

NOTE: ** Include a multiplication factor of 2 if GPC cleanup was performed.*

15.12.3 Oil or liquid waste samples

concentration (mg/Kg) = $[[(A_x)(Is)(Vt)(Df) /(A_{is})(aRF)(W)]-b] \div a$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
aRF = average RF from the initial calibration curve.
Vt = total volume of final extract (mL).

NOTE: *This is usually 10 mL.*

Df = dilution factor (if any).
W = weight of sample extracted (g).
a = slope of the curve
b = intercept of curve

NOTE: *Oil or liquid waste samples are usually diluted 1g to 10 mL. If GPC is performed 2 mL is removed and diluted to 10 mL by the GPC unit. Five mL of this is actually injected onto the GPC column. The final extract is concentrated to 1 mL. (The 2 to 10 dilution is canceled out by the 5 to 1 concentration.)*

16.0 Method Performance

16.1 Each MDL study must be labeled with the instrument number, analyst, and date.

17.0 Pollution Prevention

17.1 This method uses small quantities of organic solvents. The waste that is produced is collected for disposal as chlorinated waste.

17.2 For information concerning pollution prevention that may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Qualitative analysis - All target analytes are identified by comparing the sample mass spectrum with the mass spectrum of a standard of the suspected analyte (standard reference spectrum) and elution of the sample component at the same GC relative retention time (RRT) as those of the standard analyte RT.

18.1.1 Mass spectra - Mass spectra for the standard reference should be obtained on the user's GC/MS. These standard reference spectra are obtained through analysis of the CALs. All ions present in the standard mass spectra at a relative intensity greater than 30% (most abundant ion in the spectrum equals 100%) must be present in the sample spectrum. The relative intensities of these ions must agree within ±30% between the standard and sample spectrum. For example: an ion with an abundance of 50% in the standard spectra must be between 20 and 80% abundance in the sample spectra.

18.1.2 RT - The sample peak RT must compare within 30 seconds of the RT of the standard peak.

18.2 Initial calibration evaluation

18.2.1 System performance check compounds (SPCCs) - Five compounds are checked for a minimum mean RF of 0.050:
N-nitroso-di-n-propylamine
Hexachlorocyclopentadiene
2,4-Dinitrophenol
4-Nitrophenol

18.2.2 Calibration check compounds (CCCs) - The %RSD of the RF for these analytes must be less than or equal to 30%, or corrective action must take place:

Acenaphthene	4-Chloro-3-methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
Diphenylamine	Phenol
Di-n-ocyl phthalate	Pentachlorophenol
Fluoranthene	2,4,6-Trichlorophenol
Benzo(a)pyrene	

NOTE: *A least squares regression may be used for CCCs >15% but <30%.*

18.2.3 The %RSD of the RF must be less than or equal to 15% for each target analyte in order to employ the average RF for quantitation (<35% is acceptable for samples analyzed by Method 625). A least squares regression should be used (Section 15.11 and Section 15.12) for compounds with a %RSD greater than 15% (or 35% for Method 625). The regression calculation will generate a correlation coefficient (r) that must be greater than or equal to 0.99 in order to employ the linear regression curve.

18.2.4 The average %RSD of all the compounds must be less than or equal to 15%, or the curve or a calibration point must be reanalyzed.

18.2.5 The RRT of each analyte should agree within 0.06 RRT units.

18.3 CCS and ICV evaluation

18.3.1 Each SPCC compound in the CCS and/or ICV must meet the minimum RF in Section 18.2.1.

18.3.2 Each CCC (see Section 18.2.2) in the CCS and/or ICV must have a percent difference less than or equal to 20%, or corrective action must be taken. (See Section 15.10 for calculations).

18.3.3 The IS RTs must be evaluated in every CCS and ICV. If the RT changes by more than 30 seconds from a mid-level standard in the current initial calibration, corrective action must be taken.

18.3.4 The IS EICP area must be evaluated in every CCS and ICV. The area must be with 50% to +200% of a mid-level standard in the current initial calibration. If the IS area does not meet this requirement, corrective action must be taken.

18.3.5 The CCS and ICV should be evaluated as follows:

18.3.5.1 Do the peaks look normal (gaussian)?

18.3.5.2 Is the response comparable to previous calibrations?

18.3.5.3 Are any peaks tailing?

18.4 MS, MSD, LCS, and LCSD evaluation - Recoveries for each spiked analyte are calculated as in Section 15 and must meet MDEQ Laboratory generated limits except if the sample is for an National Pollutant Discharge Elimination System permit (see Attachment 22.14). For compounds not listed in Attachment 22.14, use the MDEQ limits.

18.5 *Quantitative analysis*

18.5.1 Target analytes identified shall be quantified by the IS method. The IS used for quantitation should be nearest in RT to the analyte of interest (see Attachment 22.8).

18.5.2 The EICP area of the characteristic ions of analytes listed in Attachment 22.9 and Attachment 22.10 are used.

18.5.3 IS responses and RTs in all standards must be evaluated during or immediately after data acquisition. If the RT time for any IS changes by more than 30 seconds from the most recent CCS (12-hour), the chromatographic system must be inspected for malfunctions and corrections made as required. For samples analyzed during the same 12-hour time period as the initial CALs, compare the IS responses and RTs against the mid-range CAL. The EICP of the ISs must be monitored and evaluated for

each sample, blank, MS, and MSD. The EICP area for the IS must be within 50% to 200% of the mid-range standard. The mass spectrometric system must be inspected for malfunction and corrections made as appropriate. Generate a IS/RT form from the software (Attachment 22.16). When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is necessary.

18.5.4 If target analytes are reported below the RL the spectra must meet the identification criteria and results estimated (J code).

18.6 TIC

18.6.1 When requested, an estimated concentration for analytes not present in the CAL may be made. The formulas given in Section 15.1 will be used with the following modifications:

18.6.1.1 The areas Ax and Ais should be from the total ion chromatogram.
18.6.1.2 The IS used will be the closest in elution time to the unknown in the sample that is free of interferences.
18.6.1.3 The average RF will be 1.
18.6.1.4 The concentration obtained will be reported as an estimate.

18.6.2 National Institute of Standards and Technology (NIST) library searches - For samples containing components not associated with the CALs, a library search may be made for the purpose of tentative identification. All target analytes are identified by comparison of the sample mass spectrum with the mass spectrum from the NIST library.

18.6.3 The relative intensities of major ions in the reference spectrum (ions >10% of the most abundant ion) should be present in the sample spectrum.

18.6.4 The relative intensities of the major ions should agree within ±20%.

18.6.5 Molecular ions present in the reference spectrum should be present in the sample spectrum.

18.6.6 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

18.6.7 Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies. Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

18.6.8 See Attachment 22.11 for more TIC criteria.

18.7 SB evaluation – The SB must not contain target analytes above the RL.

18.8 MPB evaluation – The method blank should not contain target analytes above the RL.

18.9 Data review – All data is reviewed by a second person prior to release.

18.10 Surrogate evaluation – Recoveries for each surrogate compound are calculated as in Section 15.6 and must meet MDEQ Laboratory generated limits, or corrective action must be taken (Section 19.1). Generate a surrogate summary form from the software (Attachment 22.13). Dilutions of 1:10 or greater dilute the surrogate recovery, and no value is reported.

18.11 Fill out a semivolatile organic compound (SVOC) QA summary form for each batch (Attachment 22.15).

18.12 Fingerprint matching

18.12.1 When requested, sample extracts can be compared to multi component standards or other samples for pattern recognition.

18.12.2 Samples requiring a fingerprint analysis must not undergo any cleanup procedure. Cleanup procedures could potentially remove some of the pattern needed for recognition.

18.12.3 The following multi component standards are available for fingerprint matching:
Diesel fuel
Diesel fuel (weathered)
Jet fuel
Fuel oil #2
Fuel oil #4
Hydraulic oil
30W Motor oil
JP-4 fuel
Mineral spirits
Stoddard
Turpentine
Naphtha
Lacquer thinner
Kerosene
Kerosene (weathered)
Gasoline

18.12.4 Fingerprint matching is never reported with a concentration. It is only used as a qualitative identification of a multi component parameter. Fingerprint standards are analyzed with ISs to help mark RTs and are generated for each instrument only when major instrument changes have occurred. Example fingerprint chromatograms can be found in Attachment 22.19.

18.12.5 ISs do not have to pass the criteria in Section 18.5.3.

19.0 Corrective Actions

19.1 Surrogate recovery - All surrogate recoveries must fall within the specified laboratory generated windows. If any surrogate compound is out of control due to obvious matrix problems, the sample will not be re-run, and the sample result(s) will be qualified as estimated. If the sample has a surrogate that is out for no apparent reason, the sample will be reanalyzed. If the reanalysis is within limits, the first

analysis will be discarded, and the second analysis will be reported. If the second analysis agrees with the first, the poor recovery is attributed to matrix interference, and result(s) from the first analysis will be reported with the appropriate qualifier. If many samples are out of control for no apparent reason, the mass spectrometer needs to be inspected for malfunctions, and corrections must be made as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning are necessary. If any acid surrogate recovery is above the acceptance limit, all positively identified acid compounds must be reported as estimated (J code). If any BN surrogate recovery is above the acceptance limit, all positively identified BN compounds must be flagged as estimated (J code). If any acid surrogate recovery is below the acceptance limit, all acid compounds must be flagged as estimated (J code). If any BN surrogate recovery is below the acceptance limit, all BN compounds must be flagged as estimated (J code). Determine if the recovery is within limits. If the recovery of any one surrogate is not within limits, the following are required:

19.1.1 Check all calculations and instrument performance. Check the preparation of the surrogate spiking solution and IS solution for errors or degradation.

19.1.2 Reanalyze the sample unless a calculation error was found.

19.1.3 If an undiluted analysis with acceptable surrogate recoveries is being submitted, do not reanalyze diluted samples if the surrogate recoveries are outside the limits.

19.1.4 If the sample associated with the MS and MSD does not meet criteria, it should be reanalyzed only if the MS/MSD system monitoring compound recoveries are within the limits. If the sample and associated MS/MSD show the same pattern (i.e., outside the limits), the sample does not require reanalysis.

19.1.5 If surrogate recoveries fall outside the acceptance limits and the sample is within the extraction hold time, reextraction or reanalysis is performed if possible.

19.2 MS/MSD/LCS/LCSD recoveries - If any analyte percent recovery in the MS or MSD falls outside the acceptance windows, the laboratory must determine if there is a matrix effect or a laboratory performance problem. A matrix effect is indicated if the LCS data are within limits but the MS or MSD data exceeds the limits. If a matrix effect is determined, the report will be flagged as matrix interference. If recoveries of the analytes in the LCS are outside acceptance limits, the problem may lie with the extraction or analytical system. Corrective action may include reextraction and/or reanalysis of samples once the problem has been resolved.

19.3 %RPD - If the %RPD of any analyte is outside the acceptance range, evaluate the system to locate potential problems. Corrective action may include reextraction and/or reanalysis of samples once the problem has been resolved, or the data may be flagged as estimated.

19.4 SB – SB results must be less than the RL for all target analytes If the SB does not meet this criteria, action must be taken to locate and correct the source of the contamination prior to the analysis of samples, QA/QC samples, etc.

19.5 MPB – MPB results should be less than the RL for all target analtyes. If the MPB does not meet this criteria, action should be taken to locate and reduce the source of the contamination. Samples associated with the contaminated MPB should be reextracted and/or analyzed if at all possible. If MPB results do not meet criteria and reanalysis is not possible, the MPB results must be reported to the client.

19.6 Hold times - All analysis dates must be within 40 days of the extraction date. If analysis is past the hold time, all data must be flagged as estimated.

20.0 Waste Management

20.1 The Laboratory Safety Officer arranges for proper waste disposal.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Appendix A and B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition 1986, Final Update III, December 1996.

21.3 Hewlett Packard 5890 Gas Chromatograph Manual.

21.4 Hewlett Packard Enviroquant Software Manual.

21.5 HP 6890 Gas Chromatograph Manual.

21.6 Apex Technologies, INC. prosep 800/800 Plus Operations Manual.

22.0 Attachments

22.1 Methylene chloride MSDS.

22.2 Absolute Standards - part #91759, part #91760, and part.#91761.

22.3 SS logbook page.

22.4 Semivolatile standard logbook page.

22.5 77 component standard, part #C-509, NSI Solutions, Inc.

22.6 Maintenance logbook page.

22.7 Semivolatile organic run logbook page.

22.8 ISs with corresponding target analytes and surrogates.

22.9 Characteristic ions for target compounds.

22.10 Characteristic ions for surrogates and ISs.

22.11 MDEQ Laboratory TIC criteria.

22.12 Target analyte RLs and units.

22.13 Surrogate summary form (example).

22.14 QC acceptance criteria - Method 625.

22.15 SVOC QA summary form.

22.16 IS and RT form (example).

22.17 GC operating conditions.

22.18 MS operating conditions.

22.19 Fingerprint standard chromatograms.

MDEQ SOP# 500 REVISION #____

APPROVED BY _____ DATE 7/18/01
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 7/18/01
COMPLIANCE OFFICER

APPROVED BY _____ DATE 7/18/01
QA OFFICER

APPROVED BY _____ DATE 7-18-01
UNIT MANAGER

APPROVED BY _____ DATE 7/18/01
ANALYST

ATTACHMENT 22.1

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

METHYLENE CHLORIDE

MSDS Number: M4420 — *Effective Date: 05/17/01*

1. Product Identification

Synonyms: MC; Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride
CAS No.: 75-09-2
Molecular Weight: 84.93
Chemical Formula: CH2Cl2
Product Codes: 9264, 9266, 9295, 9315, 9324, 9329, 9330, 9341, 9348, 9350, 9965, Q480

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methylene Chloride	75-09-2	> 99%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

ATTACHMENT 22.1

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes formation of carbon monoxide in blood which affects cardiovascular system and central nervous system. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. Exposure may make the symptoms of angina (chest pains) worse.

Ingestion:
May cause irritation of the gastrointestinal tract with vomiting. If vomiting results in aspiration, chemical pneumonia could follow. Absorption through gastrointestinal tract may produce symptoms of central nervous system depression ranging from light headedness to unconsciousness.

Skin Contact:
Causes irritation, redness and pain. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.

Eye Contact:
Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.

Chronic Exposure:
Can cause headache, mental confusion, depression, liver effects, kidney effects, bronchitis, loss of appetite, nausea, lack of balance, and visual disturbances. Can cause dermatitis upon prolonged skin contact. Methylene chloride may cause cancer in humans.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye problems, impaired liver, kidney, respiratory or cardiovascular function may be more susceptible to the effects of this substance.

ATTACHMENT 22.1

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Autoignition temperature: 556C (1033F)
Flammable limits in air % by volume:
lel: 12; uel: 23

Forms flammable vapor-air mixtures above 100C (212F).
Explosion:
Concentrated can be ignited by a high intensity ignition source. Vapor may form flammable mixture in atmosphere that contains a high percentage of oxygen. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste

container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Outside or detached storage is recommended. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. To minimize decomposition, all storage containers should be galvanized or lined with a phenolic coating. This material may corrode plastic and rubber. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Odor Threshold: 205 - 307 ppm. The odor threshold only serves as a warning of exposure; not smelling it does not mean you are not being exposed.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Methylene Chloride (Dichloromethane):
- OSHA Permissible Exposure Limit (PEL) -
25 ppm (TWA), 125 ppm (STEL), 12.5 ppm (8-hour TWA - Action Level)
- ACGIH Threshold Limit Value (TLV) -
50 ppm (TWA), A2 - suspected human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. The cartridges recommended for this material have a predicted service of less than 30 minutes at concentrations of ten times (10x) the exposure limits. Actual service life will vary considerbly, depending on concentration levels, temperature, humidity, and work rate. This substance has poor warning properties.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material

ATTACHMENT 22.1

for personal protective equipment. Natural rubber and polyvinyl chloride ARE NOT recommended materials for personal protective equipment.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:

Do not use closed circuit rebreathing system employing soda lime or other carbon dioxide absorber because of formation of toxic compounds capable of producing cranial nerve paralysis. See OSHA Standard for medical surveillance, record keeping, and reporting requirements for methylene chloride (29 CFR 1910.1052).

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Chloroform-like odor.
Solubility:
1.32 gm/100 gm water @ 20C.
Specific Gravity:
1.33 @ 15C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
39.8C (104F)
Melting Point:
-97C (-143F)
Vapor Density (Air=1):
2.9
Vapor Pressure (mm Hg):
350 @ 20C (68F)
Evaporation Rate (BuAc=1):
27.5

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Emits highly toxic fumes of phosgene when heated to decomposition. Decomposes in a flame or hot surface to form toxic gas phosgene and corrosive mists of hydrochloric acid. Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.

ATTACHMENT 22.1

Incompatibilities:
Strong oxidizers, strong caustics, plastics, rubber, nitric acid, water + heat, and chemically active metals, such as aluminum and magnesium powder, sodium, potassium, and lithium. Avoid contact with open flames and electrical arcs. Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.
Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Toxicological Data:
Dichloromethane: Oral rat LD50: 1600 mg/kg; inhalation rat LC50: 52 gm/m3; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Dichloromethane has been linked to spontaneous abortions in humans.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methylene Chloride (75-09-2)	No	Yes	2B

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12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. This material has a log octanol-water partition coefficient of less than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of greater than 30 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

ATTACHMENT 22.1

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

International (Air, I.C.A.O.)

Proper Shipping Name: DICHLOROMETHANE
Hazard Class: 6.1
UN/NA: UN1593
Packing Group: III
Information reported for product/size: 52L

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Methylene Chloride (75-09-2)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Methylene Chloride (75-09-2)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methylene Chloride (75-09-2)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methylene Chloride (75-09-2)	1000	U080	No

ATTACHMENT 22.1

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2Z
Poison Schedule: S5
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: 2 Flammability: 1 Reactivity: 0
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER, CARDIOVASCULAR SYSTEM, AND BLOOD. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Do not get in eyes, on skin, or on clothing.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No changes.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

CLP
SEMI-
OLATILES

CONTRACT LABORATORY PROGRAM MIXES JULY '91 STATEMENT OF WORK

CLP - SEMI-VOLATILE BASE/NEUTRAL MIX

2000 ug/mL in Methylene chloride. 1 mL

(1) Acenaphthene
(2) Acenaphthylene
(3) Anthracene
(4) Azobenzene
(5) Benzo(a)anthracene
(6) Benzo(b)fluoranthene
(7) Benzo(k)fluoranthene
(8) Benzo(g,h,i)perylene
(9) Benzo(a)pyrene
(10) Benzyl butyl phthalate
(11) 4-Bromophenyl phenyl ether
(12) bis(2-Chloroethoxy) methane
(13) bis(2-Chloroethyl) ether
(14) bis(2-Chloroisopropyl) ether
(15) 2-Chloronaphthalene
(16) 4-Chlorophenyl phenyl ether
(17) Chrysene
(18) Dibenzo(a,h)anthracene
(19) Di-n-butyl phthalate
(20) 1,2-Dichlorobenzene
(21) 1,3-Dichlorobenzene
(22) 1,4-Dichlorobenzene
(23) Diethyl phthalate
(24) Dimethyl phthalate
(25) 2,4-Dinitrotoluene
(26) 2,6-Dinitrotoluene
(27) Di-n-octyl phthalate
(28) bis(2-Ethylhexyl) phthalate
(29) Fluoranthene
(30) Fluorene
(31) Hexachlorobenzene
(32) Hexachlorobutadiene
(33) Hexachlorocyclopentadiene
(34) Hexachloroethane
(35) Indeno(1,2,3-cd)pyrene
(36) Isophorone
(37) Naphthalene
(38) Nitrobenzene
(39) N-Nitrosodimethylamine
(40) N-Nitrosodiphenylamine
(41) N-Nitrosodi-n-propylamine
(42) Phenanthrene
(43) Pyrene
(44) 1,2,4-Trichlorobenzene

Part # 91759 $110

ABSOLUTE STANDARDS, Inc.
"Your Source for Analytical Solutions"

CONTRACT LABORATORY PROGRAM MIXES JULY '91 STATEMENT OF WORK

CLP
SEMI-
VOLATILES
Continued

CLP - SEMI-VOLATILE ADDITIONAL COMPOUNDS MIX

2000 ug/mL in Methylene chloride. 1 mL

(1) Aniline
(2) Benzyl alcohol
(3) Carbazole
(4) 4-Chloroaniline
(5) Dibenzofuran
(6) 2-Methylnaphthalene
(7) 2-Nitroaniline
(8) 3-Nitroaniline
(9) 4-Nitroaniline
(10) Pyridine

Part # 91760 $20

CLP - SEMI-VOLATILE ACID MIX

2000 ug/mL in Methylene chloride. 1 mL

(1) Benzoic acid
(2) 4-Chloro-3-methylphenol
(3) 2-Chlorophenol
(4) o-Cresol (2-Methylphenol)
(5) p-Cresol (4-Methylphenol)
(6) 2,4-Dichlorophenol
(7) 2,4-Dimethylphenol
(8) 4,6-Dinitro-2-methylphenol
(9) 2,4-Dinitrophenol
(10) 2-Nitrophenol
(11) 4-Nitrophenol
(12) Pentachlorophenol
(13) Phenol
(14) 2,4,5-Trichlorophenol
(15) 2,4,6-Trichlorophenol

Part # 91761 $40

ATTACHMENT 22.2
Page 1 of 1

Call Toll-Free 800-368-1131
Fax Toll-Free 800-410-2577

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
EL-									
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ATTACHMENT 22.3

FILE:ST-STD
12/30/98

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
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ATTACHMENT 22.4

FILE:SV-STD

*INCLUDE UNITS

Certificate of Analysis

NSI Solutions, Inc. * PO Box 12313 * Research Triangle Park, NC 27709 * 1-800-234-7837

Fig 5 Calculations

Mixture Name: ReadyStock-200 (SW 846 Surrogates)
Catalog Number: C-507, C-509, C-511
Lot Number: 021599-24

Preparation Date: 02/15/99
Solvent: Methylene chloride
(CARCINOGEN, IRRITANT

EL-97-01, -02

COMPOUND NUMBER	ANALYTE	PURITY (%)	GRAVIMETRIC CONCENTRATION (ug/mL)	DILUTION	FINAL CONCENTRATION (ug/mL)
W-0001-04	Acenaphthene	99.9	2000	1:10	200
W-0075-11	Acenaphthylene	98.7	2002	1:10	200
W-0076-05	Anthracene	99.8	2001	1:10	200
W-0070-07	Benzo(a)anthracene	99.3	2001	1:10	200
W-0071-11	Benzo(a)pyrene	99.7	2000	1:10	200
W-0072-08	Benzo(b)fluoranthene	99.9	2001	1:10	200
W-0073-06	Benzo(k)fluoranthene	99.9	2001	1:10	200
W-0077-06	Benzo(g,h,i)perylene	99.5	2001	1:10	200
W-0074-06	Chrysene	99.7	2001	1:10	200
W-0231-10	Dibenz(a,h)anthracene	99.6	2001	1:10	200
W-0037-04	Fluoranthene	98.2	2000	1:10	200
W-0078-04	Fluorene	98.9	2000	1:10	200
W-0081-11	Indeno(1,2,3-c,d)pyrene	99.5	2001	1:10	200
W-0053-04	Naphthalene	99.8	2004	1:10	200
W-0079-07	Phenanthrene	99.4	2004	1:10	200
W-0082-07	Pyrene	98.9	1999	1:10	200
W-0039-03	4-Bromophenyl phenyl ether	98.8	2000	1:10	200
W-0065-03	Butyl benzyl phthalate	96.2	2000	1:10	200
W-0041-05	bis(2-Chloroethoxy)methane	99.2	2000	1:10	200
W-0016-05	bis(2-Chloroethyl)ether	99.8	2000	1:10	200
W-0040-13	bis(2-Chloroisopropyl)ether	98.3	2000	1:10	200
W-0038-07	4-Chlorophenyl phenyl ether	99.3	2000	1:10	200
W-0068-05	Diethyl phthalate	97.6	2000	1:10	200
W-0069-04	Dimethyl phthalate	99.6	2000	1:10	200
W-0066-04	Di-n-butyl phthalate	99.8	2008	1:10	201
W-0067-05	Di-n-octyl phthalate	99.6	2000	1:10	200
W-0064-05	bis(2-Ethylhexyl)phthlate	97.4	2000	1:10	200
W-0059-04	N-Nitrosodimethylamine	99.9	2000	1:10	200
W-0061-06	N-Nitrosodi-n-propylamine	99.7	2000	1:10	200
W-0060-05	N-Nitrosodiphenylamine	96.4	2000	1:10	200
W-0542-03	Aniline	99.9	2000	1:10	200
W-1250-02	Azobenzene	99.9	2002	1:10	200
W-0422-04	Carbazole	98.4	2000	1:10	200
W-0305-04	4-Chloroaniline	99.5	2008	1:10	201
W-0324-03	o-Nitroaniline	98.6	2002	1:10	200
W-0325-03	m-Nitroaniline	99.8	2000	1:10	200
W-0342-02	p-Nitroaniline	99.8	2002	1:10	200
E-0326-01	Benzyl alcohol	99.4	1990	1:10	199
E-0018-03	2-Chloronaphthalene	99.8	1998	1:10	200
E-0261-01	Dibenzofuran	98.8	1978	1:10	198
E-0023-01	1,2-Dichlorobenzene	99.8	2000	1:10	200
E-0214-01	1,3-Dichlorobenzene	99.2	1986	1:10	199
E-0025-02	1,4-Dichlorobenzene	99.9	2016	1:10	202
E-0033-03	2,4-Dinitrotoluene	97.9	1957	1:10	196

extras

Certificate of Analysis

NSI Solutions, Inc. * PO Box 12313 * Research Triangle Park, NC 27709 * 1-800-234-7837

COMPOUND NUMBER	ANALYTE	PURITY (%)	GRAVIMETRIC CONCENTRATION (ug/mL)	DILUTION	FINAL CONCENTRATION (ug/mL)
E-0034-02	2,6-Dinitrotoluene	99.6	1996	1:10	200
E-0008-01	Hexachlorobenzene	99.7	1998	1:10	200
E-0050-02	Hexachlorobutadiene	99.0	1987	1:10	199
E-0051-01	Hexachlorocyclopentadiene	99.0	1988	1:10	199
E-0011-02	Hexachloroethane	99.6	1996	1:10	200
E-0052-01	Isophorone	99.4	1992	1:10	199
E-0562-01	2-Methylnaphthalene	96.4	1931	1:10	193
E-0054-01	Nitrobenzene	99.9	2000	1:10	200
E-0007-01	1,2,4-Trichlorobenzene	99.2	1988	1:10	199
W-0541-03	Benzoic acid	99.9	5001	0.4:10	200
W-0020-05	4-Chloro-3-methylphenol	99.8	2000	1:10	200
W-0022-07	2-Chlorophenol	99.8	2000	1:10	200
W-0250-03	o-Cresol	98.6	2000	1:10	200
W-0252-03	p-Cresol	99.7	2000	1:10	200
W-0029-07	2,4-Dichlorophenol	99.4	2000	1:10	200
W-0224-07	2,4-Dimethylphenol	99.8	2000	1:10	200
W-0058-04	4,6-Dinitro-2-methylphenol	87.0	2004	1:10	200
W-0057-08	2,4-Dinitrophenol	81.3	2000	1:10	200
W-0055-04	2-Nitrophenol	99.8	2002	1:10	200
W-0056-04	4-Nitrophenol	99.4	2001	1:10	200
W-0062-07	Pentachlorophenol	99.1	2001	1:10	200
W-0063-04	Phenol	99.6	2001	1:10	200
W-0179-07	2,4,5-Trichlorophenol	99.8	2003	1:10	200
W-0019-07	2,4,6-Trichlorophenol	99.8	2003	1:10	200
W-1213-05	Benzidine	99.9	2001	1:10	200
W-1214-06	3,3'-Dichlorobenzidine	99.9	2000	1:10	200
W-0271-02	Pyridine	99.9	5000	0.4:10	200
W-0193-07	2-Fluorophenol	99.5	10,002	0.2:10	200
W-0531-14	Phenol-d5	99.9	10,001	0.2:10	200
W-0875-03	2,4,6-Tribromophenol	99.7	10,003	0.2:10	200
W-0194-13	2-Fluorobiphenyl	97.5	5000	0.4:10	200
W-0188-10	Nitrobenzene-d5	99.9	5001	0.4:10	200
W-0909-15	p-Terphenyl-d14	99.6	5000	0.4:10	200

Surrogate

PREPARATION: Reported concentration value has been corrected for purity using purity values obtained by NSI analysts. Concentration is calculated from wt/vol or vol/vol measurements using microbalances calibrated with NIST traceable weights to 0.0001 g and or ASTM Class A volumetric glassware or calibrated equivalent labware.

STORAGE & HANDLING: Store at $\leq 5^{\circ}$ C. Allow to equilibrate to room temperature before use.

MDEQ-ENVIRONMENTAL LAB
MAINTENANCE LOGBOOK
INSTRUMENT # 1

Date	Analyst/ Repair Person	Clipped Column	Changed Septa	Cleaned Injection Liner	Changed Injection Liner	Helium Tank Changed	Changed Filament	Cleaned Source	Problem	Maintenance Performed

ATTACHMENT 22.6

Date____________
Analyst__________
Method 8270/625

MDEQ-Environmental Lab
Semivolatile Organic Runlog
Instrument # 1

ATTACHMENT 22.7

Internal Standard # ______ ____________

Initial Calibration
Date______________________________

Batches Analyzed:

Solvent Tracking #

Line	Type	Vial	Data File	Method	Sample Name/ Dilutions/(Extraction Batch #)	Reanalyze Sample	Standard #

Comments

ISs with Corresponding Target Compounds and Surrogate Compounds Assigned for Quantitation

1,4-Dichlorobenzene-d_4
N-Nitrosodimethylamine
2-Fluorophenol (surrogate)
Phenol
Phenol-d_5 (surrogate)
Bis (2-chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
2-Methylphenol
Bis (2-chloroisopropyl) ether
4-Methylphenol
N-Nitrosodi-n-propylamine
Hexachloroethane

Naphthalene-d_8
Nitrobenzène-d_5 (surrogate)
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Bis (2-chloroethoxy) methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
Hexachlorobutadiene
Phenol, 4-chloro-3-methyl-
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Fluorobiphenyl (surrogate)

Acenaphthalene-d_{10}
2-Chloronaphthalene
2-Nitroaniline
Acenaphthylene
Dimethyl phthalate
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
Dibenzofuran
4-Nitrophenol
2,4 – Dinitrotoluene
Fluorene
Diethylphthalate
4-Chlorophenyl phenyl ether
4-Nitroaniline

Phenanthrene-d_{10}
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine
Azobenzene
2,4,6-Tribromophenol (surrogate)
4-Bromophenyl phenyl ether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Carbazole
Di-n-butyl phthalate
Fluoranthene

Chrysene-d_{12}

Pyrene
p-Terphenyl-d_{14} (surrogate)
Butyl benzyl phthalate
Benzo [a] anthracene
Chrysene
Di-n-octyl phthalate

Perylene-d_{12}
Benzo [b] fluoranthene
Benzo [k] fluoranthene
Benzo [a] pyrene
Indeno (1,2,3-c,d) pyrene
Dibenz [a,h] anthracene
Benzo [g,h,i] perylene

Characteristic Ions for Target Compounds

Target Compounds	Primary Q-Ion	Secondary Q-Ion(s)
N-Nitrosodimethylamine	74	44,42
Phenol	94	65,66
Bis (2-chloroethyl) ether	93	63,95
2-Chlorophenol	128	64,130
1,3-Dichlorobenzene	146	148,111
1,4-Dichlorobenzene	146	148,111
1,2-Dichlorobenzene	146	148,111
2- Methylphenol	108	108,77,79,90
Bis (2-chloroisopropyl) ether	45	77,121
Hexachloroethane	117	201,199
N-nitrosodi-n-propyl amine	70	42,101,130
4-Methylphenol	107	108,77,79,90
Nitrobenzene	77	123,65
Isophorone	82	95,138
2 - Nitrophenol	139	109,65
2,4 - Dimethylphenol	107	122,121
Bis (2-chloroethoxy) methane	93	95,123
2,4 - Dichlorophenol	162	164,98
1,2,4 - Trichlorobenzene	180	182,145
Naphthalene	128	129,127
Hexachlorobutadiene	225	223,227
Phenol, 4-chloro-3-methyl-	107	144,142
2 - Methylnaphthalene	141	142
Hexachlorocyclopentadiene	237	235,272
2,4,6 - Trichlorophenol	196	198,200
2,4,5 - Trichlorophenol	196	198,97,132,99
2- Chloronaphthalene	162	127,164
2 - Nitroaniline	65	92,138
Dimethylphthalate	163	194,164
Acenaphthylene	152	151,153
2,6 - Dinitrotoluene	165	63,89
3 - Nitroaniline	138	108,92
Acenaphthene	153	154,152
2,4 - Dinitrophenol	184	63,154
Dibenzofuran	168	139
2,4 - Dinitrotoluene	109	63,89
4 - Nitrophenol	109	109,65
Fluorene	166	165,167
Diethylphthalate	149	177,150
4-Chlorophenyl phenyl ether	204	206,141
4 - Nitroaniline	138	65,108,92,80,39

* - The primary Q-Ion should be used unless matrix interference ions cause inacuate quantitation in which case a secondary Q-Ion may be used.

Characteristic Ions for Target Compounds

Target Compounds	Q-Ion	Secondary Q-Ion(s)
4,6 - Dinitro-2-methylphenol	198	51,105
N-Nitrosodiphenylamine	169	168,167
Azobenzene	77	105,182
4-Bromophenyl phenyl ether	248	250,141
Hexachlorobenzene	284	142,249
Pentachlorophenol	266	264,268
Phenanthrene	178	179,176
Anthracene	178	176,179
Carbazole	167	139,140
Di-n-butyl phthalate	149	150,104
Fluoranthene	202	101,203
Pyrene	202	200,203
Butylbenzyl phthalate	149	91,206
Benzo [a] anthracene	228	229,226
Chrysene	228	102,236
Bis (2-ethylhexyl) phthalate	149	167,279
Di-n-octyl phthalate	149	167,43
Benzo [b] fluoranthene	252	253,125
Benzo [k] fluoranthene	252	253,125
Benzo [a] pyrene	252	253,125
Indeno (1,2,3-cd) pyrene	276	138,227
Dibenzo [a,h] anthracene	278	139,279
Benzo [g,h,i] perylene	276	138,277

* - The primary Q-Ion should be used unless matrix interference ions cause inacuate quantitation in which case a secondary Q-Ion may be used.

ATTACHMENT 22.10

CHARACTERISTIC IONS FOR SURROGATES AND ISs

ISs	Primary Q-Ion	Secondary Q-Ion(s)
1,4-Dichlorobenzene-d_4	152	150,115
Naphthalene-d_8	136	68
Acenaphthene-d_{10}	164	162,160
Phenanthrene-d_{10}	188	94,80
Chyrsene-d_{12}	240	120,236
Perylene-d_{12}	264	260,265

Surrogate Compounds	Primary Q-Ion	Secondary Q-Ion(s)
2-Fluorophenol	112	64
Phenol-d_5	99	42,71
Nitrobenzene-d_5	82	128,54
2-Fluorobiphenyl	172	171
2,4,6-Tribromophenol	330	332,141
p-Terphenyl-d_{14}	244	122,212

*-The primary Q-Ion should be used unless matrix interference ions cause inacuate quantitation in which case a secondary Q-Ion may be used.

Tentatively Identified Compounds

Criteria used by the MDEQ lab.

1. Q or probability factor criteria.
   >90% is a good match
   <50% should be investigated.
2. Spectra for all peaks must be evaluated, regardless of the Q factor.
3. We will report up to 30 peaks as TICs per sample. (The largest 30)
4. Isomer reporting:
   Report all isomers individually using the word "isomer". Example:
   1,2,4-Trimethylbenzene becomes Trimethylbenzene isomer.
   1,3,5-Trimethylbenzene becomes Trimethylbenzene isomer.
5. Minimum reporting limits:

Water volatiles:	10 ug/L	Water semivolatiles:	10 ug/L
Soil Volatiles:	500 ug/Kg(dry)	Soil Base/Neutrals:	500 ug/Kg(dry)
Oil volatiles:	5 mg/Kg	Soil Phenols:	1000 ug/Kg(dry)
		Oil semivolatiles:	50 mg/Kg

   Air Canister: 1 ppbv
6. Use the "LSC Detailed Report".
7. Use the following statement when a sample is clean or the peaks are below the minimum reporting concentration or the peaks are target compounds on another list reported out:
   A library search found no reportable compounds
8. When a peak does not meet the minimum criteria for identification but is greater than the minimum reporting concentration put the following narrative: **Peaks(s) were found that did not meet identification criteria.**
9. Units. Use the same units that are on the report (ug/L, ug/Kg, mg/Kg, or ppbv)
10. Use the area of the total ion chromatogram and areas from the nearest internal standard with a response factor of one to calculate concentration of a TIC. If a large interference is present then the areas from the mass chromatograms should be used.
11. Statement, which is hardcoded into LIMS for library searches: **Reported library search compounds are tentative identifications with estimated concentrations.**
12. Report concentrations to two significant figures.
13. Target compounds as TICs. Any peak originally ID'd by the computer as a target compound which does not meet the target compound identification criteria should be considered as a TIC and reported if TIC criteria is met.
14. TICs identified as target compounds. Double check the quant report to ensure that the target compound was reported correctly. (RT may have been off or the detector may have been saturated) Fix the quant report if necessary. IF the quant report was correct and this TIC is a different peak than the target peak, then choose the next spectrum that meets criteria. If none meet the criteria report as in #8.
15. Multiple peaks...same compound
    If more than one peak is identified as the same compound, report the compound once at the highest concentration (unless it is an isomer, then see #4)
16. Statements for hydrocarbons:
    Fraction of hydrocarbons similar to _____ present in sample. (Diesel fuel, gasoline, etc)
    Fraction of hydrocarbons from C ____ to C____ present in sample.
17. HP Chemstation settings for PBM Search:

U + A = 4	Low report MW = 40 (38 for canisters)
Tilting = on	High report MW = 9999
Flag Threshold = 3%	Max hits = 20
Cross-correlation sort = off	Remove duplicate CAS numbers = on
Minimum estimated purity = 50%	

18. Method blanks should be evaluated to verify that TIC peaks present in the sample are not found in the blank. Common laboratory contaminants and some sources:
    - Siloxanes (m/z 73) from column bleed.

- Carbon Dioxide (m/z 44), diethyl ether, hexane, freons, methylene chloride, acetone. These may be found in VOC analysis.
- Phthalates from plastics. These may be found in SVOC analysis.
- Solvent preservatives such as cyclohexene which is a MeCl preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene,and chlorocyclohexanol. These may be found in SVOC analysis.
- Aldol condensation reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone. These may be found in SVOC analysis of soil samples due to the extraction process.

19. Library searches should **NOT** be performed on internal standards or surrogates.
20. Do not report non-organic compounds as TICs.
21. Do not report sulfur compounds as TICs.

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Semivolatile Organics Base/Neutral/Acids Method 625/8270	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
1,2,4-Trichlorobenzene	2.0	200	50	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
1,2-Dichlorobenzene	1.0	100	50	amber bottles	14 days HT	"
1,3-Dichlorobenzene	1.0	100	50	7 days HT	"	"
1,4-Dichlorobenzene	1.0	100	50	"	"	"
2,4,5-Trichlorophenol	10	330	100	"	"	"
2,4,6-Trichlorophenol	10	330	100	"	"	"
2,4-Dichlorophenol	10	330	100	"	"	"
2,4-Dimethylphenol	10	330	100	"	"	"
2,4-Dinitrophenol	50	1,700	200	"	"	"
2,4-Dinitrotoluene	5.0	330	50	"	"	"
2,6-Dinitrotoluene	5.0	330	50	"	"	"
2-Chloronephthalene	2.0	200	50	"	"	"
2-Chlorophenol	10	330	100	"	"	"
2-Methyl-4,6-dinitrophenol	50	1,700	200	"	"	"
2-Methylnaphthalene	5.0	250	50	"	"	"
2-Methylphenol	10	330	100	"	"	"
2-Nitroaniline	20	1,700	200	"	"	"
2-Nitrophenol	10	330	100	"	"	"
3/4-Methylphenol	20	660	200	"	"	"
3-Nitroaniline	20	1,700	200	"	"	"
4-Bromophenyl phenylether	2.0	200	50	"	"	"
4-Chloro-3-methylphenol	10	330	100	"	"	"
4-Chlorophenyl phenylether	1.0	100	50	"	"	"
4-Nitroaniline	20	1,700	200	"	"	"
4-Nitrophenol	50	1,700	200	"	"	"
Acenaphthene	1.0	100	50	"	"	"
Acenaphthylene	1.0	100	50	"	"	"
Anthracene	1.0	100	50	"	"	"
Azobenzene	2.0	200	50	"	"	"
Benz(a)anthracene	1.0	100	50	"	"	"
Benzo(a)pyrene	2.0	200	50	"	"	"
Benzo(b)fluoranthene	2.0	200	50	"	"	"
Benzo(g,h,i)perylene	2.0	200	50	"	"	"
Benzo(k)fluoranthene	2.0	200	50	"	"	"
Bis(2-chloroethoxy)methane	2.0	200	50	"	"	"
Bis(2-chloroethyl)ether	1.0	100	50	"	"	"
Bis(2-chloroisopropyl)ether	1.0	100	50	"	"	"
Bis(2-ethylhexyl)phthalate	2.0	200	50	"	"	"
Butyl benzyl phthalate	1.0	100	50	"	"	"
Carbazole	10	330	50	"	"	"
Chrysene	1.0	100	50	"	"	"
Dibenz(a,h)anthracene	2.0	200	50	"	"	"
Dibenzofuran	5.0	330	50	"	"	"
Diethyl phthalate	1.0	100	50	"	"	"
Dimethyl phthalate	2.0	200	50	"	"	"
Di-n-butyl phthalate	1.0	100	50	"	"	"
Di-n-octyl phthalate	2.0	200	50	"	"	"
Fluoranthene	1.0	100	50	"	"	"
Fluorene	1.0	100	50	"	"	"
Hexachlorobenzene	2.0	200	50	"	"	"
Hexachlorobutadiene	2.0	200	50	"	"	"
Hexachlorocyclopentadiene	10	2,000	100	"	"	"
Hexachloroethane	1.0	100	50	"	"	"
Indeno(1,2,3-cd)pyrene	2.0	200	50	"	"	"
Isophorone	1.0	100	50	"	"	"
Naphthalene	1.0	100	50	"	"	"
Nitrobenzene	2.0	200	50	"	"	"
N-Nitrosodimethylamine	5.0	330	50	"	"	"
N-Nitrosodi-n-propylamine	2.0	200	50	"	"	"
N-Nitrosodiphenylamine	2.0	200	50	"	"	"
Pentachlorophenol	50	3,400	200	"	"	"
Phenanthrene	1.0	100	50	"	"	"
Phenol	10	330	100	"	"	"
Pyrene	1.0	100	50	"	"	"

MICHIGAN DEPARTMENT OF ENVIROMENTIAL QUALITY

Drinking water and radiological protection division - Enviromental Laboratory.

Semivolatile analysis Surrogate summary

DATE OF RUN: 4/13/01

DATA PATH: D:\DATA\5973\2001\BNA0413\

ANALYST: 5973 / #3 SMH/PCR

	DATA FILE	SMC1 (2FB)	SMC2 (PHL)	SMC3 (NBZ)	SMC4 (FBP)	SMC5 (TBP)	SMC6 (TPH)	Time Acquired
QC LIMIT :	WATER	4.2-65.1	3.1-51.1	38-101	39.1-99	42.1-126	56.2-126	
	SEDIMENT	14-79	3.8-92	29.1-114	46.4-97	32.6-120	47.9-131	
DFTTP Tune File	TUNE04.D							4/13/01 11:14
RINSE BLANK	BLANK2.D	0.00 #	0.00 #	0.00 #	0.21 #	0.00 #	0.00 #	4/13/01 12:09
CAL 20/50 SE 388	CAL2.D	34.89	35.58	71.34	72.47	36.73 #	75.95	4/13/01 11:32
s03146-08 (1295)	SAMPLE12.D	35.05	42.10	41.63	51.37	49.63	68.68	4/13/01 12:46
s03146-09 (1295)	SAMPLE13.D	45.81	51.51	52.23	60.42	61.82	76.60	4/13/01 13:22
s03146-10 (1295)	SAMPLE14.D	50.85	57.26	59.52	67.43	68.69	113.81	4/13/01 13:59
s03146-11 (1295)	SAMPLE15.D	21.04	23.40	23.98 #	28.31 #	28.86 #	40.20 #	4/13/01 14:36
s03146-12 (1295)	SAMPLE16.D	56.17	63.40	60.52	70.42	68.55	93.33	4/13/01 15:13
s03146-13(1295)	SAMPLE17.D	45.22	51.80	46.55	52.57	61.29	87.98	4/13/01 15:50
s03146-14(1295)	SAMPLE18.D	48.69	54.85	52.49	58.77	57.73	76.19	4/13/01 16:27
s03146-15(1295)	SAMPLE19.D	38.88	43.80	44.29	56.19	53.88	87.96	4/13/01 17:03
s03146-16(1295)	SAMPLE20.D	33.77	36.76	38.55	46.87	43.89	62.49	4/13/01 17:40

System monitoring compounds

Smc1=(2FB) 2-Fluorophenol

Smc2=(PHL) Phenol - D5

Smc3=(NBZ) Nitrobenzene - D5

Smc4=(FBP) 2 - Fluorobiphenyl

Smc5=(TPB) 2,4,6, - Tribromophenol

Smc6=(TPH) p - Terphenyl - D14

= Indicates values outside QC limits

ATTACHMENT 22.13

Table 7 - Method Accuracy and Precision as Functions of Concentration- Method 625

Parameter	Spike Conc. (ug/L)	Accuracy, as recovery (ug/L)	Overall precision, (ug/L)	T' (%)	RPD
Acenaphthene	50	48.19	9.4499	50.26 - 142.50	19.60967
Acenaphthylene	50	45.24	11.2224	35.71 - 145.25	24.80637
Aldrin	50	40.66	18.6138	-9.52 - 172.16	45.77914
Anthracene	50	40.68	10.3436	30.88 - 131.84	25.42675
Benzo(a)anthracene	50	43.4	11.004	33.10 - 140.50	25.35484
Benzo(b)fluoranthene	50	44.7	13.923	21.46 - 157.34	31.14765
Benzo(k)fluoranthene	50	41.94	15.079	10.29 - 157.47	35.95374
Benzo(a)pyrene	50	44.87	15.7084	13.08 - 166.40	35.00869
Benzo(ghi)perylene	50	48.14	24.1114	-21.38 - 213.94	50.086
Benzyl butyl phthalate	50	31.32	17.5196	-22.86 - 148.14	55.93742
Beta-BHC	50	42.56	10.828	32.28 - 137.96	25.44173
Gamma-BHC	50	13.41	12.3013	-33.21 - 86.85	91.73229
Bis(2-chloroethyl)ether	50	41.46	14.611	11.62 - 154.22	35.2412
Bis(2-chloroethoxy)methane	50	50.96	15.2596	27.45 - 176.39	29.94427
Bis(2-chloroisopropyl)ether	50	49.19	13.3375	33.29 - 163.47	27.11425
Bis(2-ethylhexyl)phthalate	50	40.82	15.3652	6.66 - 156.62	37.64135
4-Bromophenyl phenyl ether	50	44.16	7.7256	50.62 - 126.02	17.49457
2-Chloronaphthalene	50	44.51	6.1263	59.12 - 118.92	13.76387
4-Chlorophenyl phenyl ether	50	46.03	13.349	26.92 - 157.20	29.00065
Chrysene	50	45.5	14.925	18.17 - 163.83	32.8022
4,4'-DDD	50	27.6	17.256	-29.01 - 139.41	62.52174
4,4'-DDE	50	34.46	12.3994	8.41 - 129.43	35.98201
4,4'-DDT	50	36.22	22.963	-39.62 - 184.50	63.39867
Dibenzo(a,h)anthracene	50	48.72	28.9948	-44.05 - 238.93	59.51314
Di-n-butyl phthalate	50	30.21	12.3819	0.00 - 120.84	40.9861
1,2-Dichlorobenzene	50	40.28	10.0572	31.48 - 129.64	24.96822
1,3-Dichlorobenzene	50	42.3	17.453	-0.57 - 169.77	41.26005
1,4-Dichlorobenzene	50	35.03	10.5187	18.73 - 121.39	30.02769
3,3'-Dichlorobenzidine	50	48.85	26.4095	-31.18 - 226.58	54.06244
Dieldrin	50	40.84	10.5484	30.20 - 133.16	25.8286
Diethyl phthalate	50	22.5	11.92	-13.17 - 103.17	52.97778
Dimethyl phthalate	50	11.03	10.6615	-29.97 - 74.09	96.65911
2,4-Dinitrotoluene	50	41.19	10.1499	32.85 - 131.91	24.64166
2,6-Dinitrotoluene	50	49.4	44.386	-117.80 - 315.40	89.8502
Di-n-octyl phthalate	50	37.21	14.9577	1.43 - 147.41	40.19807
Endosulfan sulfate	50	19.91	11.5133	-16.36 - 96.00	57.82672
Endrin aldehyde	50	34.14	24.3022	-50.31 - 186.87	71.18395
Fluoranthene	50	41.6	11.048	29.29 - 137.11	26.55769
Fluorene	50	45	6.46	58.48 - 121.52	14.35556
Heptachlor	50	40.53	20.035	-16.71 - 178.83	49.43252
Heptachlor epoxide	50	44.13	12.9964	24.84 - 151.68	29.45026
Hexachlorobenzene	50	37.66	15.6738	-1.17 - 151.81	41.61922
Hexachlorobutadiene	50	34.49	9.4574	22.83 - 115.13	27.4207
Hexachloroethane	50	35.67	6.8639	37.84 - 104.84	19.24278
Indeno(1,2,3-cd)pyrene	50	35.9	18.39	-17.94 - 161.54	51.22563
Isophorone	50	57.41	19.2053	21.10 - 208.54	33.45288
Naphthalene	50	39.58	11.194	24.53 - 133.79	28.28196
Nitrobenzene	50	51.45	14.1015	34.08 - 171.72	27.40816

Table 7 - Method Accuracy and Precision as Functions of Concentration- Method 625

Parameter	Spike Conc. (ug/L)	Accuracy, as recovery (ug/L)	Overall precision, (ug/L)	T' (%)	RPD
N-Nitrosodi-n-propylamine	50	49.78	22.3732	-9.62 - 208.74	44.94415
PCB-1260	50	29.64	14.5652	-11.80 - 130.36	49.14035
Phenanthrene	50	43.44	6.766	53.86 - 119.90	15.57551
Pyrene	50	41.84	6.586	51.54 - 115.82	15.74092
1,2,4-Trichlorobenzene	50	46.21	10.0941	43.16 - 141.68	21.84397
4-Chloro-3-methylphenol	100	84.35	25.7715	21.47 - 147.23	30.55305
2-Chlorophenol	100	78.29	22.8912	22.44 - 134.14	29.23898
2,4-Dichlorophenol	100	87.13	19.5773	39.36 - 134.90	22.46907
2,4-Dimethylphenol	100	75.41	17.9002	31.73 - 119.09	23.73717
2,4-Dinitrophenol	100	62.96	52.7332	-65.71 - 191.63	83.75667
2-Methyl-4,6-Dinitrophenol	100	75.96	42.8496	-28.59 - 180.51	56.41074
2-Nitrophenol	100	105.85	31.1795	29.77 - 181.93	29.45631
4-Nitrophenol	100	59.78	29.5432	-12.31 - 131.87	49.41987
Pentachlorophenol	100	94.99	32.827	14.89 - 175.09	34.55837
Phenol	100	44.26	16.071	5.05 - 83.47	36.31044
2,4,6-Trichlorophenol	100	90.82	21.7904	37.65 - 143.99	23.99295

BNA Water QC Spike Recoveries

Batch # _____
Date Analyzed _____
Date Extracted _____

Analysts Initials _____
Extractors Initials _____

Spike # _____
Amt. Spk. _____
Sample Spiked _____

								Method Spk Accuracy		Matrix Spk Accuracy		MS / MSD Precision		
Base Neutral	Spk. Conc. ug/l	Accuracy % MS Limits	Accuracy % LCS Limits	CONC. SAMPLE	LCS Rec.	MS Rec.	MSD Rec.	LCS % Rec	Pass/ Fail	MS % Rec	Pass/ Fail	Precision Limit	Relative % Diff	Pass/ Fail
1,4-Dichlorobenzene	50	10.6 - 76.8	19.7 - 62.6	0								40.1%		
N-Nitroso-Di-N-Propylamine	50	20.3 - 124	37.3 - 111	0								27.3%		
1,2,4-Trichlorobenzene	50	14.5 - 88.2	25.7 - 70.9	0								38.1%		
Acenaphthene	50	17.8 - 119	35.1 - 100	0								25.7%		
2,4-Dinitrotoluene	50	39.0 - 115	48.1 - 106	0								19.1%		
Pyrene	50	28.4 - 139	27.3 - 151	0								43.6%		
Acids														
Phenol	100	5.8 - 68.4	7.6 - 50.5	0								53.4%		
2-Chlorophenol	100	14.2 - 101	32.3 - 87.4	0								31.6%		
4-Chloro-m-cresol	100	27.0 - 119	39.9 - 111	0								16.1%		
4-Nitrophenol	100	20.5 - 79	13.8 - 55.6	0								50.0%		
Pentachlorophenol	100	46.0 - 121	64.1 - 109	0								26.9%		

Notes / Problems: _____

ATTACHMENT 22.15

BNA Sediment QC Spike Recoveries

Batch # _____ Analysts Initials _____ Spike # _____

Date Analyzed _____ Extractors Initials _____ Amt. Spk. _____

Date Extracted _____ Sample Spiked _____

								Method Spk Accuracy		Matrix Spk Accuracy		MS / MSD Precision		
Base Neutral	Spk. Conc. ug/kg	Accuracy % MS Limits	Accuracy % LCS Limits	CONC. SAMPLE	LCS Rec. ug/kg	MS Rec. ug/kg	MSD Rec. ug/kg	LCS % Rec	Pass/ Fail	MS % Rec	Pass/ Fail	Precision Limit	Relative % Diff	Pass/ Fail
1,4-Dichlorobenzene	2000	30.1 - 70.1	29.8 - 81.5	0								26%		
N-Nitroso-Di-N-Propylamine	2000	46.4 - 94.3	26.8 - 120	0								21%		
1,2,4-Trichlorobenzene	2000	44.1 - 81.5	43.4 - 90.8	0								20%		
Acenaphthene	2000	56.0 - 89.0	50.0 - 97.1	0								18%		
2,4-Dinitrotoluene	2000	25.3 - 110	30.7 - 117	0								18%		
Pyrene	2000	45.3 - 98.0	30.6 - 113	0								18%		
Acids														
Phenol	4000	44.7 - 87.6	34.9 - 103	0								15%		
2-Chlorophenol	4000	47.6 - 85.4	36.9 - 100	0								16%		
4-Chloro-m-cresol	4000	53.1 - 99.1	41.8 - 114	0								16%		
4-Nitrophenol	4000	23.4 - 133	13.0 - 151	0								26%		
Pentachlorophenol	4000	9.2 - 115	17.8 - 122	0								56%		

Notes / Problems: _____

ATTACHMENT 22.15

MICHIGAN DEPARTMENT OF ENVIROMENTIAL QUALITY

Drinking water and radiological protection division - Enviromental Laboratory.

Semivolatile analysis internal standard area and rt summary

DATE OF RUN: 4/13/01

DATA PATH: D:\DATA\5973\2001\BNA0413\

ANALYST: 5973 / #3 SMH/PCR

	DATA FILE	DCB AREA	DCB RT	NPT AREA	NPT RT	ANT AREA	ANT RT	PHN AREA	PHN RT	CRY AREA	CRY RT	PRY AREA	PRY RT
12 HR STD	CAL2.D	495255	8.06	1.85E+06	10.51	1.06E+06	14.45	1.58E+06	17.22	1.04E+06	23.71	679350	26.30
UPPER LIMIT		990510	8.56	3.70E+06	11.01	2.11E+06	14.95	3.15E+06	17.72	2.09E+06	24.21	1.36E+06	26.80
LOWER LIMIT		247628	7.56	924586	10.01	527810	13.95	787870	16.72	522070	23.21	339675	25.80
RINSE BLANK	BLANK2.D	801287	8.06	2.91E+06	10.51	1.62E+06	14.45	2.32E+06	17.21	1.33E+06	23.71	811661	26.29
CAL 20/50 SE 388	CAL2.D	495255	8.06	1.85E+06	10.51	1.06E+06	14.45	1.58E+06	17.22	1.04E+06	23.71	679350	26.30
s03146-08 (1295)	SAMPLE12.D	591538	8.06	2.16E+06	10.51	1.24E+06	14.45	1.83E+06	17.21	1.15E+06	23.71	603787	26.29
s03146-09 (1295)	SAMPLE13.D	592788	8.06	2.17E+06	10.50	1.23E+06	14.45	1.82E+06	17.21	1.14E+06	23.71	503942	26.30
s03146-10 (1295)	SAMPLE14.D	606795	8.06	2.20E+06	10.51	1.28E+06	14.45	1.90E+06	17.21	807770	23.71	245777 #	26.30
s03146-11 (1295)	SAMPLE15.D	595902	8.06	2.16E+06	10.51	1.26E+06	14.45	1.86E+06	17.21	976196	23.71	326042 #	26.30
s03146-12 (1295)	SAMPLE16.D	432347	8.06	1.59E+06	10.51	922258	14.45	1.42E+06	17.21	843658	23.71	295684 #	26.29
s03146-13(1295)	SAMPLE17.D	452182	8.06	1.68E+06	10.50	957620	14.45	1.46E+06	17.21	814783	23.71	244242 #	26.29
s03146-14(1295)	SAMPLE18.D	340200	8.06	1.29E+06	10.50	744769	14.45	1.15E+06	17.21	730256	23.71	248674 #	26.29
s03146-15(1295)	SAMPLE19.D	589505	8.06	2.09E+06	10.51	1.26E+06	14.45	1.85E+06	17.22	999050	23.71	321589 #	26.29
s03146-16(1295)	SAMPLE20.D	581739	8.06	2.13E+06	10.51	1.24E+06	14.45	1.84E+06	17.21	977258	23.71	314178 #	26.30

Internal Standards

DCB=1,4 - Dichlorobenzene -D4

NPT= Naphthalene - D8

ANT= Acenaphthalene - D10

PHN= Phenathrene - D10

CRY= Chrysene - D12

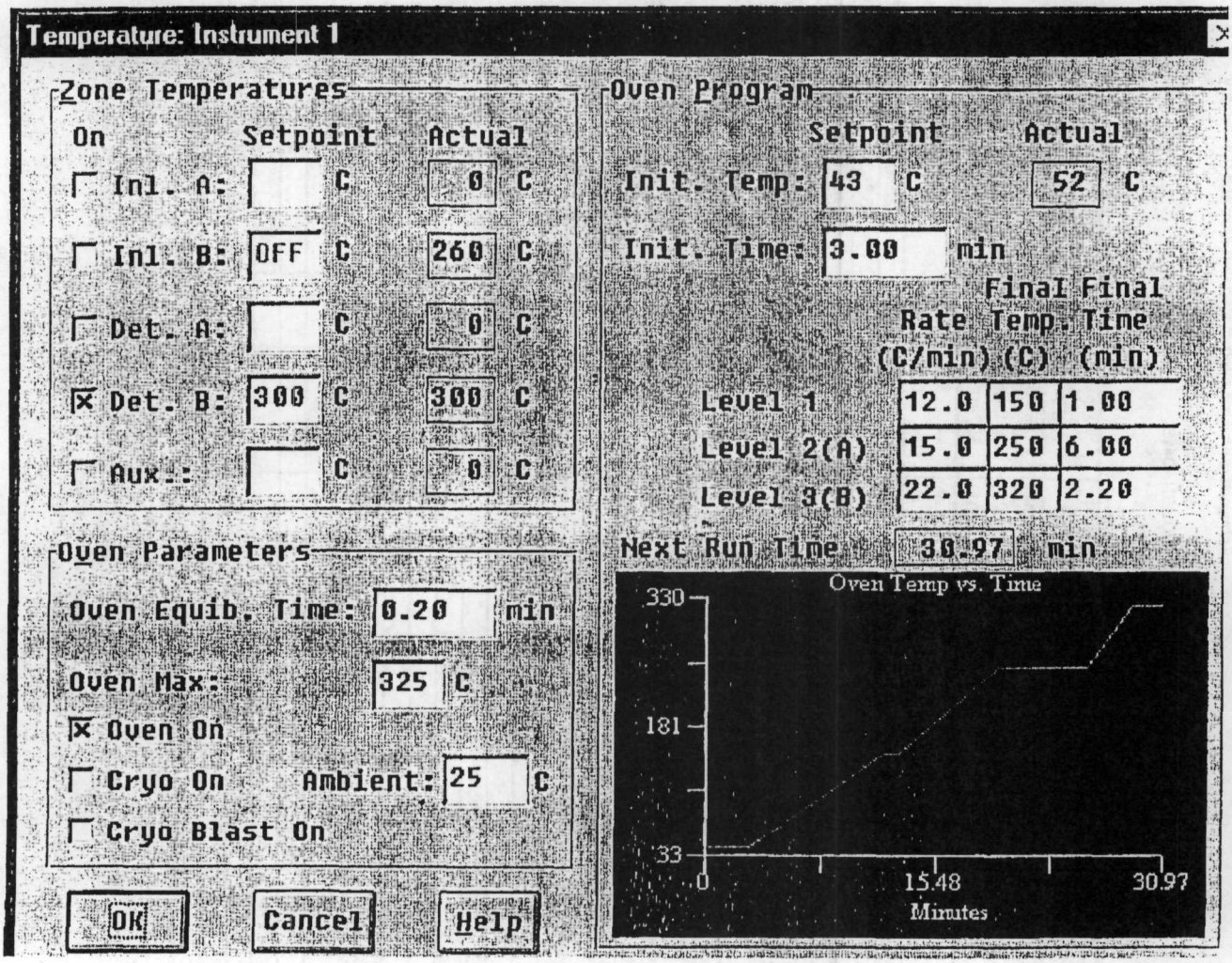
PRY= Perylene - D12

Area Upper/lower cotrol limit= +100/-50% of Internal Standard

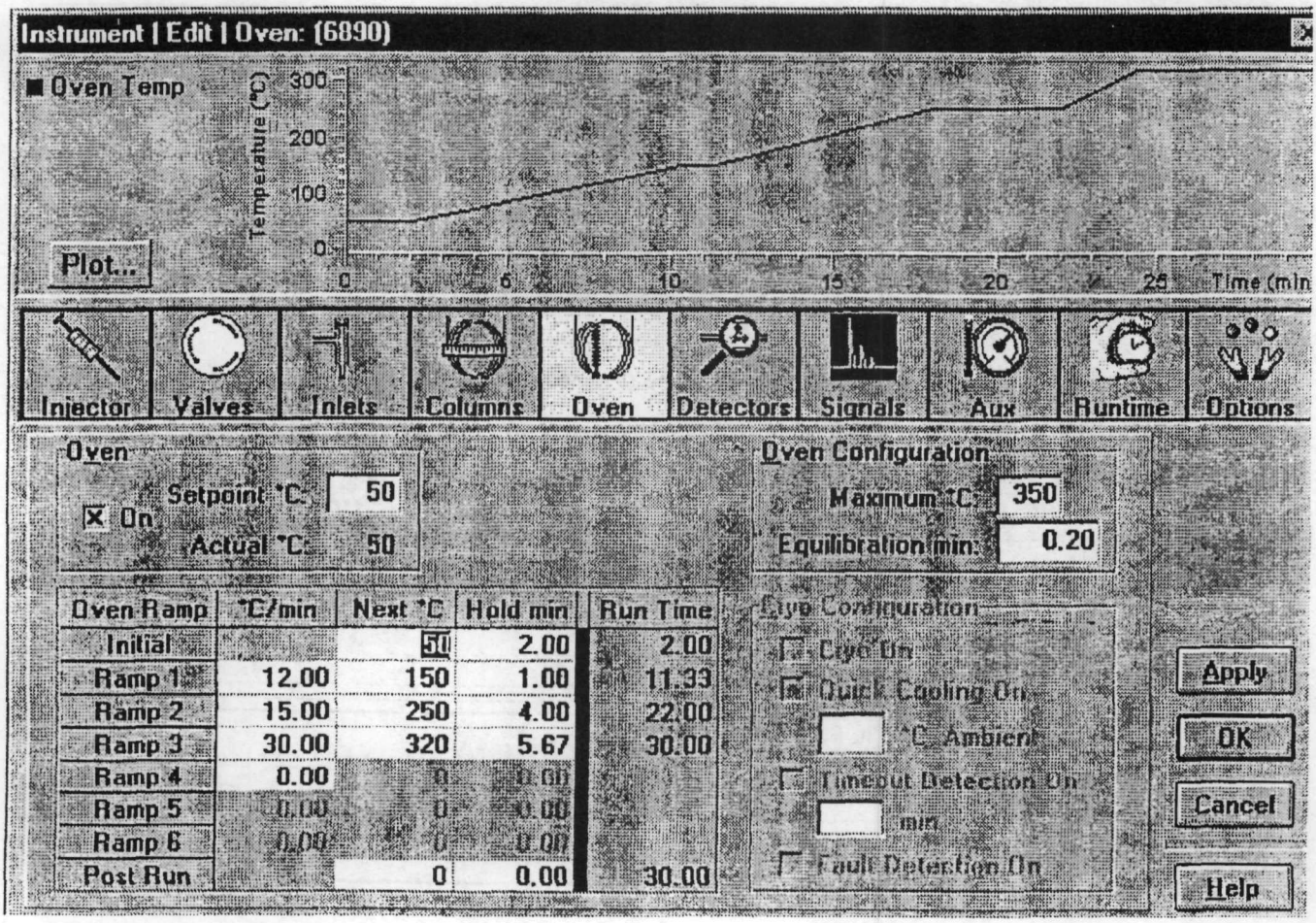
= Indicates values outside QC limits

ATTACHMENT 22.16

INSTRUMENT #1

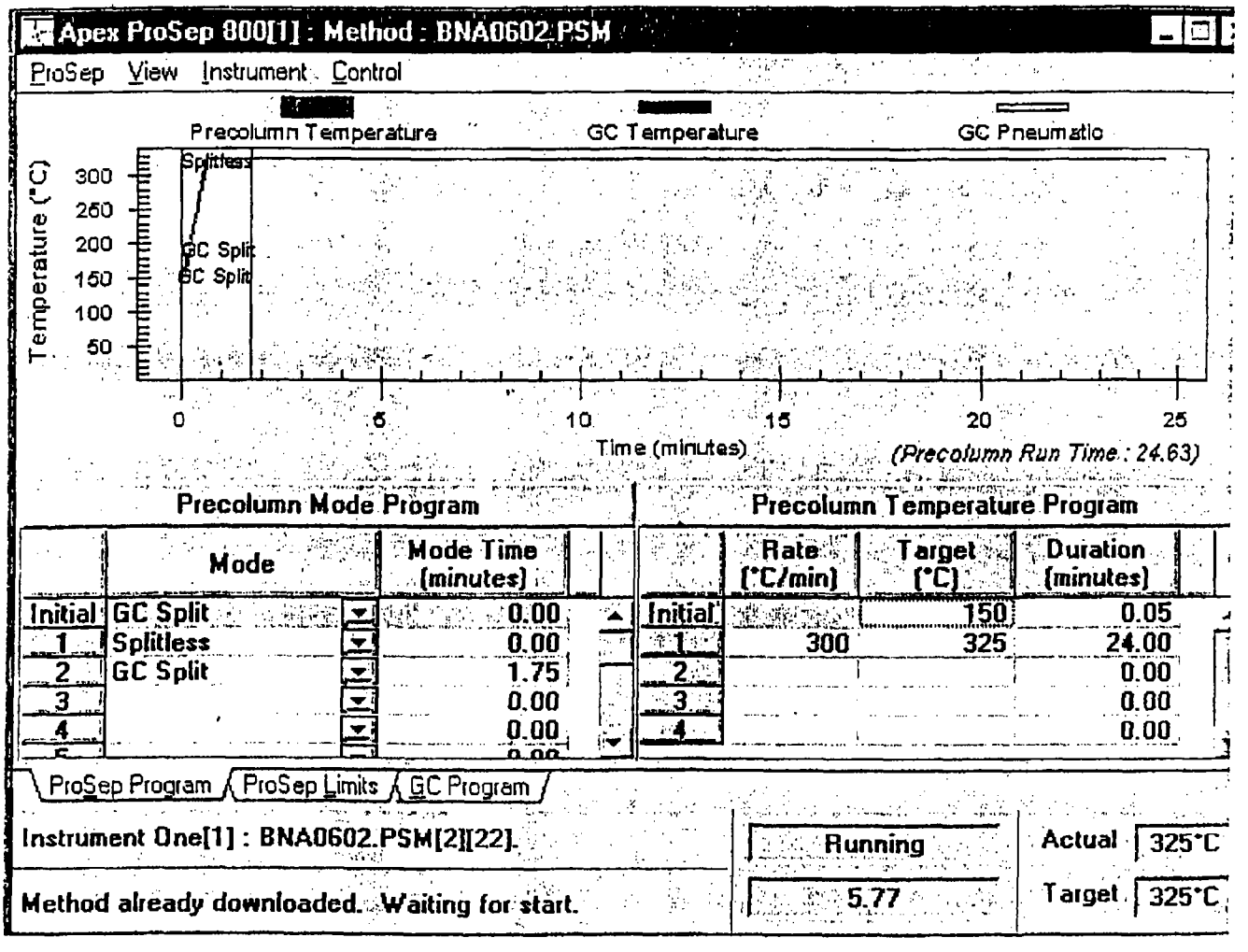


INSTRUMENT #3



INSTRUMENT #1

APEX INJECTION CONDITIONS



Plunger Speed	Fast
PreInjection Dwell	0.00 minutes
PostInjection Dwell	0.00 minutes

Back Injector:
No parameters specified

ATTACHMENT 22.18

MS ACQUISITION PARAMETERS

General Information
------- -----------

Tune File	: DFTPP.U
Acquistion Mode	: Scan

MS Information
-- -----------

Solvent Delay	: 2.45 min
EM Absolute	: False
EM Offset	: 0
Resulting EM Voltage	: 1600.0

[Scan Parameters]

Low Mass	: 40		
High Mass	: 450		
Threshold	: 150		
Sample #	: 2	A/D Samples	4
Plot 2 low mass	: 50		
Plot 2 high mass	: 550		

[MSZones]

MS Quad	: 150 C	maximum 200 C
MS Source	: 200 C	maximum 250 C

END OF MS ACQUISITION PARAMETERS

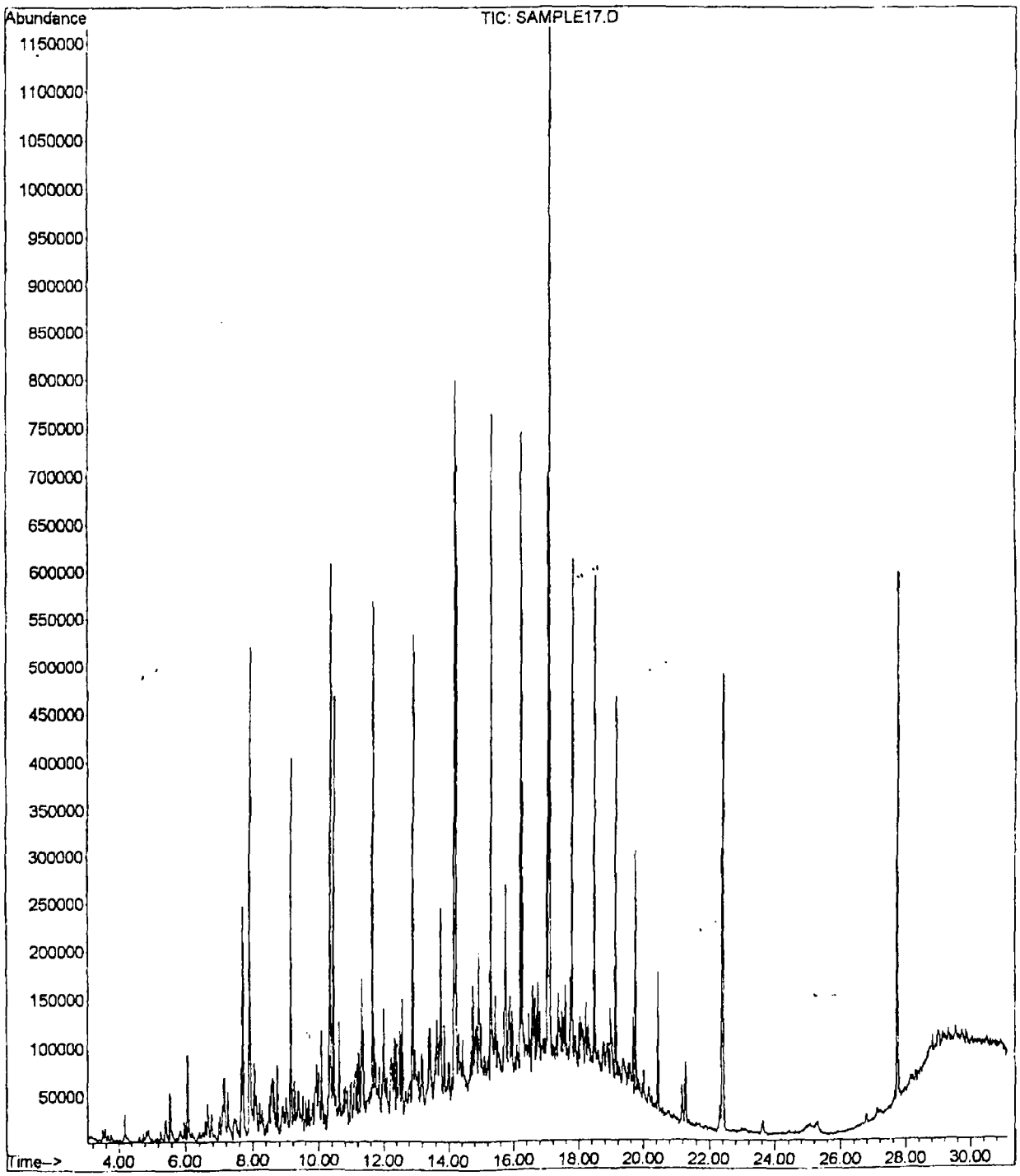
END OF INSTRUMENT CONTROL PARAMETERS

DATA ANALYSIS PARAMETERS

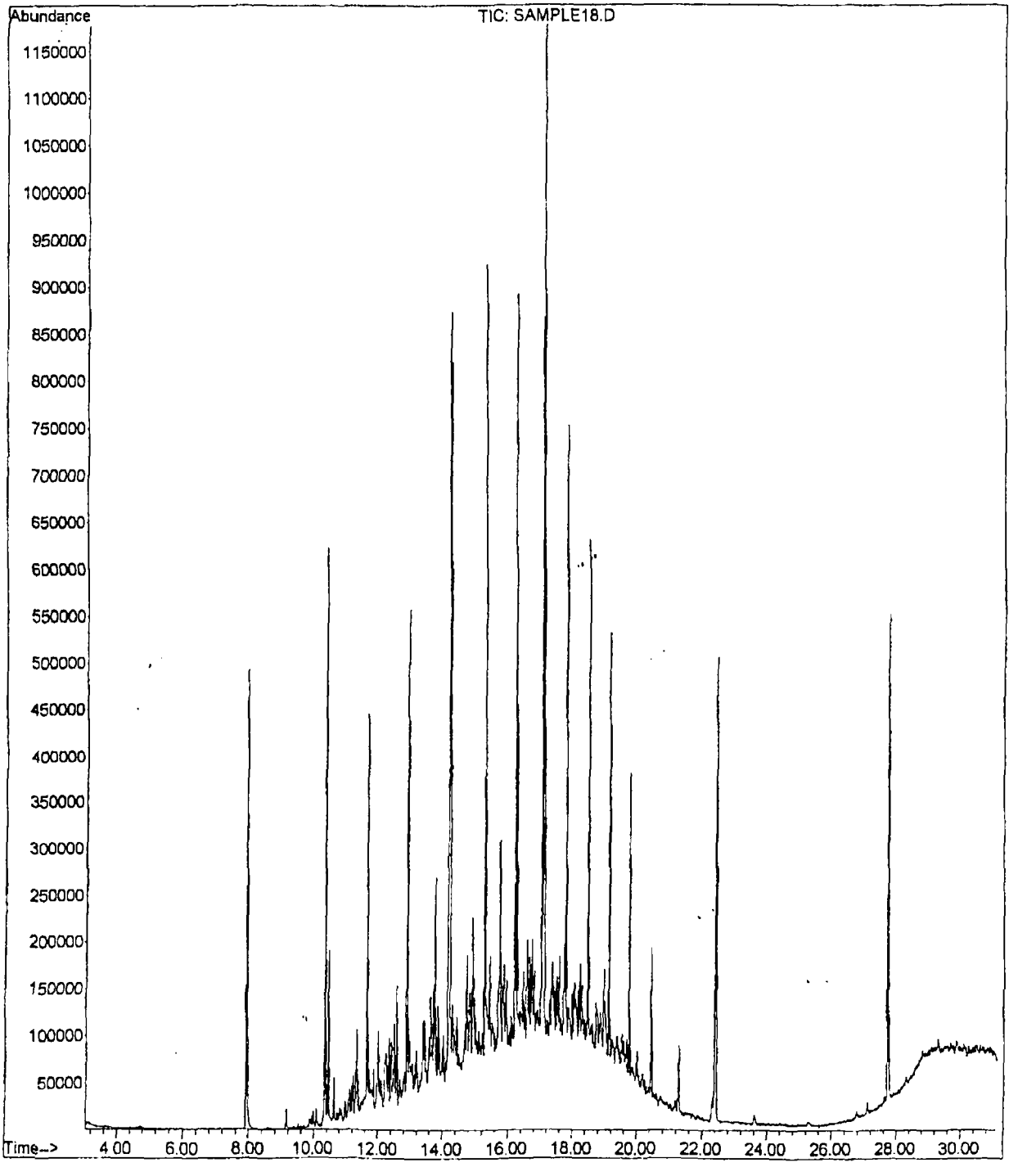
Method Name: C:\HPCHEM\1\METHODS\BA010516.M

Percent Report Settings

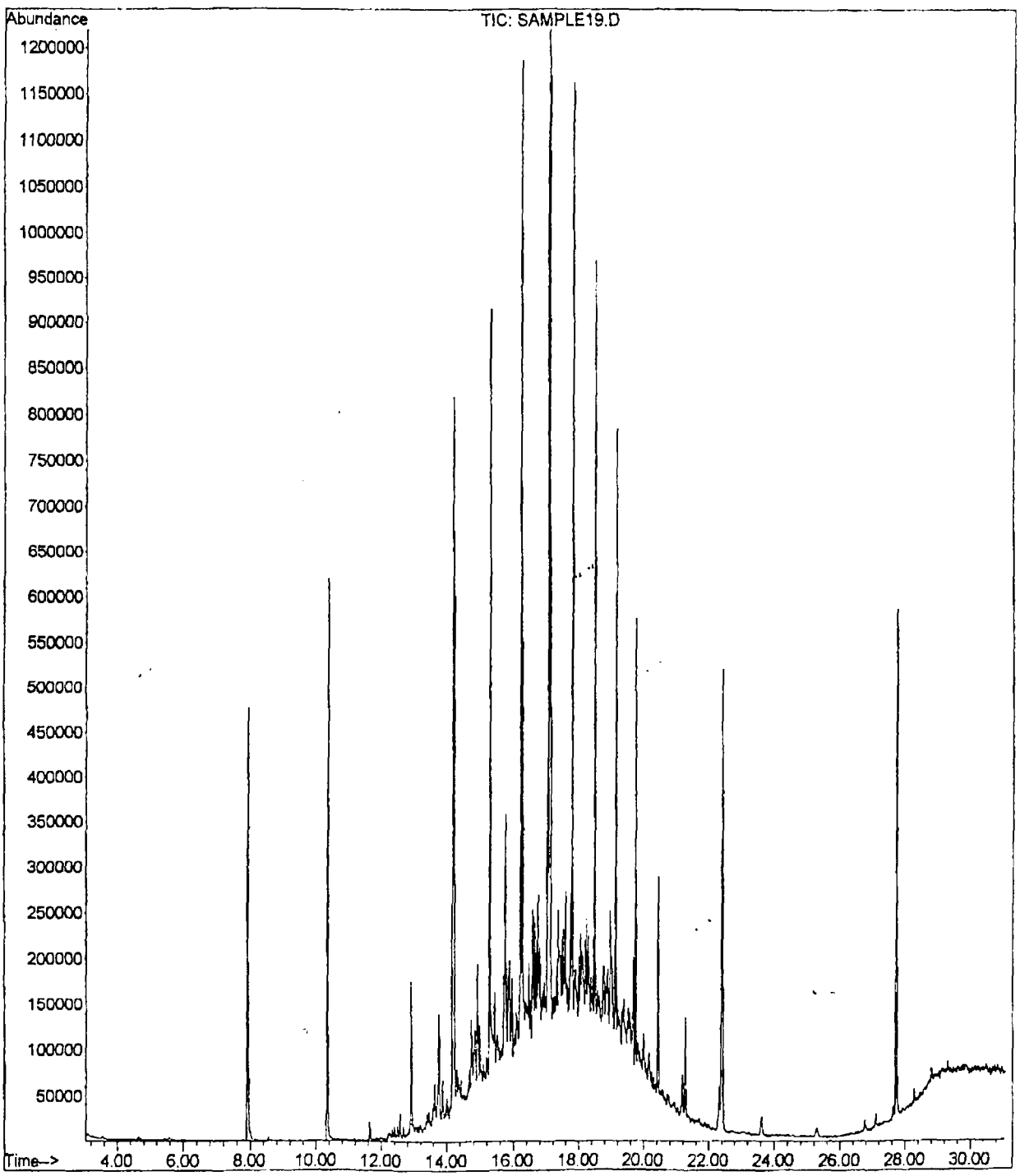
File : D:\DATA\1\5972\2001\BA010618\SAMPLE17.D
Operator : SMH APEX-BNA#1
Acquired : 18 Jun 2001 10:50 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: DIESEL FUEL 500PPM
Misc Info :
Vial Number: 19



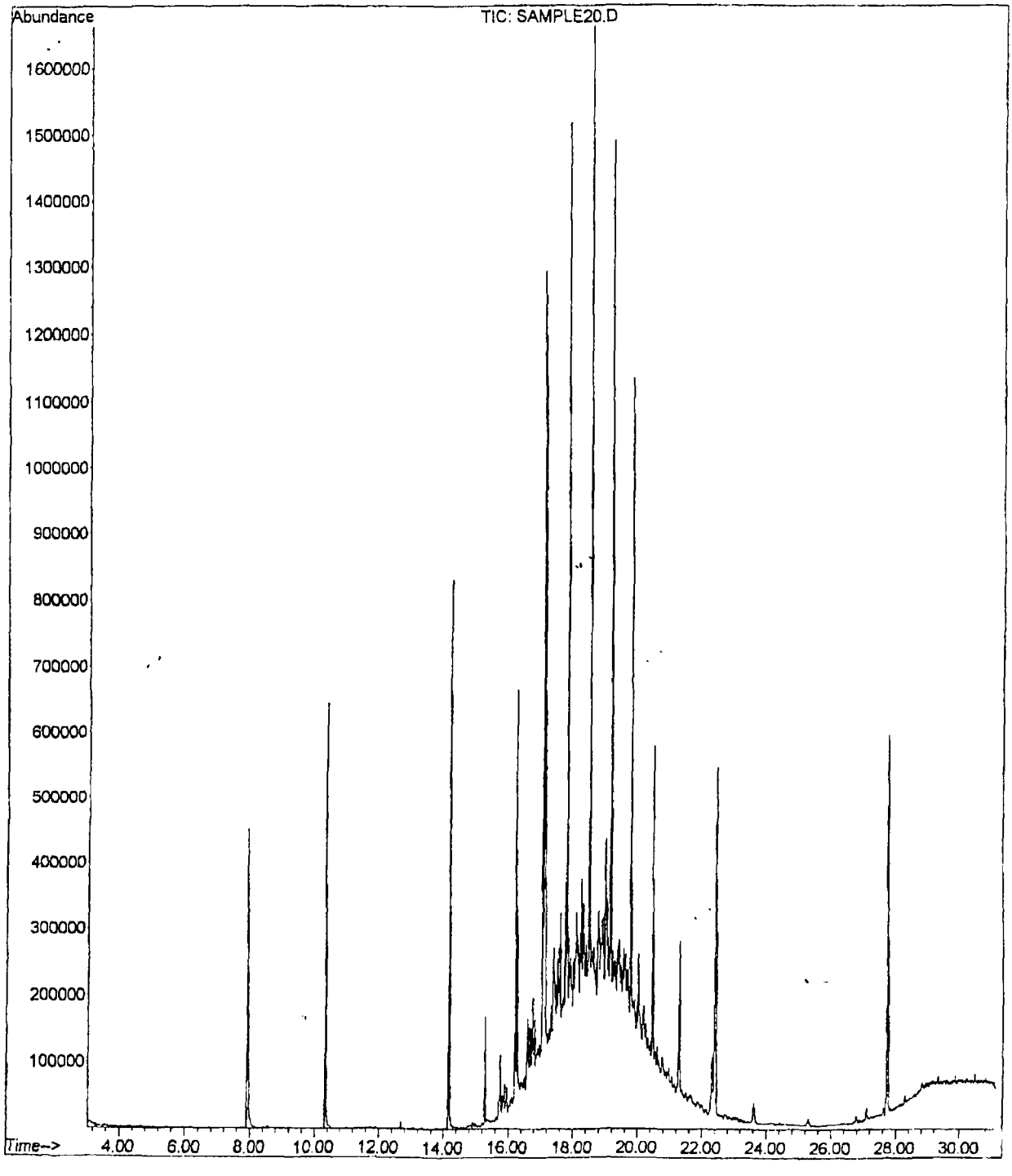
File : D:\DATA\1\5972\2001\BA010618\SAMPLE18.D
Operator : SMH APEX-BNA#1
Acquired : 18 Jun 2001 11:29 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 25% WEATHERED D.F. 500PPM
Misc Info :
Vial Number: 20



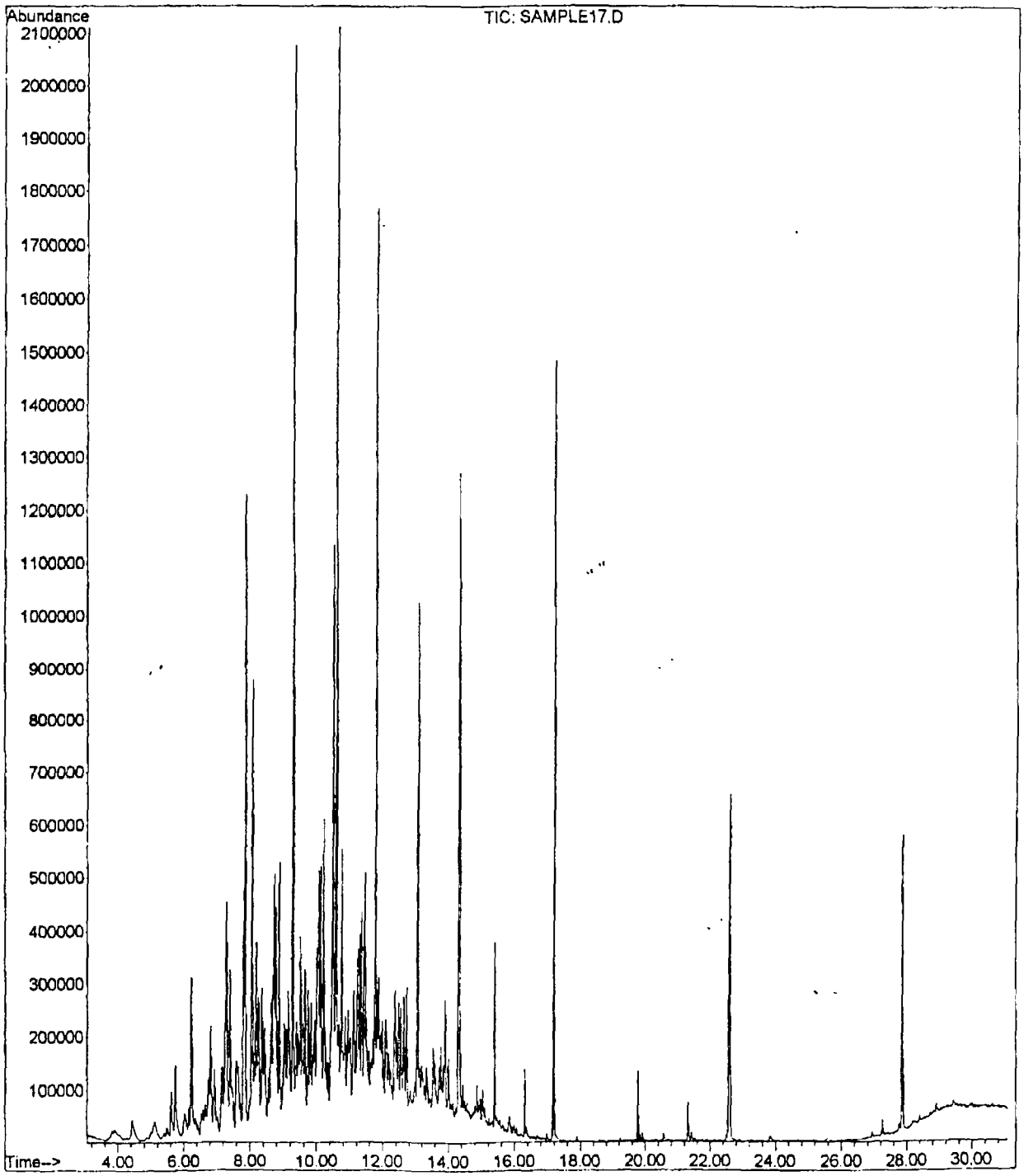
File : D:\DATA\1\5972\2001\BA010618\SAMPLE19.D
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 12:08 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 50% WEATHERED D.F. 500PPM
Misc Info :
Vial Number: 21



File : D:\DATA\1\5972\2001\BA010618\SAMPLE20.D
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 12:47 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 75% WEATHERED D.F. 500PPM
Misc Info :
Vial Number: 22



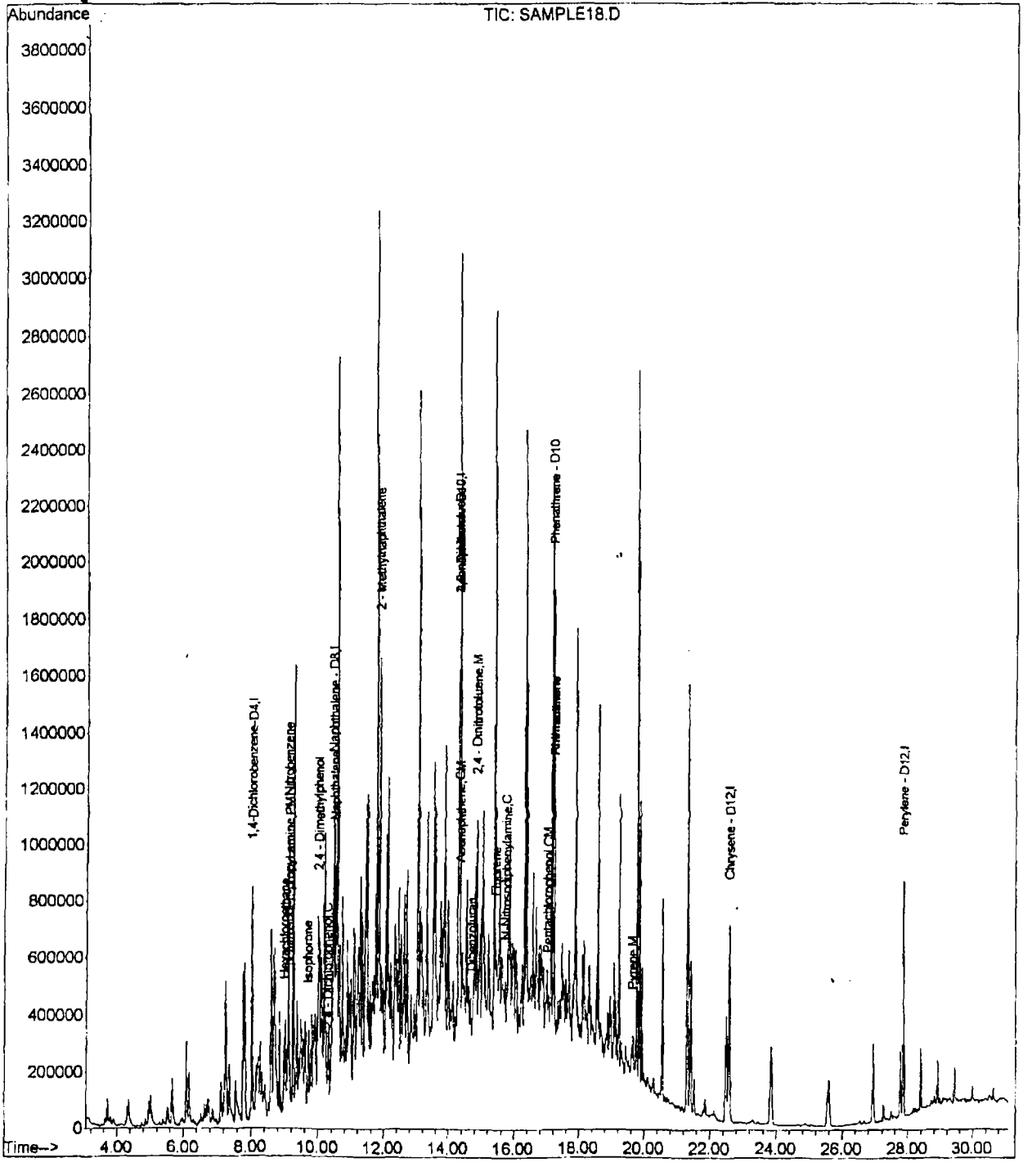
File : D:\DATA\1\5972\2001\BA010515\SAMPLE17.D
Operator : SMH APEX-BNA#1
Acquired : 16 May 2001 12:45 am using AcqMethod BA010502
Instrument : GC/MS Ins
Sample Name: JET FUEL
Misc Info :
Vial Number: 19



Quantitation Report

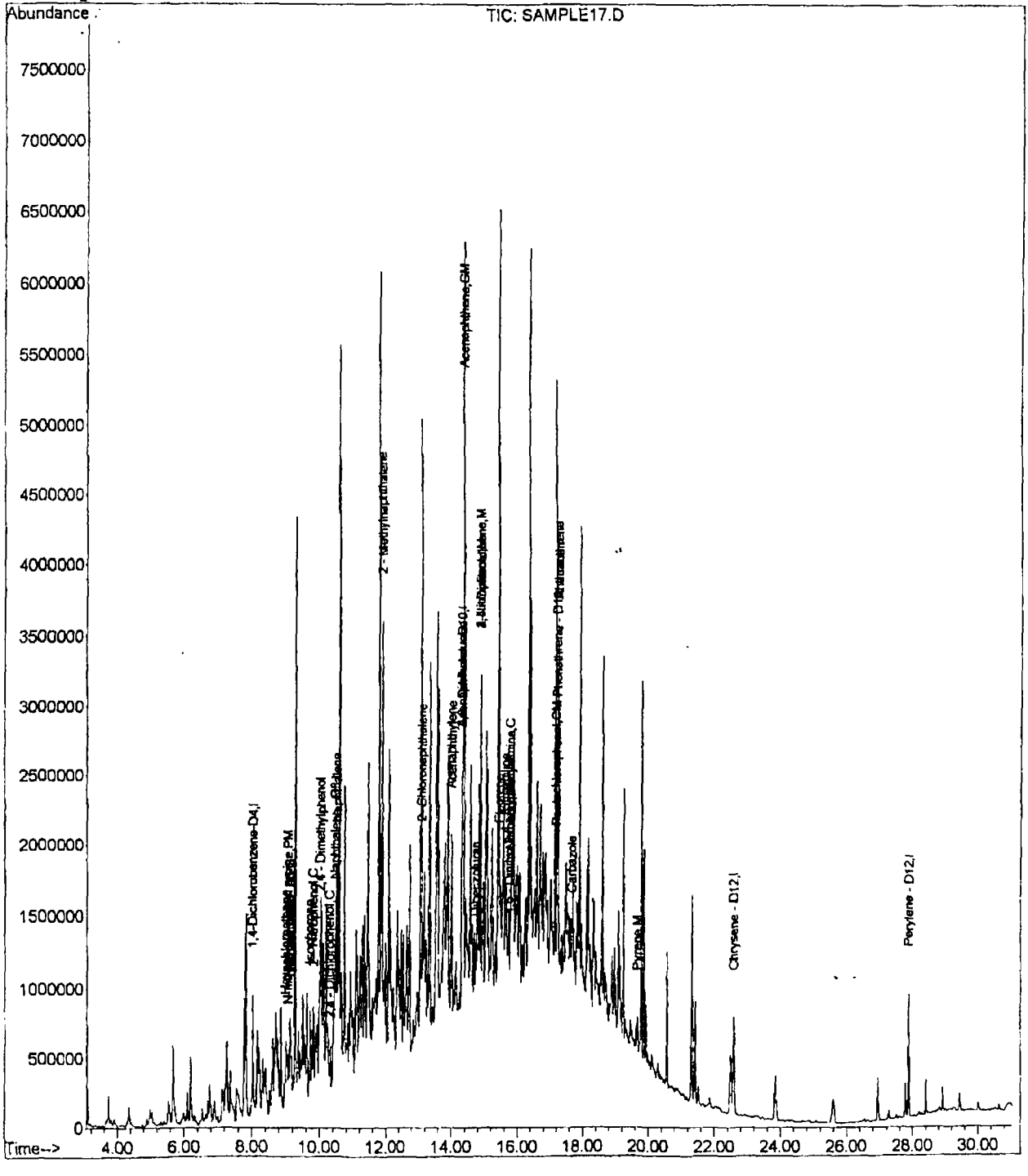
Data File : D:\DATA\1\5972\2001\BA010508\SAMPLE18.D Vial: 20
Acq On : 8 May 2001 10:42 pm Operator: SMH APEX-B
Sample : FUEL OIL #2 Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: May 9 7:48 2001 Quant Results File: BA010502.R

Method : C:\HPCHEM\1\METHODS\BA010502.M (RTE Integrator)
Title : 8270 GC/MS BNA analysis
Last Update : Mon May 07 09:29:03 2001
Response via : Initial Calibration

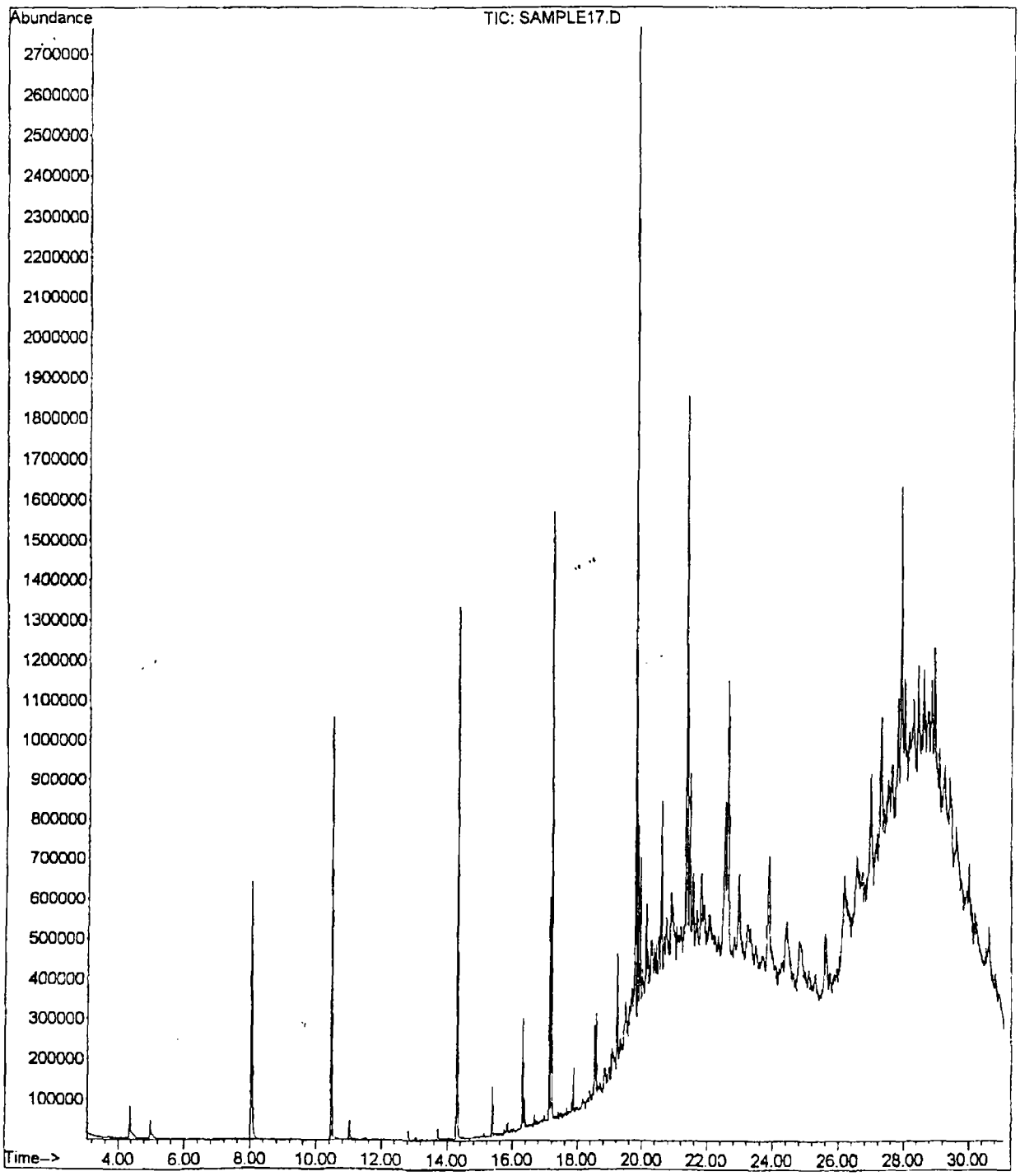


Data File : D:\DATA\1\5972\2001\BA010508\SAMPLE17.D Vial: 19
Acq On : 8 May 2001 10:02 pm Operator: SMH APEX-B
Sample : FUEL OIL #4 Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: May 9 7:48 2001 Quant Results File: BA010502.R

Method : C:\HPCHEM\1\METHODS\BA010502.M (RTE Integrator)
Title : 8270 GC/MS BNA analysis
Last Update : Mon May 07 09:29:03 2001
Response via : Initial Calibration



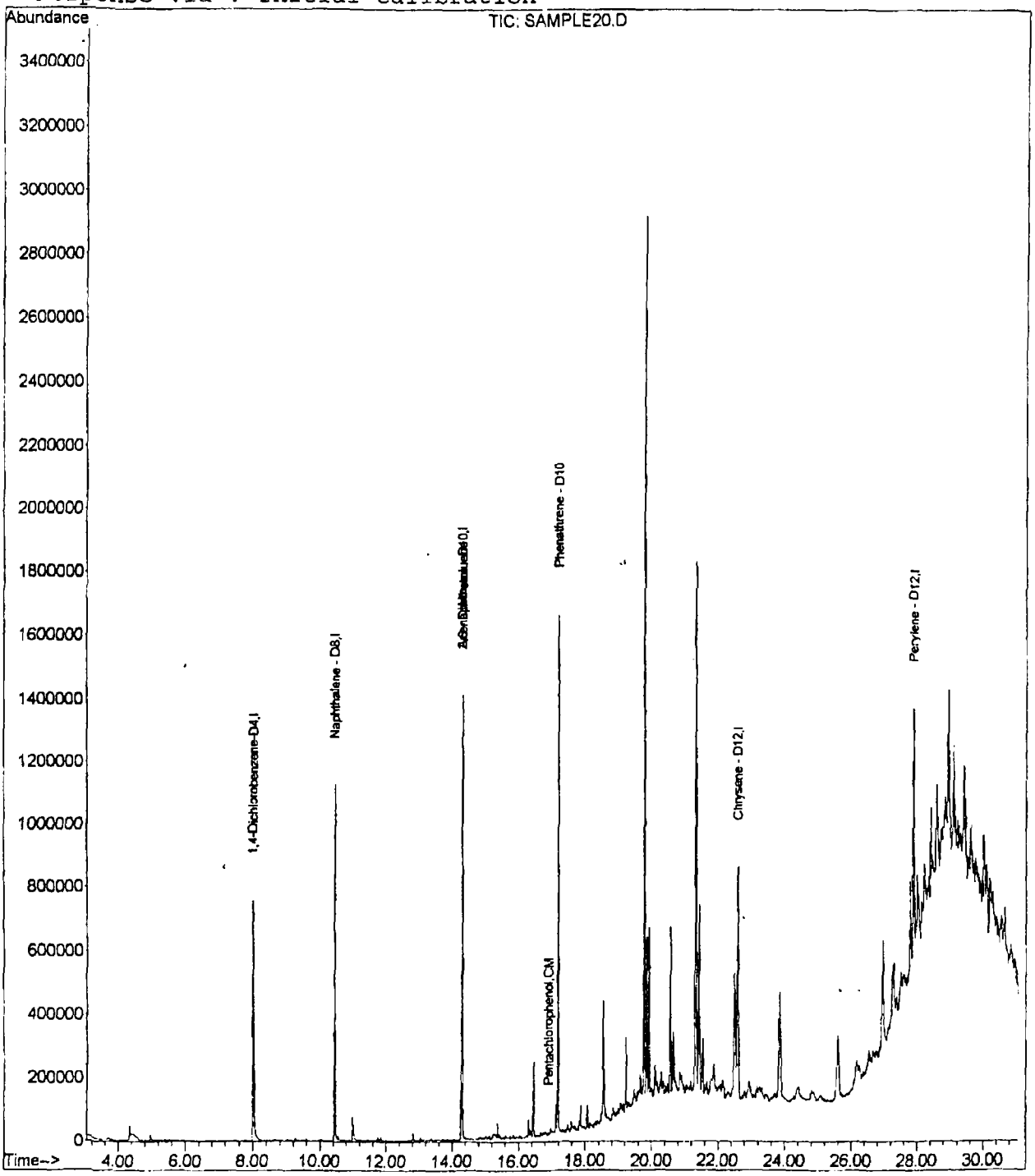
File : D:\DATA\1\5972\2001\BA010511\SAMPLE17.D
Operator : SMH APEX-BNA#1
Acquired : 11 May 2001 9:25 pm using AcqMethod BA010502
Instrument : GC/MS Ins
Sample Name: HYDROLIC OIL
Misc Info :
Vial Number: 19



Quantitation Report

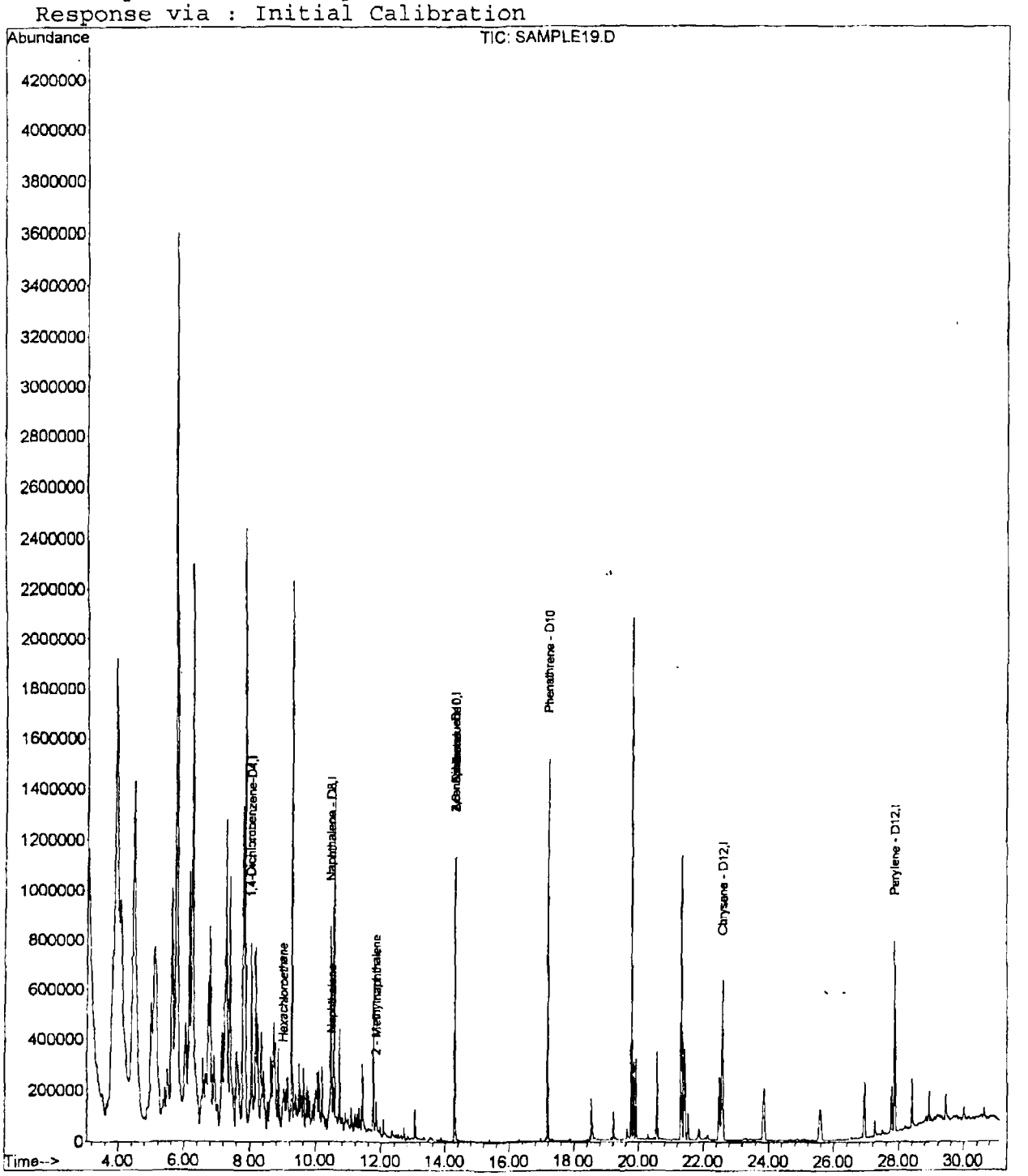
Data File : D:\DATA\1\5972\2001\BA010508\SAMPLE20.D Vial: 22
Acq On : 9 May 2001 12:00 am Operator: SMH APEX-B
Sample : 30W MOTOR OIL Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: May 9 7:49 2001 Quant Results File: BA010502.R

Method : C:\HPCHEM\1\METHODS\BA010502.M (RTE Integrator)
Title : 8270 GC/MS BNA analysis
Last Update : Mon May 07 09:29:03 2001
Response via : Initial Calibration

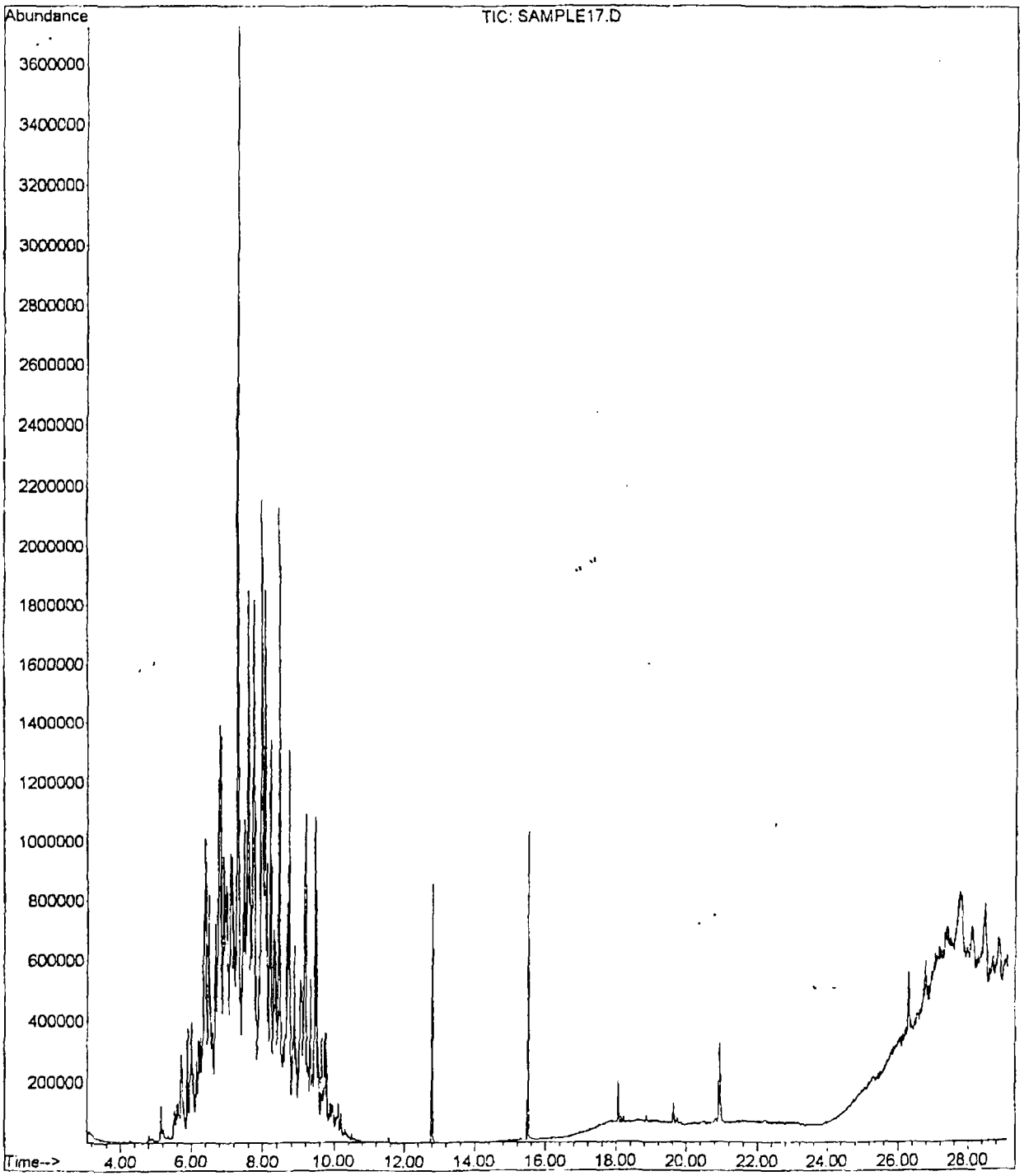


Data File : D:\DATA\1\5972\2001\BA010508\SAMPLE19.D Vial: 21
Acq On : 8 May 2001 11:21 pm Operator: SMH APEX-B
Sample : JP-4 Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: May 9 7:48 2001 Quant Results File: BA010502.R

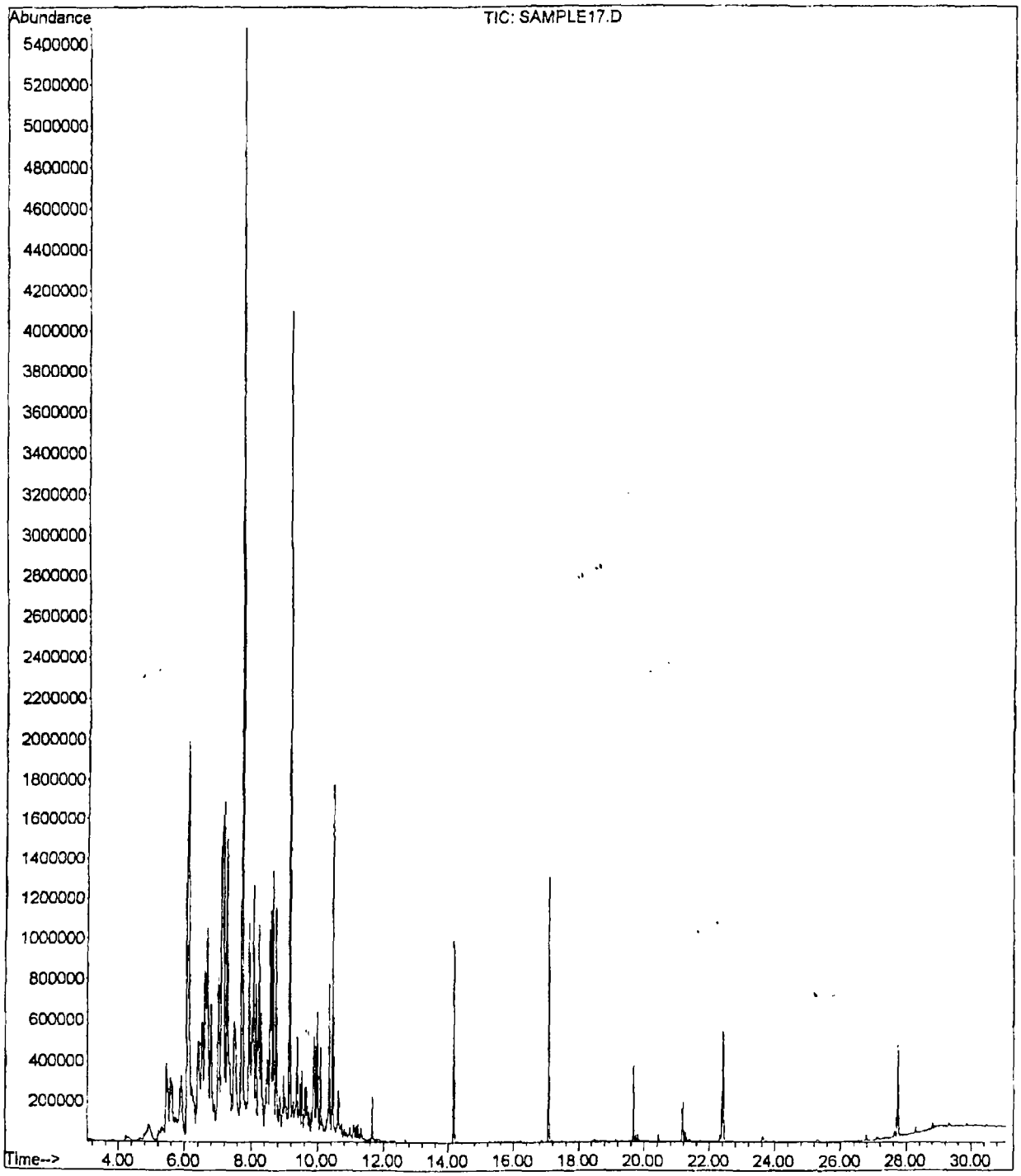
Method : C:\HPCHEM\1\METHODS\BA010502.M (RTE Integrator)
Title : 8270 GC/MS BNA analysis
Last Update : Mon May 07 09:29:03 2001
Response via : Initial Calibration



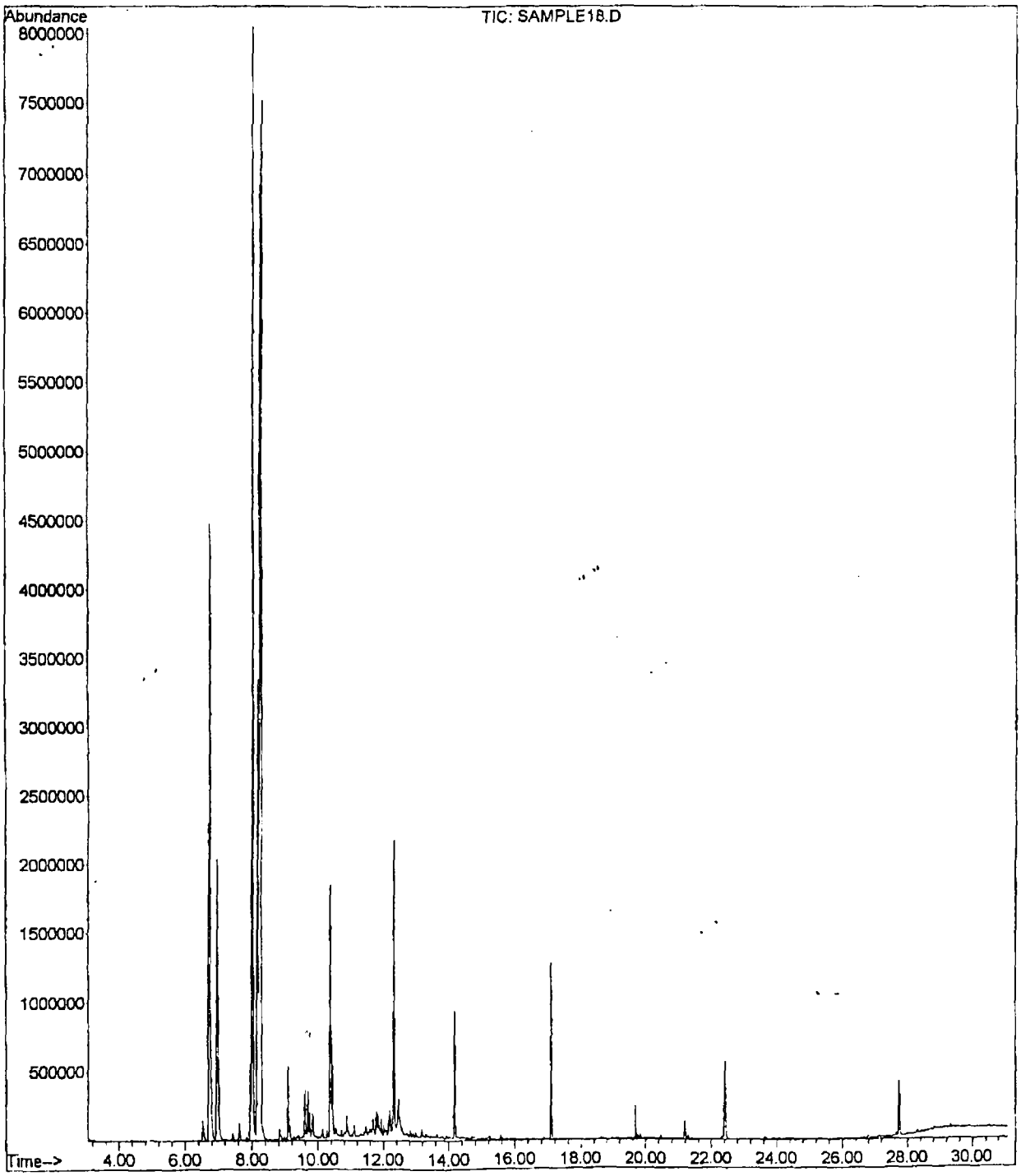
File : D:\DATA\1\5972\2001\BA010327\SAMPLE17.D
Operator : SMH APEX-BNA#1
Acquired : 27 Mar 2001 10:33 pm using AcqMethod BA010307
Instrument : GC/MS Ins
Sample Name: MINERAL SP 1000PPM
Misc Info :
Vial Number: 18



File : D:\DATA\1\5972\2001\BA010615\SAMPLE17.D
Operator : SMH APEX-BNA#1
Acquired : 15 Jun 2001 10:06 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: STODDARD 1000PPM
Misc Info :
Vial Number: 19



File : D:\DATA\1\5972\2001\BA010615\SAMPLE18.D
Operator : SMH APEX-BNA#1
Acquired : 15 Jun 2001 10:45 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: TERPINTINE 1000PPM
Misc Info :
Vial Number: 20



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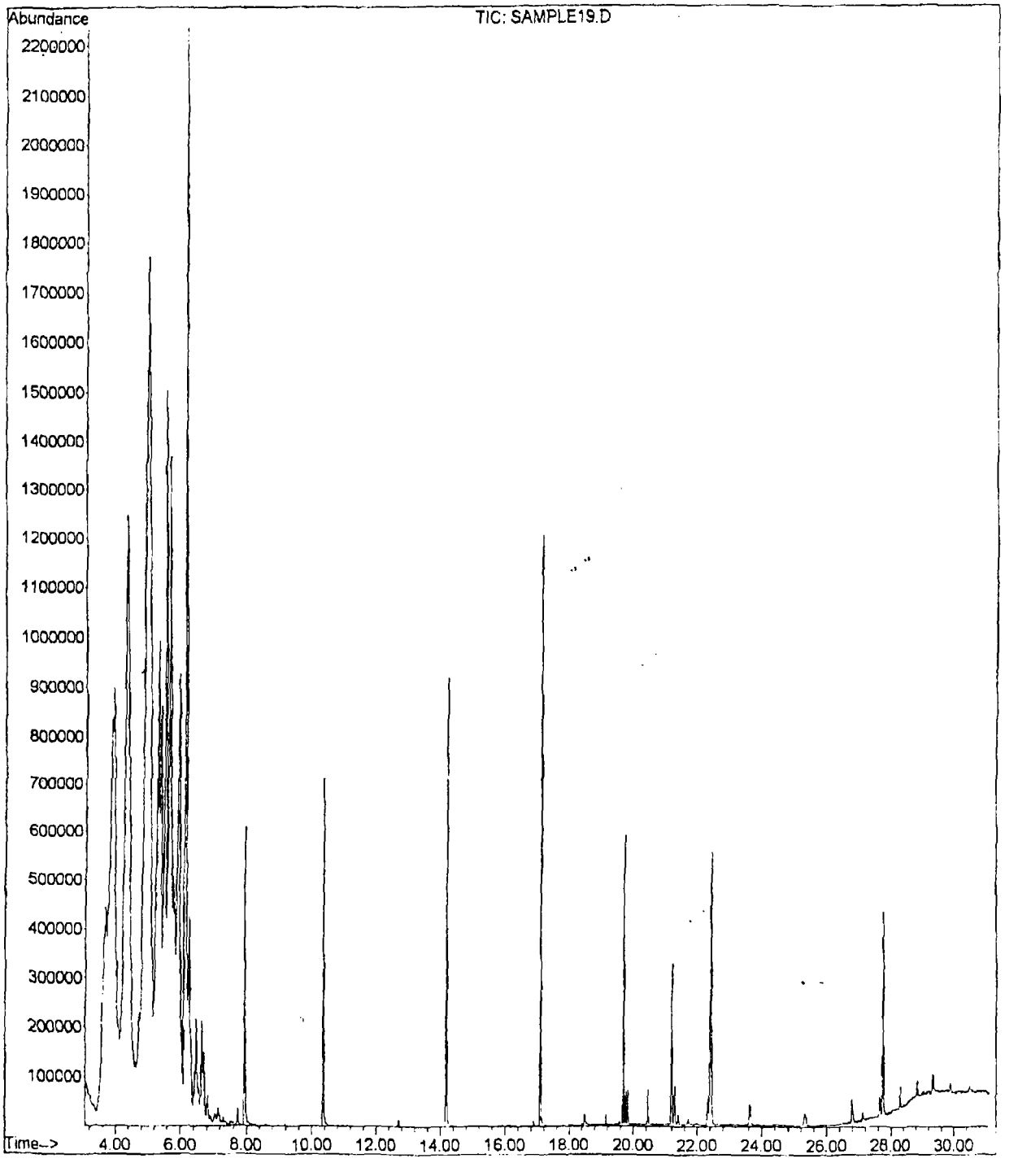
Operator : SMH APEX-BNA#1
Acquired : 15 Jun 2001 11:25 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: NAPHTHA 1000PPM
Misc Info :
Vial Number: 21



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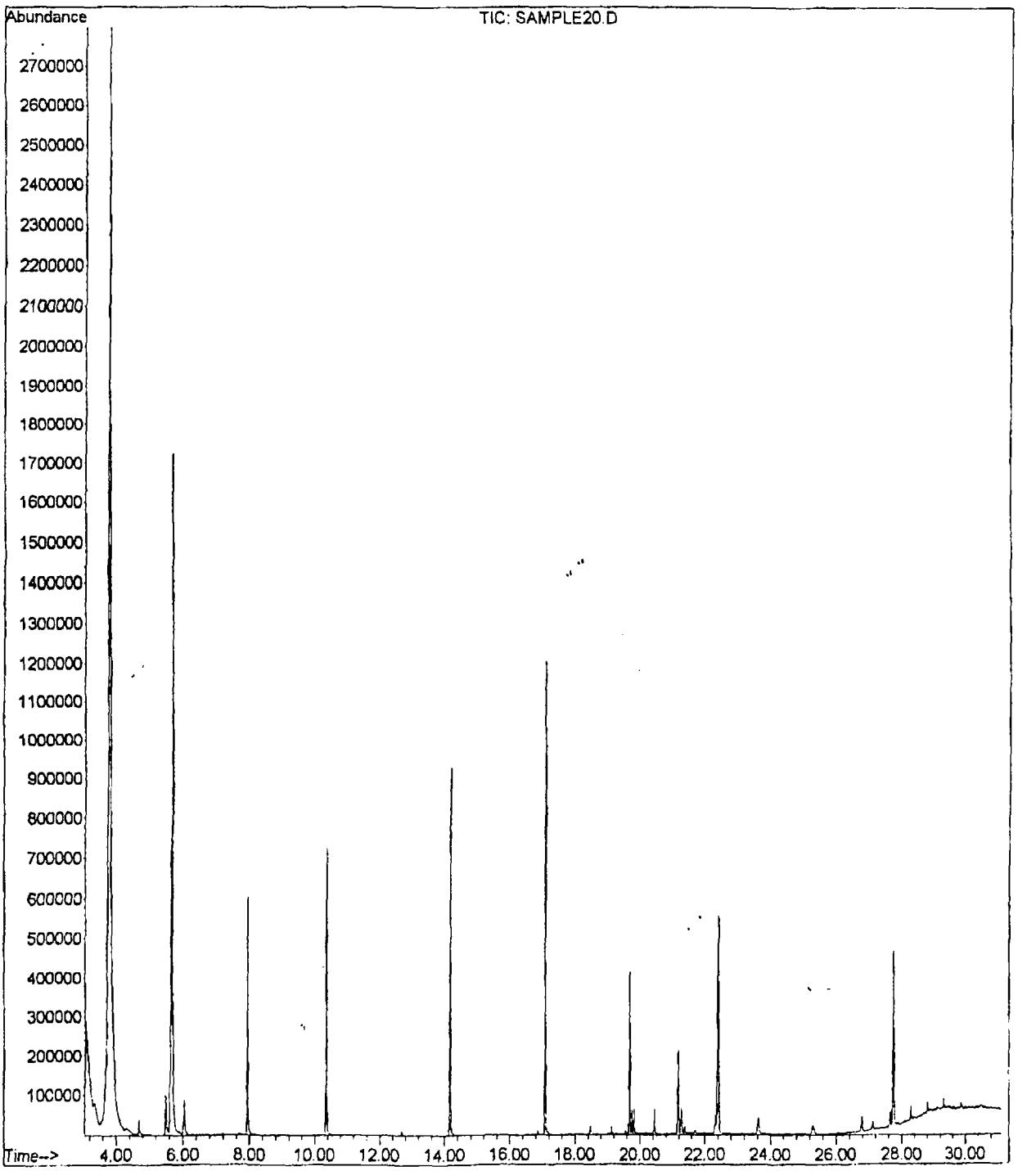
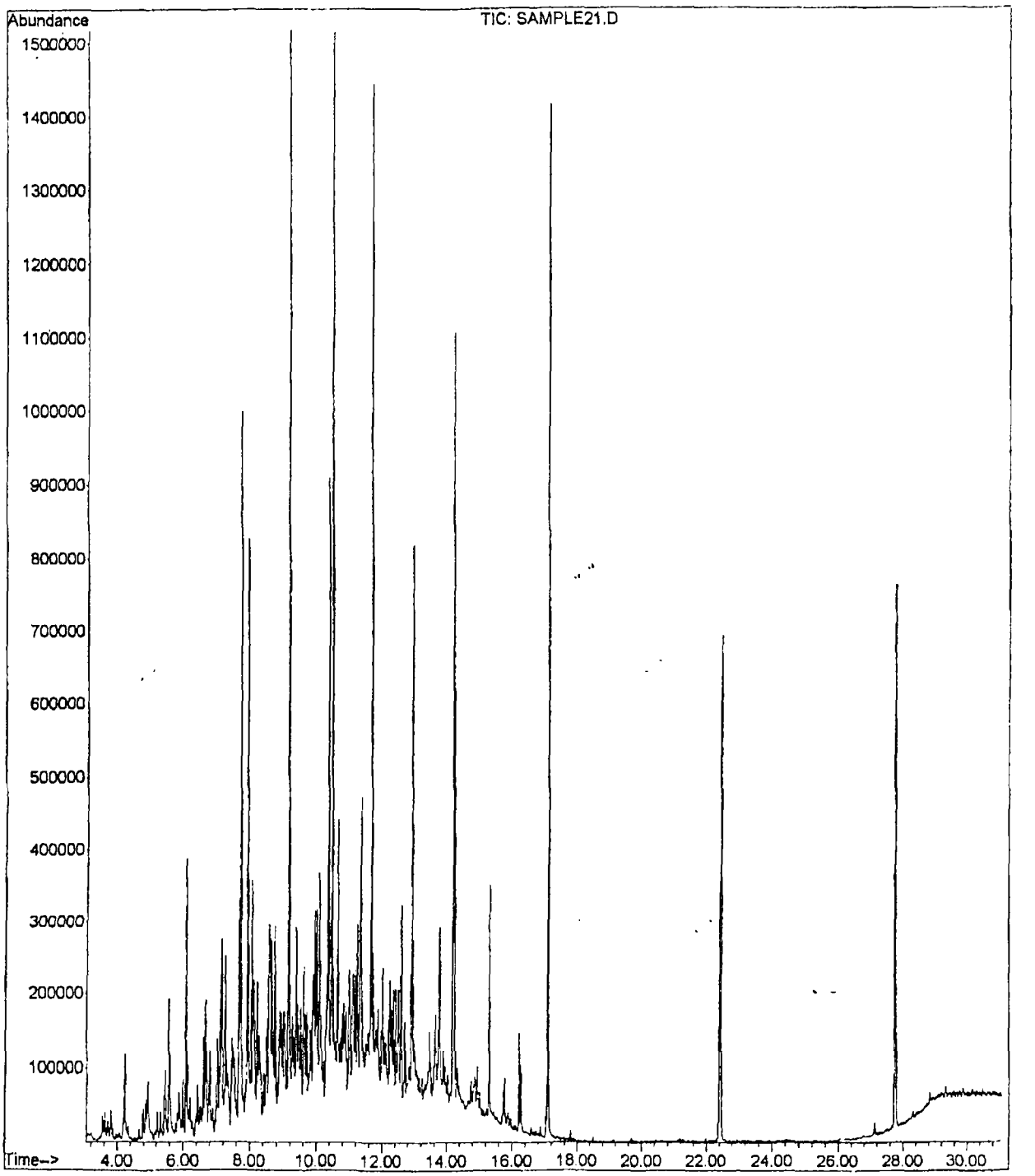
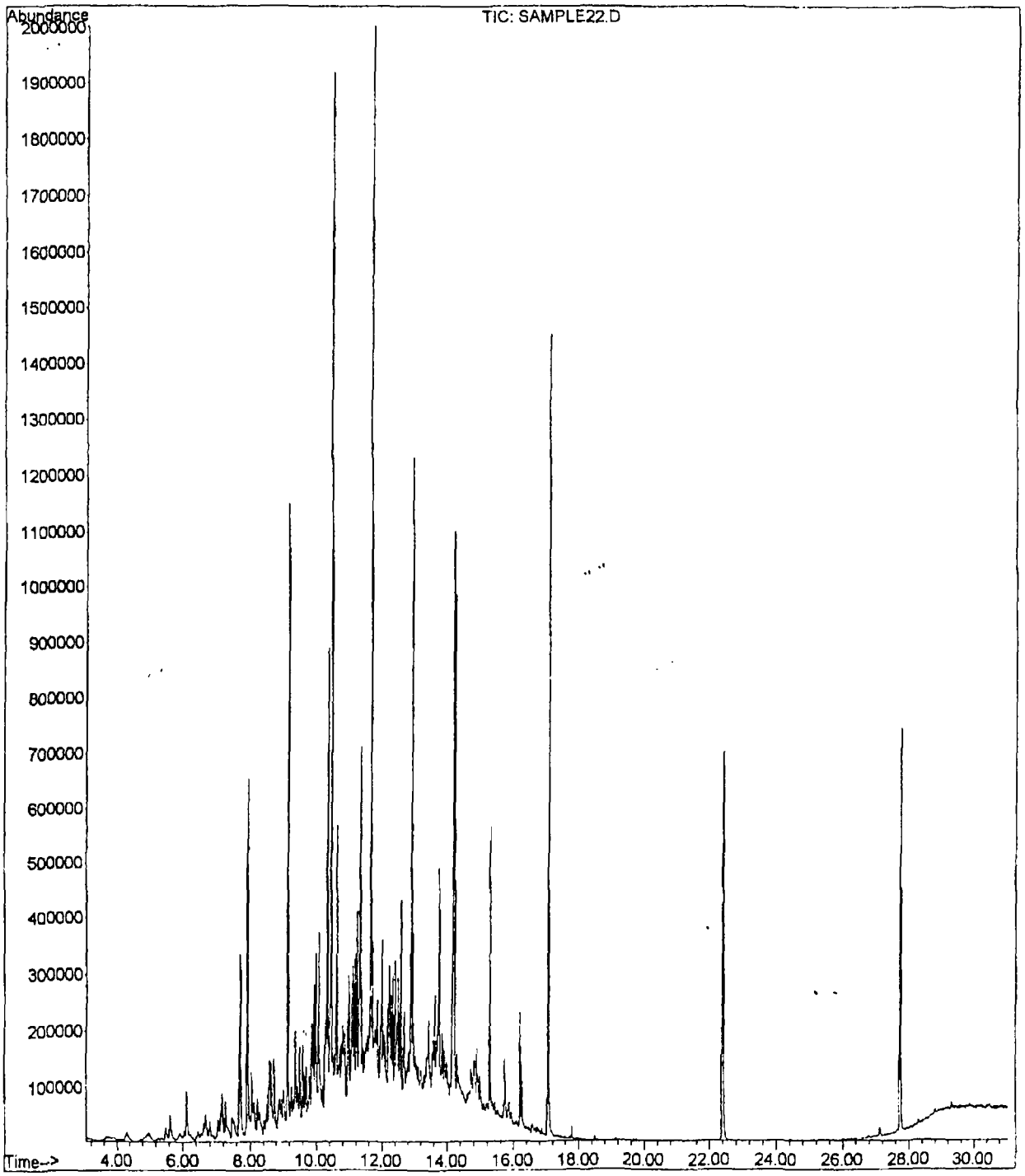
Operator : SMH APEX-BNA#1
Acquired : 16 Jun 2001 12:04 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: LAQUER THINNER 1000PPM
Misc Info :
Vial Number: 22



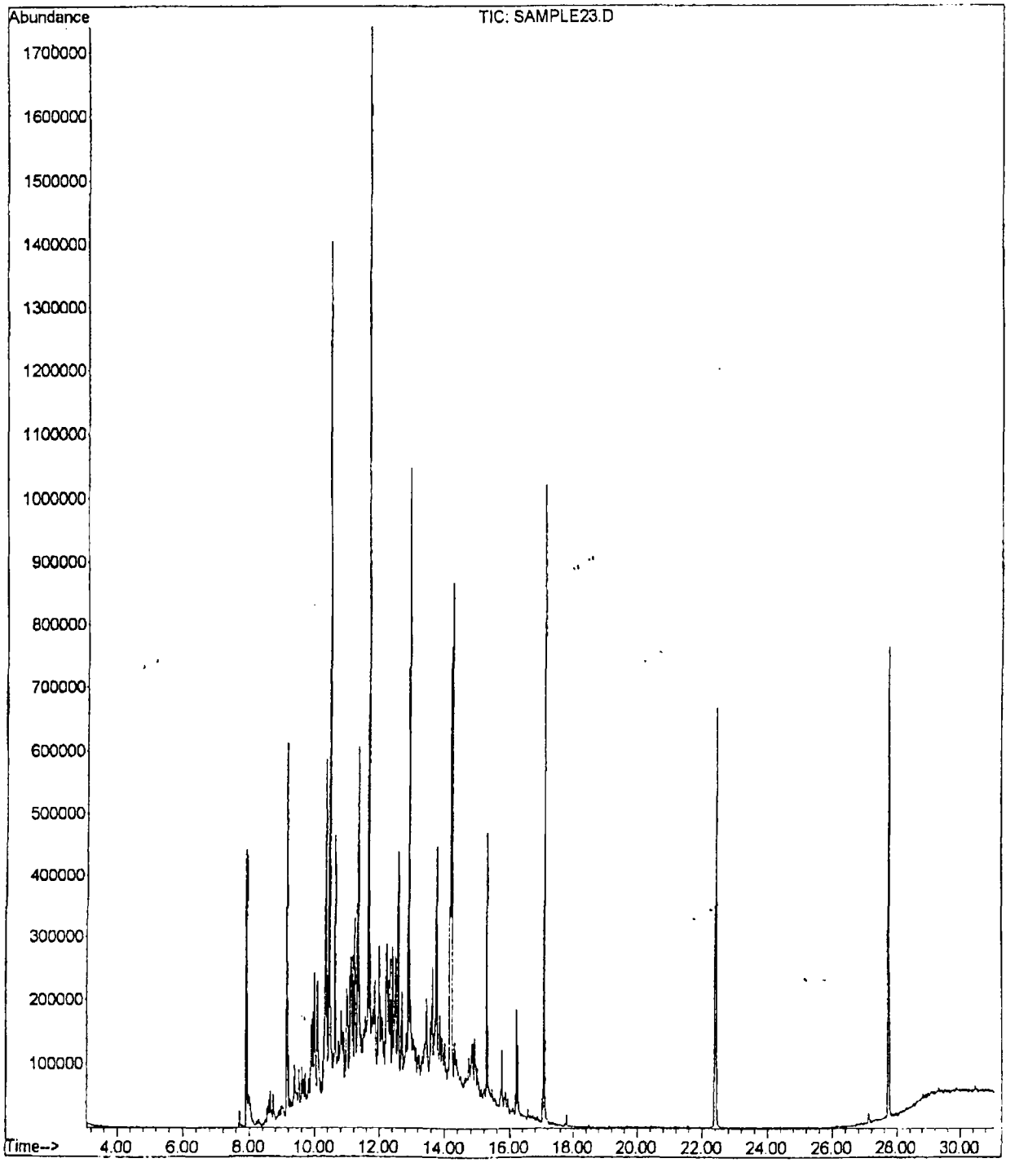
File : D:\DATA\1\5972\2001\BA010618\SAMPLE21.D
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 1:27 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: KEROSENE 500PPM
Misc Info :
Vial Number: 23



File : D:\DATA\1\5972\2001\BA010618\SAMPLE22.D
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 2:06 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 25% WEATHERED KERO. 500PPM
Misc Info :
Vial Number: 24



File : D:\DATA\1\5972\2001\BA010618\SAMPLE23.D
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 2:45 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 50% WEATHERED KERO. 500PPM
Misc Info :
Vial Number: 25



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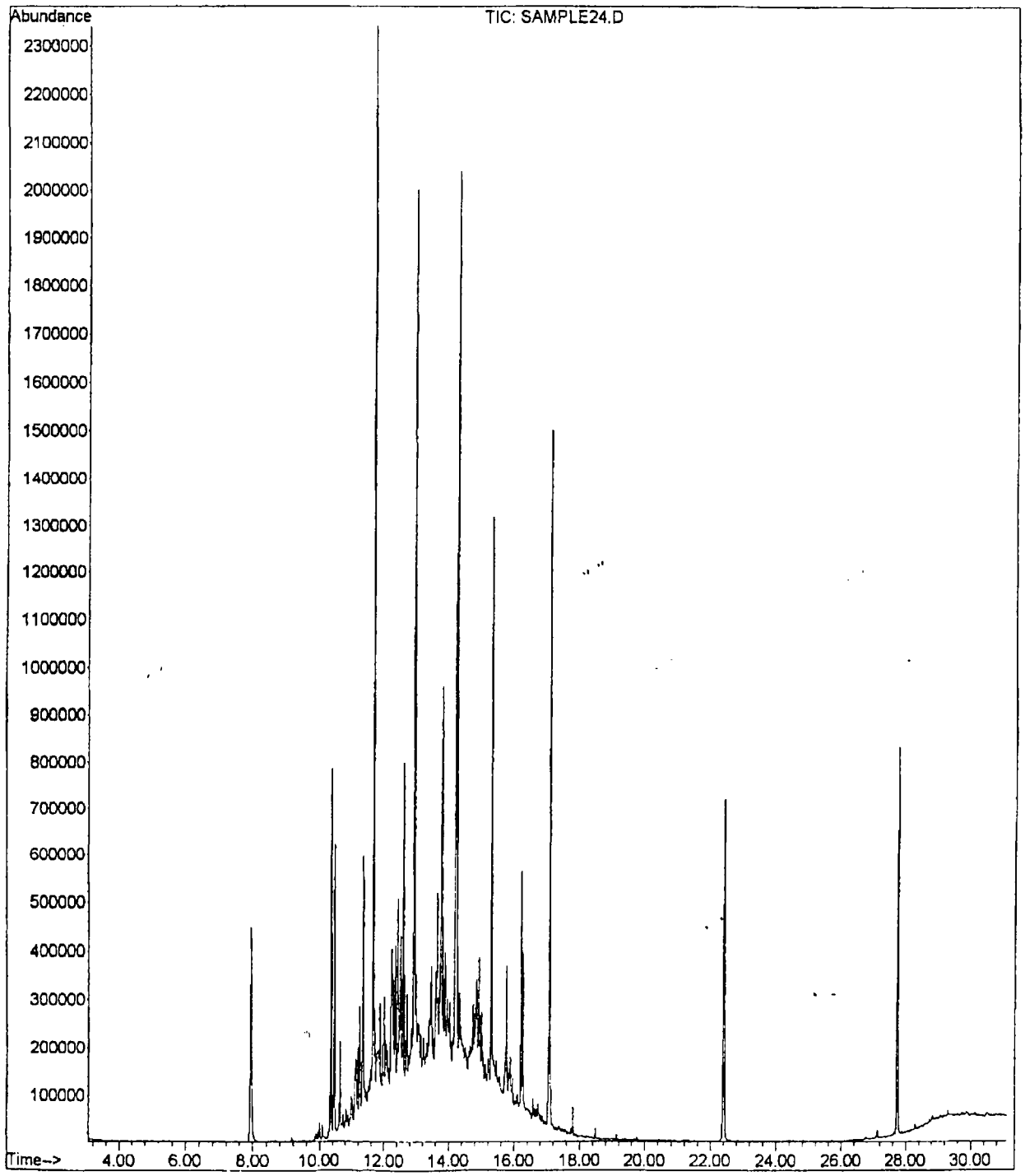
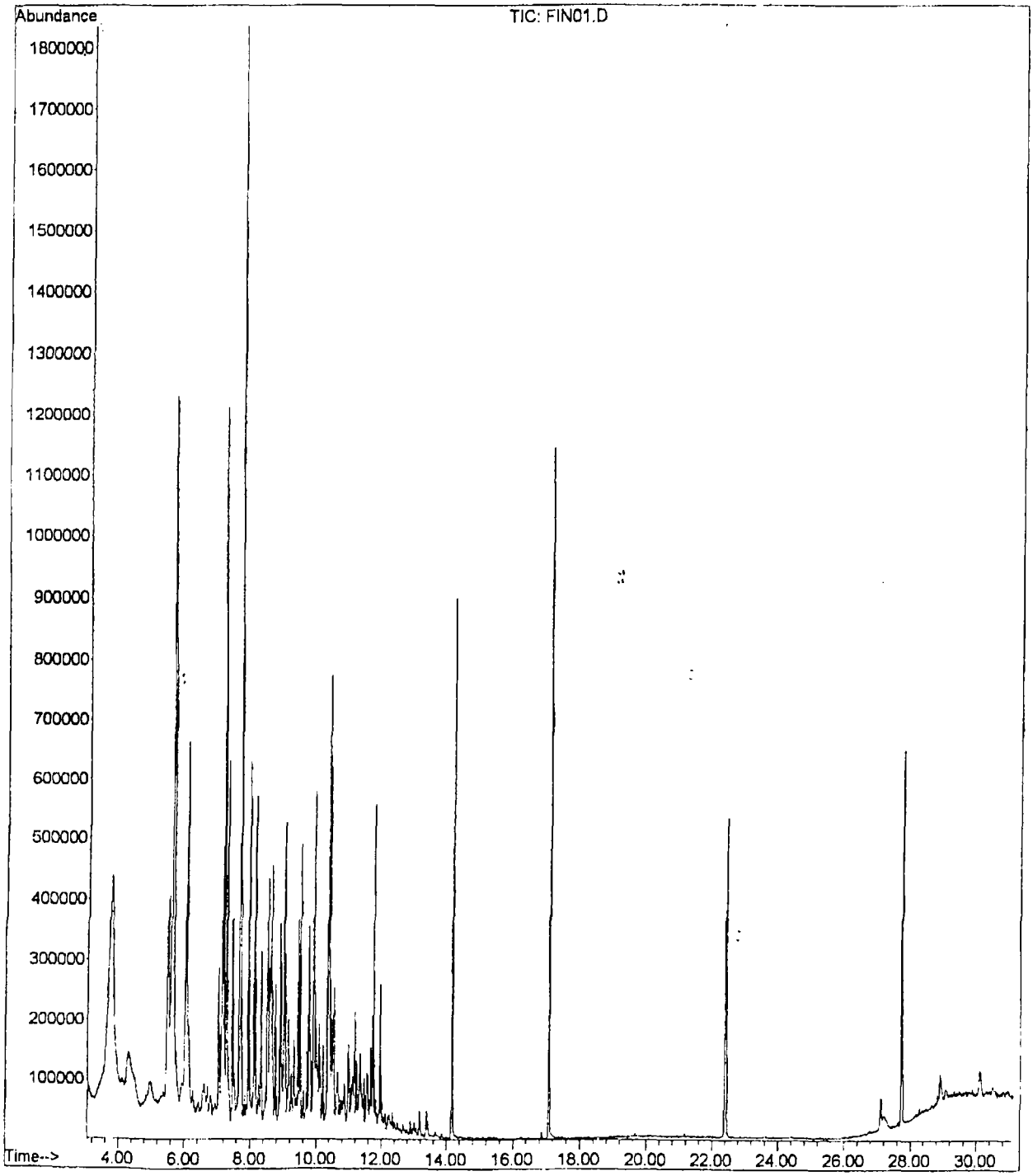
Operator : SMH APEX-BNA#1
Acquired : 19 Jun 2001 3:24 am using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: 75% WEATHERED KERO. 500PPM
Misc Info :
Vial Number: 26



File : D:\DATA\1\5972\2001\BA010622\FIN01.D
Operator : SMH APEX-BNA#1
Acquired : 22 Jun 2001 12:09 pm using AcqMethod BA010605
Instrument : GC/MS Ins
Sample Name: GAS 2000PPM
Misc Info :
Vial Number: 2



DEQ

ENVIRONMENTAL LAB

MDEQ SOP # 501 REVISION # 1

EFFECTIVE DATE 12/02

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RELEASED BY _____ DATE 12/10/02
COMPLIANCE OFFICER

VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

1.0 Applicable Analytical Methods

1.1 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), U.S. Environmental Protection Agency, Method 8260B, SW846, Revision 2, December 1996.

1.2 Purgeables, U.S. Environmental Protection Agency, Method 624, 40-CFR, Part 136, Appendix A.

1.3 Determinative Chromatographic Separations, U.S. Environmental Protection Agency, Method 8000B, SW846, Revision 2, December 1996.

1.4 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.5 Sample Preparation for Volatile Organic Compounds, U.S. Environmental Protection Agency, Method 5000, SW846, Revision 0, December 1996.

1.6 Waste Dilution for Volatile Organics, U.S. Environmental Protection Agency, Method 3585, SW846, Revision 0, December 1996.

1.7 Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples, U.S. Environmental Protection Agency, Method 5035, SW846, Revision 0, December 1996.

1.8 Purge-and-Trap for Aqueous Samples, U.S. Environmental Protection Agency, Method 5030B, SW846, Revision 2, December 1996.

VOC

1.9 Toxicity Characteristic Leaching Procedure, U.S. Environmental Protection Agency, Method 1311, SW846, Revision 0, July 1992.

1.10 Synthetic Precipitation Leaching Procedure, U.S. Environmental Protection Agency, Method 1312, SW846, Revision 0, September 1994.

2.0 Matrix or Matrices

2.1 Aqueous.

2.2 Soil.

2.3 Sediment.

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Waste solids.

2.8 TCLP extracts.

2.9 SPLP extracts.

3.0 Method Detection Limits

3.1 All method detection limits (MDLs) are performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 Every analyte to be quantitated by this method must have an MDL study performed for it. Results obtained for analytes that have not had an MDL calculated by this method must be considered estimated. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. MDLs are analyzed annually or whenever major instrument maintenance occurs. MDLs should be calculated as in 40 CFR, Part 136, Appendix B.

3.2.1 Water MDLs - A minimum of seven replicate analyses are performed using reagent water spiked with every analyte of interest at 1 µg/L concentration. Prepare as in Section 13.2. Some compounds may need to be prepared at other levels.

3.2.2 Soil MDLs – Eight replicate samples are prepared and analyzed using the methanol extraction method. A 10 µg/mL (Section 10.13.6.6) stock standard (SS) is used to spike the samples at the various MDL concentration levels. Four different concentration levels of 250 µg/kg, 125 µg/kg, 50 µg/kg, and 25 µg/kg are typically sufficient to complete the MDL study.

3.2.2.1 Prepare the SS at a concentration of 10 µg/mL (Section 10.13.6.6).
3.2.2.2 Weigh 10 g of baked sand (105°C for 4 hours) into 8 different 40 mL vials.
3.2.2.3 Add 10 mL of methanol to each vial.
3.2.2.4 Add 10 µL of surrogate stock solution (Section 10.12.5) to each vial.
3.2.2.5 Add 250 µL of SS solution prepared (Section 3.2.2.1) to each vial.
3.2.2.6 Proceed as in Section 14.4.3.4 through Section 14.4.3.5.
3.2.2.7 Analyze the samples according to Section 14.4.4. Enter the data into the Excel spreadsheet to calculate the MDLs for the particular concentration level.
3.2.2.8 Prepare and analyze the remaining concentration levels of 125 µg/kg, 50 µg/kg, and 25 µg/kg if needed.

4.0 Scope and Application

4.1 This method provides for the GC/MS determination of volatile organic compounds in aqueous and solid matrices. This method is restricted to use by, or under the supervision of, analysts experienced in the use of purge and trap systems and GC/MS and skilled in the interpretation of mass spectra and their use as a quantitative tool. The reporting limits (RLs) for solid samples are reported on a dry weight basis. See Attachment 22.12 for RLs and units. The following compounds are analyzed by this method:

Analyte	Chemical Abstract Services Registry Number
Acrylonitrile	107-13-1
Acetone (2-Propanone)	67-64-1
Benzene	71-43-2
Bromobenzene	108-86-1
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9
2-Butanone (MEK)	78-93-3
n-Butylbenzene	104-51-8
sec-Butylbenzene	135-98-8
tert-Butylbenzene	98-06-6
Carbon Disulfide	75-15-0
Carbon Tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
Dibromochloromethane	124-48-1
1,2-Dibromo-3-Chloropropane	96-12-8
1,2-Dibromoethane	106-93-4
Dibromomethane	74-95-3

1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
trans-1,4-Dichloro-2-Butene	110-57-6
Dichlorodifluoromethane	75-71-8
1,1-Dichloroethane	75-34-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-2
trans-1,2-Dichloroethene	156-60-5
1,2-Dichloropropane	78-87-5
cis-1,3-Dichloropropene	10061-01-5
trans-1,3-Dichloropropene	10061-02-6
Diethylether	60-29-7
Ethylbenzene	100-41-4
Hexachloroethane	67-72-1
2-Hexanone	591-78-6
p-Isopropyl Toluene (p-Cymene)	99-87-6
Methyl Tertiary Butyl Ether (MTBE)	1634-04-4
4-Methyl-2-Propanone (MIBK)	108-10-1
Methylene Chloride	75-09-2
Methyl Iodide (Iodomethane)	74-88-4
2-Methylnaphthalene	91-57-6
Naphthalene	91-20-3
n-Propylbenzene	98-82-8
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethene	127-18-4
Tetrahydrofuran	109-99-9
Toluene	108-88-3
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,1,1-Trichloroethane	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
1,2,3-Trichloropropane	96-18-4
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene (Mesitylene)	108-67-8
Vinyl Chloride	75-01-4
o-Xylene	95-47-6
m-Xylene	108-38-3
p-Xylene	108-42-3

5.0 Method Summary

5.1 An inert gas (helium) is bubbled through a sample which has been transferred to a purging vessel. The volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile organic compounds are trapped. After purging is completed, the sorbent column is heated and backflushed with an inert gas, which desorbs the analytes into a split injector connected to a capillary column. The gas chromatograph is temperature programmed to separate the analytes which are then detected with a mass spectrometer detector. The capillary column is directly interfaced into the ion source.

5.2 Interpretations are performed by analyzing samples under the same conditions used for standards and comparing retention times, resultant mass spectra, and intensities of individual ions produced by that compound to the mass spectra response for a specific ion produced by an internal standard (IS). Quantitation is accomplished by comparing the response of a major ion relative to an IS using the initial calibration curve.

6.0 Definitions

6.1 MDL - The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

6.2 Surrogate analyte (SA) - A pure analyte which is extremely unlikely to be found in any sample and which is added to a sample aliquot in known amounts before extraction or other processing and is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

6.3 Method preparation blank (MPB) - An aliquot of a blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples.

6.4 Laboratory control sample (LCS) - An aliquot of blank matrix to which known quantities of the method analytes are added in the laboratory. The LCS is treated exactly as a sample including extraction and analysis.

6.5 Matrix spike (MS) - An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is treated exactly as a sample including extraction and analysis. The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.6 Matrix spike duplicate (MSD) - A second aliquot of sample to which known quantities of the target analytes are added in the laboratory. The MSD is treated exactly as a sample including extraction and analysis The background concentrations of the analytes in the sample must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

6.7 Initial calibration verification (ICV) – A second source standard used to check the accuracy of the calibration standards. This standard includes all target analytes and should be from a different vendor than the calibration standards.

6.8 Continuing calibration standard (CCS) – A mid-range standard to check the overall instrument performance. This includes all analytes that are to be reported.

6.9 IS – A pure analyte added to a sample, extract, or standard solution in known amounts and used to measure the relative responses of other method analytes and surrogates that are components of the same sample or solution. The IS must be an analyte that is not a sample component.

6.10 SS – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

6.11 Working standard (WS) – A solution of an analyte(s) prepared in the laboratory from SSs and diluted as needed to prepare calibration solutions and other needed analyte solutions.

6.12 System blank (SB) – An aliquot of reagent water that has not undergone any preparation and is analyzed under the same analytical conditions as a sample. The purpose of the SB is to check the purity of the water and instrument contamination.

7.0 Interferences

7.1 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running method preparation blanks (a minimum of 1 per 12-hour period).

7.2 Contamination by carryover can occur whenever high level and low level samples are sequentially analyzed. To reduce carryover, the purging vessel and sample syringe is rinsed with reagent water between sample analysis. Whenever an unusually concentrated sample is encountered, it must be followed by an analysis of reagent water to check for cross contamination. If this is not possible due to overnight unattended operation, the sample following a high-level sample is reanalyzed if detected target analytes are suspected to be due to carryover. The trap and other parts of the system are also subject to contamination. Therefore, frequent baking and purging of the entire system may be required.

7.3 The analysis for volatile organic compounds should be performed in an environment completely free of target analytes.

7.4 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the container. A trip blank

prepared from volatile-free reagent water and carried through sampling, handling, and storage can serve as a check on such contamination.

7.5 Sample containers can be a source of contamination and should be checked prior to purchase.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (SOP 100).

8.4 Gas cylinders must be secured to a wall or countertop.

8.5 Methanol and hydrochloric acid material safety data sheets (MSDSs) are attached.

8.6 Protective gloves must be worn when handling solvents.

9.0 Equipment and Supplies

9.1 Microsyringes - 5, 10, 25, 50, 100, 250, 500, and 1000 µL, 0.006 inch ID needle.

9.2 Syringes - 5 mL and 10 mL, gas-tight with luerlock ends.

9.3 Balance - Top-loading, capable of weighing $\pm$ 0.01 g.

9.4 Oven - Capable of maintaining 105°C.

9.5 Bottle top dispensers - 1 to 10 mL.

9.6 Table top fume hoods.

9.7 Weigh boats - Aluminum, capable of holding up to 10 g.

9.8 Plastic syringes - Plastic syringes with end cap and label.

9.9 Ultrasonic Waterbath.

9.10 Traps - Supelco's K-trap is packed with Carbopack B/Carboxen 1000 and 1001.

9.10.1 Trap for LSC 2000 - Part #21066-u.
9.10.2 Trap for LSC 3000 or 3100 - Part #24920-u.

9.11 Glassware

9.11.1 Vials - 40 mL, screw cap, with teflon cap liner.
9.11.2 Vials – Tared, 40 mL, screw cap, with teflon cap liner.
9.11.3 Volumetric flasks - Class A with ground-glass stoppers.
9.11.4 Vials - 2 mL crimp cap.
9.11.5 Disposable purge and trap tubes.
9.11.6 Pipettes - Class A.
9.11.7 Fitted sample purge tube – 5 mL, for Tekmar 3000, Part #22748 (Supelco).

9.12 Purge and trap devices

9.12.1 Tekmar model LSC 3000 concentrator.
9.12.2 Tekmar model LSC 2000 concentrator.
9.12.3 Tekmar model LSC 3100 concentrator.
9.12.4 Specific instrument operating conditions can be found in their respective maintenance logbooks. Typical operating conditions include:

9.12.4.1 Purge conditions
Purge gas – Helium.
Purge time - 11.0 ± 0.1 minutes.
Purge flow rate - 40 mL/min.
Purge (trap) temperature – Ambient.
MCS purge temperature – 40°C.
Prepurge time - 0.5 minutes.
Preheat time - 2.0 minutes.
Sample heater temperature – 40°C for water and soil samples (mobile lab only).

9.12.4.2 Desorb conditions
Desorb preheat temperature – 245°C.
Desorb temperature – 250°C.
Desorb flow rate - 15 mL/min.
Desorb time - 2.0 ± 0.1 minutes.
MCS desorb temperature – 40°C.

9.12.4.3 Trap reconditioning conditions
Bake temperature – 260°C.
Bake time - 8.0 minutes ± 0.1 minute.
MCS bake temperature – 260°C.

9.12.4.4 All the purge and trap and autosampler transfer lines and valves are set at a temperature of 100°C. Before initial use, condition the trap for 2 hours at 270°C by backflushing with 40 mL/min. flow of helium gas. Vent the trap effluent to the room and not to the analytical column. Prior to daily use, condition the trap by heating at 260°C for 8 minutes while backflushing. Do not vent the trap effluent into the column during bake out.

9.13 Autosamplers

9.13.1 Tekmar 2016 autosampler (available with heater jackets in the mobile laboratory) - A 16-place autosampler designed to accept 5 -10 mL samples using disposable glassware. The purge gas passes through the water column as finely divided bubbles. The purge needle has four orifices, and the base is pointed rather than tapered. The orifices are not more than 5 mm from the base of the water column. The headspace at the top of the water column is more than 15 mL in capacity.

9.13.2 Tekmar Aqua Tek 70 Liquid Autosampler - A 70-position autosampler designed to accept 40 mL screw cap vials with septa. This autosampler automatically adds 2µL of combined IS and surrogate to water samples and 2µL of IS solution to soil samples.

9.14 Gas chromatograph

9.4.1 Hewlett Packard model 5890 series II or 6890 GC - Equipped with a split/splitless capillary injector and electronic pressure controller or equivalent. The purge and trap system is directly interfaced to the injector via soft nickel tubing heated transfer line. The electronic pressure controller maintains constant pressure as the GC temperature increases during programming.

9.14.2 Specific instrument operating conditions can be found in their respective maintenance logbooks. Typical operating conditions include:

9.14.2.1 Injector conditions
Injector port temperature – 200°C.
Injector split ratio - 1:20.
Electronic pressure controller - 18 psig.

9.14.2.2 Oven
Carrier gas – Helium.
Flow rate - 1 mL/min.
Initial temperature – 30°C (40°C in the mobile lab).
Initial hold time - 4.0 minutes (± 0.1 minutes).
Ramp rate – 8°C/min.
Final temperature – 230°C.
Final hold time - 0.75 minutes.

9.15 Mass spectrometer

9.15.1 The mass spectrophotometer must be capable of scanning from 35 to 300 amu every 1 second or less, utilizing 70 volts (nominal) of electron energy in the electron impact ionization mode. It produces a mass spectrum that meets all the instrument performance criteria when 50 ng of p-bromofluorbenzene (BFB) is analyzed through the purge and trap system or directly injected via the injection port. To ensure sufficient precision of mass spectral data, the MS scan rate should allow acquisition of at least five spectra while a sample component elutes from the GC.

9.15.2 Hewlett Packard mass selective detector (MSD) model 5971.

9.15.3 Hewlett Packard MSD model 5972.

9.15.4 Hewlett Packard MSD model 5973.

9.15.5 Specific instrument operating conditions can be found in their respective maintenance logbooks. Typical operating conditions include:

9.15.5.1 Electron Energy - 70 volts (nominal).
9.15.5.2 Mass Range - 40-280 amu.
9.15.5.3 Scan Time - To give at least five scans per peak, not to exceed one second per scan.

9.16 GC/MS interface

9.16.1 The capillary column in the GC is directly interfaced into the ion source of the mass spectrometer via a heated transfer line. The transfer line temperature is 280°C.

NOTE: *The same GC conditions are used for the analysis of all standards, samples, blanks, matrix spikes, and matrix spike duplicates.*

9.17 Capillary column

9.17.1 Used on HP 5971 and HP 5972 instruments – J & W Scientific DB-5 narrow bore capillary column, 60 m long x 0.25 mm ID x 1 μm film thickness or equivalent.
9.17.2 Used on HP 5973 instruments - J & W Scientific DB-624 narrow bore capillary column, 25 m long x 0.2 mm ID x 1.12 μm film thickness or equivalent.

9.18 Data system - A personal computer is interfaced to the whole GC/MS and purge and trap system. The computer system is equipped with an assortment of disk drives, a hard drive, and tape back-up accessories. The software (HPCHEMPC with Enviroquant) is from Hewlett Packard and is multitasking and window driven. This software allows for searches of any GC/MS data file for ions of a specified mass, and it plots such ion abundance versus time or scan number. This type of plot is defined as an extracted ion current profile (EICP). The software also allows integration of the abundance of any EICP between specified time or scan number limits. In addition, it allows the tentative identification (TIC) of non-target compounds by comparing the unknown mass spectra with that of a reference library.

9.19 Dessicator and dessicant.

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to that standard. Original certificates are kept by the Laboratory's QA/QC Officer.

10.6 Reagent water - Organic-free reagent water.

10.7 Hydrochloric acid, (1:1 v/v) HCL - Carefully add concentrated hydrochloric acid to an equal volume of reagent water.

10.8 Sand - Free of volatile organic compounds and stored in a 105°C oven.

10.9 Helium – Ultra-high purity.

10.10 Nitrogen – Ultra-high purity.

10.11 Methanol.

10.11.1 Purge and trap grade, demonstrated to be free of analytes.
10.11.2 10 mL teflon tubes containing purge and trap grade methanol, demonstrated to be free of analytes.

10.12 Stock standards (SSs) - All standards must be certified reference materials. Manufacturer's certificates of analysis are retained by the Laboratory and kept as part of the overall QA/QC requirements. All SSs must be given a unique lab tracking number and logged into the SS tracking logbook. Store SSs in amber sealed ampules at 10°C to 20°C. Protect the standards from light. All standards are received in methanol.

10.12.1 SSs (2000 µg/mL in methanol) - SSs are purchased as mixes at 2000 µg/mL in methanol. These mixtures are purchased in sealed ampules and are stored in a freezer at a temperature lower than 0°C.
10.12.2 Calibration standards (2000 µg/mL)

10.12.2.1 Gas standard - Ultra Scientific part # CUS-1153 or equivalent.

bromomethane	dichlorodifluoromethane
chloroethane	vinyl chloride
chloromethane	

10.12.2.2 62 component standard - Ultra Scientific part # 011200MQ or equivalent. See Attachment 22.11 for compound list.

10.12.3 ICV at 2000 µg/mL.

10.12.3.1 Gas standard - Absolute Part # 30058 or equivalent.

bromomethane	dichlorodifluoromethane
chloroethane	trichlorofluoromethane
chloromethane	vinyl chloride

10.12.3.2 Ketones – Absolute Part # 82402 or equivalent.

acetone
2-butanone (methyl ethyl ketone)
2-hexanone
4-methyl-2-pentanone

10.12.3.3 57 component standard - Absolute Part # 92516 or equivalent. See Attachment 22.13 for compound list.

10.12.4 Internal standard – Restek, Part # 30174 or equivalent. The IS is at a concentration of 2500 µg/mL and contains:

chlorobenzene-d5	1,4-dichlorobenzene-d4
1,4-difluorobenzene	pentafluorobenzene

10.12.5 Surrogate stock solution - Restek Part # 30073 or equivalent. Surrogate stock solution is at a concentration of 2500 µg/mL and contains:
dibromofluoromethane toluene-d8
4-BFB

10.12.6 Tuning standard - Ultra Scientific Part # STS-110N or equivalent. The tuning standard is at a concentration of 2000 µg/mL and contains:
4-BFB

10.12.7 Matrix spiking solutions (1000 µg/mL)

10.12.7.1 SW-846 list - Ultra Scientific Part # CLP-100N or equivalent.

1,1-dichloroethene	trichloroethene
chlorobenzene	toluene
benzene	

10.12.7.2 TCLP list - Ultra Scientific Part # TCLP-500 or equivalent.

benzene	2-butanone
carbon tetrachloride	chlorobenzene
chloroform	1,4-dichlorobenzene
1,2-dichlorobenzene	1,1-dichloroethylene
tetrachloroethylene	trichloroethylene
vinyl chloride	

10.12.7.3 Full list - See Section 10.13.5.

10.13 Intermediate and working standards - All prepared standards must be given a unique laboratory tracking number and logged into the volatile standards logbook. Store intermediate and working solutions in 2 mL teflon-sealed crimp cap vials with minimal headspace at -10°C to -20°C. The intermediate standards must be checked frequently for signs of degradation or evaporation. Fresh standards should be prepared if a check exceeds a 20% drift. All standards are good for up to a maximum of six months. Recapping the vials at appropriate intervals after repeated usage will minimize loss of early eluting compounds in the standards.

10.13.1 Tuning standard

10.13.1.1 Intermediate BFB solution (200 µg/mL) - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 1000 µL of the stock

standard of BFB (Section 10.12.6) directly into the methanol in the volumetric flask. Bring to volume with methanol.

10.13.1.2 BFB working standard (25 µg/mL) - Place approximately 40 mL of methanol into a 50 mL volumetric flask. Inject 1.25 mL (1000 µL) of intermediate BFB solution (Section 10.13.1.1) directly into the methanol in the volumetric flask. Bring to volume with methanol. Prepare fresh BFB solution every six months or sooner if the solution has degraded or evaporated.

NOTE: *For purge and trap analysis, a 2 µL injection of the 25 µg/mL solution is mixed with 5 mL of reagent blank water, or 2 µL is injected directly through the injection port of the GC.*

10.13.2 IS solution (50 µg/mL) - Place approximately 40 mL of methanol into a 50 mL volumetric flask. Inject 1000 µL of stock IS (Section 10.12.4) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.13.3 Combined surrogate and IS solution

10.13.3.1 50 µg/mL - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 200 µL of stock IS (Section 10.12.4) and 200 µL of stock surrogate solution (Section 10.12.5) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.13.3.2 125 µg/mL - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 500 µL of stock IS (Section 10.12.4) and 500 µL of stock surrogate solution (Section 10.12.5) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.13.4 Matrix spike solution (50 µg/mL)

10.13.4.1 SW-846 List - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 500 µL of matrix spiking solution (Section 10.12.7.1) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.13.4.2 TCLP list - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 500 µL of matrix spiking solution (Section 10.12.7.2) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

10.13.5 Intermediate ICV and full list matrix spike solution - Place approximately 8 mL of methanol into a 10 mL volumetric flask. Inject 250 µL of each stock ICV (Section 10.12.3.1, Section 10.12.3.2, and Section 10.12.3.3) directly into the methanol in the volumetric flask. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared solution into crimp cap vials. Cap each vial securely Label. Store in a freezer.

10.13.6 Intermediate calibration standards - Carefully rinse five 10 mL volumetric flasks with methanol. Bake at 125°C for at least one hour. Place approximately 8 mL of methanol into each volumetric flask. Transfer the contents of the stock standard ampules (Section 10.12.2.1 and Section 10.12.2.2) into crimp cap vials. Inject the amount of each SS directly into the methanol in the volumetric flasks according to the list below. Bring to volume with methanol. Mix by inverting the flask three times. Distribute each prepared intermediate calibration standard into crimp cap vials. Cap each vial securely. Label. Store in a freezer.

	Intermediate Standard Final Conc. (µg/mL)	SS (Sections 10.12.2.1 and 10.12 2.2 to add (µL)	Final Volume (mL)
10.13.6.1	1	5	10
10.13.6.2	5	25	10
10.13.6.3	20	100	10
10.13.6.4	50	250	10
10.13.6.5	100	500	10
10.13.6.6	10	50	10

NOTE: *Recap vials each time the septum on the cap is pierced by a syringe. This will keep the gases from escaping from the standard.*

11.0 Sample Collection, Preservation, and Handling

11.1 Aqueous samples - Aqueous samples should be introduced into 40 mL glass screw-cap VOA vials with teflon-lined silicone septa. This should be done gently to reduce agitation, which might drive off volatile compounds. Each VOA vial should be filled until there is a meniscus over the lip of the vial. The screw-top lid with the septum (teflon side toward the sample) should then be tightened onto the vial. After tightening the lid, the vial should be inverted and tapped to check for air bubbles. If there are any air bubbles present, the sample must be recollected. Two VOA vials should be filled per sample location. VOA vials should be filled and labeled immediately at the point at which the sample is collected. They should not be filled near a running motor or any type of exhaust system because discharged fumes and vapors may contaminate the samples. The two vials from each sampling location should then be sealed in separate plastic bags to prevent cross-contamination between samples, particularly if the sampled waste is suspected of containing high levels of volatile organic compounds. VOA samples may also be contaminated by diffusion of volatiles through the septum.

11.2 Solid samples - Approximately 10 g of solid sample is collected in a plastic syringe. The sample is then transferred to a tared 40 mL glass screw-cap VOA vial with teflon-lined silicone septa. A teflon tube containing 10 mL of purge and trap grade methanol

is opened and added to the sample container. The sample container is capped and labeled. Care must be taken to ensure that the vial seals properly, and excess soil must be wiped from the threads of the vial. The syringe is then filled with solid from the same location, capped, and labeled to be used to determine percent solids.

11.3 Oil samples – Collect in a 40 mL glass screw-cap VOA vial with teflon-lined silicone septa.

11.4 Aqueous samples do not need any preservatives if they will be analyzed within seven days. If aqueous samples are not analyzed within seven days for aromatic compounds, they must be preserved with five drops of 1:1 hydrochloric acid at the time of collection. Samples must be stored at 4°C.

11.5 Solid samples must be preserved with methanol. All samples must be maintained at 4°C.

11.6 Holding times - The holding time for properly-preserved volatile organic compounds is 14 days from the sampling date.

12.0 Quality Control (QC)

12.1 BFB performance criteria - The BFB must meet the criteria in Section 13.1 before any standards, blanks, or samples are analyzed. A BFB analysis must be performed every 12-hour shift.

12.2 Sample batches

12.2.1 Sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS.

12.2.2 MSs and MSDs are actual samples that are selected at random from within the batch of 20.

12.2.3 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction of individual samples.

12.2.4 The MS, MSD, and LCS are spiked at a known concentration with the analyte compounds. The replicate MSs are used to evaluate the entire batch for precision and accuracy.

12.3 Initial calibration standards

12.3.1 A set of 6 (1, 5, 20, 50, 100, and 200 µg/L) calibration standards are analyzed. See Section 15.1 for RF calculations and Section 18.2 for acceptance criteria. A five- or six-point initial calibration curve is used to determined the average RF for each analyte.

12.3.2 Upon completion of the initial calibration, samples may be analyzed if time remains in the 12-hour time period.

12.4 CCS – A check of the calibration curve must be performed once every 12 hours. It is not necessary to analyze a CCS within the 12-hour time period in which the initial calibration was performed. Calculate the RFs for all analytes in the CCS. If the criteria in Section 18.3 is met, the initial calibration curve is considered to still be valid.

12.5 Blanks – An SB or MPB must be analyzed after the CCS. A blank must be analyzed every 12 hours to show that the analytical system is free from interferences and contamination. A blank will be run more frequently if contamination is a concern. The blank will be carried through all the purge and trap system steps and will be spiked with IS and surrogate (Section 14.1 and Section 14.2). If the criteria in Section 18.7 or Section 18.8 is met, the analysis of samples can begin.

12.6 MS

12.6.1 The laboratory analyzes a MS and MSD at a minimum of once every 20 water or solid samples to assess precision and accuracy. See Section 14.4.1 and Section 14.4.2 for water samples and Section 14.4.4 and Section 14.4.5 for solid samples.

12.6.2 Do not reanalyze the MS or MSD if the system monitoring compound recoveries are outside the limits.

12.6.3 If the sample associated with the MS and MSD does not meet specifications (Section 18.4), it should be reanalyzed only if the MS/MSD system monitoring compound recoveries are within the limits. If the sample and associated MS/MSD show the same pattern (i.e., outside the limits), the sample does not require reanalysis.

12.7 LCS

12.7.1 One LCS must be prepared for every batch of samples.

12.7.2 The LCS is prepared in reagent water for water samples as in Section 14.4.1.13 and Section 14.4.2.8.

12.7.3 The LCS is prepared in methanol for solid samples as in Section 14.4.4.6 and Section 14.4.5.7.

12.7.4 The LCS is spiked with the same spiking solution used for the MS and MSD.

12.7.5 See Section 18.4 for acceptance criteria.

12.8 IS - IS responses and retention times in all standards must be evaluated during or immediately after data acquisition. If the retention time for any IS changes by more than 0.50 minutes (30 seconds) from the most recent continuing (12-hour) calibration standard, the chromatographic system must be inspected for malfunctions, and corrections must be made as required. The extracted ion current profile (EICP) of the ISs must be monitored and evaluated for each standard. If the EICP area for any IS changes by more than a factor of 2 (-50% to +100%), the mass spectrometric system must be inspected for malfunction, and corrections must be made as appropriate. When corrections are made, reanalysis of those samples analyzed while the system was malfunctioning is necessary.

12.9 ICV - This is analyzed after every initial calibration and at least once per quarter. The ICV may be analyzed in place of the CCS. See Section 18.3 for acceptance criteria.

12.10 The sample analyzed immediately after a contaminated sample must be evaluated for contamination. Reanalyze if any analytes are reportable. An instrument blank will be analyzed on the same purge vessel where the contaminated sample was analyzed if a 2016 autosampler was used. No samples will be analyzed on that particular purge vessel until the system has been properly purged of contaminants. Blanks will be analyzed on the Aquatek 70 until the system is clean.

12.11 IDOA - Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for the target analytes. This is accomplished by preparing and analyzing four aliquots of a reference sample.

12.11.1 Aqueous reference sample on a 2016 autosampler

12.11.1.1 Remove the plunger from a 5 mL gas tight syringe. Plug the end of the syringe. Pour reagent water into the syringe barrel to just short of overflowing. Replace the syringe plunger. Compress the sample. Compress the sample venting any residual air while adjusting the sample volume to 5.0 mL. Care must be taken to prevent air from leaking into the syringe.

12.11.1.2 Inject 5.0 µL of the combined surrogate and IS solution (Section 10.13.3.1) through the luerlock end of the syringe. This is equivalent to a concentration of 50 µg/L.

12.11.1.3 Inject 5 µL of intermediate secondary calibration source standard (Section 10.13.6.4) through the luerlock end of the syringe. This prepares a 50 µg/L solution.

12.11.1.4 Attach the syringe luerlock to the syringe valve on the purge and trap. Inject the sample into the purging chamber. Close the purge valve before removing the syringe. Follow the conditions for the purge and trap system. After the trap has finished the bake cycle, remove and dispose of the purge tube. Rinse the purge needle with two 5 mL flushes of reagent water.

12.11.2 Aqueous reference sample on an Aquatek 70 autosampler

12.11.2.1 Place approximately 40 mL of reagent water into a 50 mL volumetric flask.

12.11.2.2 Inject 50 µL of intermediate secondary calibration source standard (Section 10.13.6.4) into the water in the volumetric flask. This prepares a 50 µg/L solution.

12.11.2.3 Dilute to the mark with reagent water. Cap. Invert three times to mix.

12.11.2.4 Pour into a 40 mL volatile vial until overflowing. Cap the vial. Invert to ensure that no bubbles are present.

12.11.2.5 Place on the aquatek 70 for analysis.

12.11.3 Calculate the average recovery of each compound (Section 15.8) and average the four results. Compare to laboratory generated limits.

12.11.4 Calculate the standard deviation (SD) of each compound (Section 15.3) and compare to laboratory generated limits.

12.12 Surrogates – Surrogate compounds are added to all samples, MPBs, MSs, MSDs, and LCSs. Surrogate recovery data is compared to in-house generated limits (Section 18.10).

13.0 Calibration and Standardization

13.1 BFB tuning analysis - Prior to the analyses of any samples, blanks, calibration standards, or QA/QC samples, the GC/MS system must meet the mass spectral ion abundance criteria for the instrument performance check solution containing 4-BFB. This analysis can be performed by one of the following procedures: Section 13.1.1, Section 13.1.2, or Section 13.1.3.

13.1.1 Direct inject 2 µL of a 25 µg/mL solution of BFB (Section 10.13.1.2) into the GC/MS via the GC injection port

OR

13.1.2 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL. Inject 2 µL of the 25 µg/mL solution of BFB (Section 10.13.1.2) into the syringe. Attach the syringe to the valve assembly of the purge and trap 2016 autosampler. Open the valve. Inject the sample into the purging tube. Close the valve. Start the purge and trap.

OR

13.1.3 Place approximately 40 mL of reagent water into a 50 mL volumetric flask. Inject 20 µL of the 25µ/mL solution of BFB (Section 10.13.1.2) into the water in the volumetric flask. Dilute to the mark with reagent water. Cap. Invert three times to mix. Transfer to a 40 mL volatile vial without headspace. Place on an Aquatek 70 autosampler for analysis.

Note: *Do not add IS/Surrogate solution.*

13.1.4 The mass spectrum and ion abundance criteria of BFB are determined by averaging three scans (the scan at the apex, the scan preceding the apex, and the scan following the apex). Background subtraction is performed using a single scan no more than 20 scans prior to the elution of BFB.

13.1.5 The analysis of the instrument performance check solution (BFB) must meet the ion abundance criteria given below.

Mass	Ion abundance criteria
50	15 - 40.0 percent of mass 95
75	30.0 - 60.0 percent of mass 95
95	Base peak, 100 percent relative abundance
96	5.0 - 9.0 percent of mass 95 (see note)
173	Less than 2.0 percent of mass 174
174	Greater than 50 percent of mass 95
175	5.0 - 9.0 percent of mass 174
176	95.0 - 101.0 percent of mass 174
177	5.0 - 9.0 percent of mass 176

NOTE: *All ion abundances must be normalized to m/z 95 (the nominal base peak) even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.*

13.1.6 The tuning standard (BFB) is analyzed once at the beginning of each 12-hour period in which samples, blanks, or standards are to be analyzed. The 12-hour time period starts with the injection of BFB. The time period ends after 12 hours have elapsed. If the analysis of a sample starts within the first 12-hour period but ends past the first 12-hour period, the last sample is considered to have been analyzed within the first 12-hour period.

13.2 Initial calibration curve - Prior to the analysis of samples and after the tuning criteria has been met, the GC/MS system is calibrated. A six-point calibration curve (1, 5, 20, 50, 100, and 200 µg/L) is analyzed to determine instrument sensitivity and linearity of the GC/MS. ISs and surrogates are in each standard and blank at a constant concentration of 50 µg/L throughout the curve. The initial calibration is performed whenever the CCS (daily) fails to meet acceptance criteria or when major instrument repairs are made.

13.2.1 Initial calibration preparation for use on a 2016 autosampler

13.2.1.1 For each point in the calibration curve fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL.

13.2.1.2 Inject 5 µL of combined surrogate and IS solution (Section 10.13.3.1) directly into the water in each syringe.

13.2.1.3 Inject the volumes listed below of each intermediate standard directly into the water in the syringe. If this is a calibration curve for solid samples, add the additional volume of methanol listed.

Intermediate Calibration Standard	µL of Intermediate Calibration Standard	µL of Methanol (Solid curves only)	Final Conc. (µg/L)
10.13.6.1	5	95	1.0
10.13.6.2	5	95	20
10.13.6.4	5	95	50
10.13.6.5	5	95	100
10.13.6.5	10	90	200

13.2.1.4 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Start the purge and trap.

NOTE: *The additional methanol is added to keep the volume of methanol constant in the solid samples and standards. Standards may be kept in the purge tube for up to 12 hours when connected to the autosampler and purge and trap device.*

13.2.2 Initial calibration preparation for use on an Aquatek 70 autosampler

13.2.2.1 For each point in the calibration curve place 40 mL of reagent water into a 50 mL volumetric flask.

13.2.2.2 Inject the volumes listed below of each intermediate standard directly into the water in the volumetric flask. If this is a calibration curve for solid samples, add the additional volume of methanol as listed and also add 50µL of IS solution (Section 10.13.2).

Intermediate Calibration Standard	µL of Intermediate Calibration Standard	µL of Methanol (Solid curves only)	Final Conc. (µg/L)
10.13.6.1	50	950	1.0
10.13.6.2	50	950	5.0
10.13.6.3	50	950	20
10.13.6.4	50	950	50
10.13.6.5	50	950	100
10.13.6.5	100	900	200

13.2.2.3 Dilute to the mark with reagent water. Cap. Invert three times to mix.

13.2.2.4 Transfer to a 40 mL volatile vial without headspace.

13.2.2.5 Place on the Aquatek 70 and analyze.

13.2.3 Calculate the RF for every analyte in each standard as in Section 15.1.

13.2.4 Calculate the average RF for each analyte as in Section 15.2.

13.2.5 Calculate the SD for each analyte as in Section 15.3.

13.2.6 Calculate the %RSD for each analyte as in Section 15.4.

13.2.7 Evaluate the initial calibration as in Section 18.2. If the criteria is met, analysis of the ICV may proceed.

13.3 ICV - The ICV is analyzed after every acceptable initial calibration to verify the accuracy of the initial calibration standards.

13.3.1 ICV Preparation for use on a 2016 autosampler.

13.3.1.1 Fill a 5 mL syringe barrel with reagent water until it overflows.

13.3.1.2 Replace the syringe plunger. Adjust the sample volume to 5 mL.

13.3.1.3 Inject 5 µL of combined surrogate and IS solution (Section 10.13.3.1) directly into the water in the syringe.

13.3.1.4 Inject 5 µL of intermediate ICV (Section 10.13.5) directly into the water in the syringe. If this is to verify an initial calibration curve for solids, add 90 µL of methanol directly into the water in the syringe.

NOTE: *The additional methanol is added to keep the volume of methanol constant.*

13.3.1.5 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Start the purge and trap. Standards may be kept in the purge tube for up to12 hours when connected to the autosampler and purge and trap device.

13.3.2 ICV Preparation for use on an Aquatek 70 autosampler

13.3.2.1 Place 40 mL of reagent water into a 50 mL volumetric flask.

13.3.2.2 Inject 50 µL of intermediate ICV (Section 10.13.5) directly into the water in the volumetric flask. If this is to verify an initial calibration curve for solids, add 950 µL of methanol and also add 50µL of IS solution (Section 10.13.2).

13.3.2.3 Dilute to the mark with reagent water. Cap. Invert three times to mix.

13.3.2.4 Transfer to a 40 mL volatile vial without headspace.

13.3.2.5 Place on the Aquatek 70 and analyze.

13.3.3 Calculate the recovery of each analyte as in Section15.8.

13.3.4 Evaluate the ICV as in Section 18.3. If the ICV meets the criteria, proceed with Section 14.

14.0 Procedure

14.1 SB - Reagent water containing surrogates and ISs is analyzed once every 12-hour shift in which water samples are analyzed. An instrument blank is also analyzed after an initial calibration curve for waters. The instrument blank ensures that the system is free of contamination.

14.1.1 SB preparation for use on a 2016 autosampler

14.1.1.1 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL.

14.1.1.2 Inject 5 µL of combined surrogate and IS solution (Section 10.13.3.1) directly into the water in the syringe.

14.1.1.3 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Close the valve. Start the purge and trap. An instrument blank will be analyzed more frequently if contamination is suspected from a high level sample.

14.1.2 SB preparation for use on an Aquatek 70 autosampler

14.1.2.1 Fill a 40 mL vial with reagent water and cap.
14.1.2.2 Place on the Aquatek 70 and analyze.

14.2 MPB - A MPB is analyzed only if solid samples are to be analyzed. Reagent water containing surrogates, ISs, and methanol is analyzed once every 12-hour shift in which solid samples are analyzed. The method blank ensures that the system is free of contamination.

14.2.1 MPB for use on a 2016 autosampler

14.2.1.1 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL.
14.2.1.2 Inject 5 µL of combined surrogate and IS solution (Section 10.13.3.1) directly into the water in the syringe.
14.2.1.3 Inject 95 µL of methanol directly into the water in the syringe.
14.2.1.4 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Close the valve. Start the purge and trap. A method blank may be analyzed more frequently if contamination is suspected from a high level sample.

14.2.2 MPB for use on an Aquatek 70 autosampler

14.2.2.1 Place 40 mL of reagent water into a 50 mL volumetric flask.
14.2.2.2 Inject 50µL of IS solution (Section 10.13.2) directly into the water in the volumetric flask.
14.2.2.3 Inject 950 µL of methanol directly into the water in the volumetric flask.
14.2.2.4 Dilute to the mark with reagent water. Cap. Invert three times to mix.
14.2.2.5 Transfer to a 40 mL volatile vial without headspace.
14.2.2.6 Place on the Aquatek 70 and analyze using the soil method.

14.3 CCS - The CCS verifies that the initial calibration curve is still valid. It is analyzed once every 12-hour shift. The concentration is 50 µg/L and is prepared the same as in Section 13.2.1 and Section 3.2.2.

NOTE: *An ICV (Section 13.3) may be analyzed in place of the CCS.*

14.3.1 Calculate the RF of each compound as in Section 15.1.
14.3.2 Evaluate the data as in Section 18.3. If the criteria is met, proceed with Section 14.4.

14.4 Sample analysis

14.4.1 Aqueous sample preparation for use on a 2016 autosampler

14.4.1.1 All aqueous samples must be allowed to warm to ambient temperature before analysis.

14.4.1.2 Remove the plunger from a 5 mL gas tight syringe. Plug the end of the syringe. Open the sample bottle. Carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Compress the sample venting any residual air while adjusting the sample volume to 5.0 mL. Care must be taken to prevent air from leaking into the syringe.

14.4.1.3 Inject 5.0 µL of the combined surrogate and IS solution (Section 10.13.3.1) through the luerlock end of the syringe. This is equivalent to a concentration of 50 µg/L.

14.4.1.4 Attach the syringe luerlock to the syringe valve on the purge and trap. Inject the sample into the purging chamber. Close the purge valve before removing the syringe. Follow the conditions for the purge and trap system. After the trap has finished the bake cycle, remove and dispose of the purge tube. Rinse the purge needle with two 5 mL flushes of reagent water.

14.4.1.5 If a dilution of the sample is required because of the presence of high level contaminants, the dilution is made just prior to GC/MS analysis of the sample. All steps in the dilution procedure must be performed without delays until the point at which the diluted sample is in the purge chamber.

14.4.1.6 All dilutions are made using gas tight syringes. Dilutions are made by filling a gas tight syringe with reagent water and adjusting the plunger to a specific volume depending upon the dilution factor desired (i.e., if a 1:5 dilution of a sample is required, the volume of the plunger is brought up to the 4 mL mark). Making sure there is no residual air in the syringe system, open the vial from which the desired dilution is required. Insert the luerlock end of the syringe into the water sample. Very carefully withdraw 1 mL of sample into the syringe barrel. Make sure that no air is withdrawn during this procedure. If air is allowed during this process, the entire procedure must be repeated.

14.4.1.7 For dilutions greater than 1:5, the same procedure outlined above is followed with the exception that gas tight syringes are used for introducing the sample (i.e., for a 1:100 dilution, adjust the volume of reagent water as outlined above to 5.0 mL). Use a syringe to pierce the teflon portion of the cap. Withdraw 50 µL of sample from the VOA vial without removing the cap. Insert the needle portion of the syringe through the luerlock end of the syringe. Inject the contents into the water in the barrel. Inject 5 µL of combined surrogate and IS solution (Section 13.3.3.1) into the syringe. Analyze as in Section 14.4.1.4.

14.4.1.8 The following table provides a guide for the dilutions to be made using the procedures outlined above:

Dilution	µL of Sample	Reagent water (mL)
1:10	500	4.50
1:20	250	4.75
1:50	100	4.90
1:100	50	5.00

1:200	25	5.00
1:250	20	5.00
1:500	10	5.00
1:1000	5	5.00

14.4.1.9 Volumetric flasks are required for dilutions greater than 1:1000.

14.4.1.10 Never use a sample volume less than 5 µL when making a dilution. Any volume less than 5 µL may not be representative enough of the sample being diluted.

14.4.1.11 Proceed with the purge and trap analysis as described in Section 14.4.1.4.

14.4.1.12 At a minimum, 1 pair of MS samples per 20 samples should be analyzed.

14.4.1.12.1 Prepare MS and MSD aqueous samples as in Section 14.4.1.1 through Section 14.4.1.3.

14.4.1.12.2 Inject 5 µL of only one MS solution listed below into each of the 5 mL aliquots of the sample chosen for matrix spiking.

14.4.1.12.2.1 Use the MS solution 10.13.4.2 to spike TCLP or SPLP extracts.

14.4.1.12.2.2 Use the MS solution 10.13.5 (full list) to spike aqueous samples that are used for NPDES permits.

14.4.1.12.2.3 Use the MS solution 10.13.4.1 (SW-846 list) for all other samples. Disregarding any dilutions, this is equivalent to a concentration of 50 µg/L of each matrix spike compound.

14.4.1.12.2.4 Proceed as in Section 14.4.1.4.

14.4.1.12.2.5 Calculate recovery of each spiked compound as in Section 15.7.

14.4.1.12.2.6 Calculate the relative percent difference (RPD) as in Section 15.9.

14.4.1.12.2.7 Evaluate recovery and RPD as in Section 18.4.

14.4.1.13 LCS - One LCS must be prepared for every MS/MSD prepared.

14.4.1.13.1 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL.

14.4.1.13.2 Inject 5 µL of combined surrogate and IS solution (Section 13.3.3.1) directly into the water in the syringe.

14.4.1.13.3 Inject 5 µL of the same MS solution used for the sample MS/MSD in Section 14.4.1.12.

14.4.1.13.4 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Start the purge and trap. A blank will be

analyzed more frequently if contamination is suspected from a high level sample.

14.4.1.13.5 Calculate recovery of each spiked compound as in Section 15.8.

14.4.1.13.6 Evaluate recovery as in Section 18.4.

14.4.2 Aqueous sample preparation for use on an Aquatek 70 autosampler

14.4.2.1 Place sample vials directly into the vial tray on the Aquatek 70 and analyze.

14.4.2.2 If a dilution of the sample is required because of the presence of high level contaminants, the dilution is made just prior to GC/MS analysis of the sample. All steps inthe dilution procedure must be performed without delays until the point at which the diluted sample is into a 40 mL vial.

14.4.2.3 Place 40 mL of reagent water into a 50 mL volumetric flask. Pipet or inject the volume of sample needed for the desired dilution directly into the water in the volumetric flask.

14.4.2.4 The following table provides a guide for the dilutions to be made using the procedures outlined above:

Dilution	mL of Sample
1:10	5
1:20	2.5
1:50	1
1:100	0.5
1:200	0.25
1:250	0.2

14.4.2.5 Dilute to the mark with reagent water. Cap. Invert three times to mix. Transfer to a 40 mL volatile vial without headspace.

14.4.2.6 Place on the Aquatek 70 and analyze using the water method.

14.4.2.7 MS – At a minimum, 1 pair of MS samples per 20 samples should be analyzed.

14.4.2.7.1 Inject 40 µL of only one MS solution listed below into the extra vial of sample chosen for the MS.

14.4.2.7.1.1 Use the MS solution 10.13.4.2 to spike TCLP or SPLP extracts.

14.4.2.7.1.2 Use the MS solution 10.13.5 (full list) to spike aqueous samples that are used for NPDES permits.

14.4.2.7.1.3 Use the MS solution 10.13.4.1 (SW-846 list) for all other samples.

14.4.2.7.2 Disregarding any dilutions, this is equivalent to a concentration of 50 µg/L of each matrix spike compound.

14.4.2.7.3 Place on the Aquatek 70 and analyze.

14.4.2.7.4 Calculate recovery of each spiked compound as in Section 15.7.

14.4.2.7.5 Calculate the relative percent difference (RPD) as in Section 15.9.

14.4.2.7.6 Evaluate recovery and RPD as in Section 18.4.

14.4.2.8 LCS - One LCS must be prepared for every MS/MSD prepared.

14.4.2.8.1 Inject 40 µL of the same MS solution chosen in Section 14.4.2.7 in a 40 mL vial filled with reagent water.

14.4.2.8.2 Place on the Aquatek 70 and analyze.

14.4.2.8.3 Calculate recovery of each spiked compound as in Section 15.8.

14.4.2.8.4 Evaluate recovery as in Section 18.4.

14.4.3 Solid sample preparation

14.4.3.1 Record all sample extraction information in the methanol extraction logbook (Attachment 22.15). Solid samples should be field preserved with methanol. If samples are preserved in the laboratory it must be noted on the final report.

14.4.3.2 Weigh the 40 mL sample vial. Subtract the tare weight of the vial and the weight of 10 mL of methanol to obtain the actual weight of the solid sample. Determine if the solid to methanol ratio is 1:1. Add additional methanol in 1 mL increments if sample weighs more than 10 g to obtain a 1:1 ratio.

14.4.3.3 Add 1.0 µL of surrogate stock solution (Section 10.12.5) to the sample vial for every 1 mL of methanol in the container (i.e., 10 µL of surrogate solution to 10 mL of methanol).

14.4.3.4 Shake the sample for two minutes. Sonicate the sample for 20 minutes.

14.4.3.5 Allow the sample and methanol to separate. Remove 1 to 2 mL of the methanol extract. Place the extract in a crimp cap vial. Place in a freezer until analysis.

14.4.4 Solid sample preparation for use on a 2016 autosampler

14.4.4.1 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the sample volume to 5 mL.

14.4.4.2 Inject 5 µL of IS solution (Section 10.13.2) directly into the water in the syringe.

14.4.4.3 Inject up to 100 µL of the methanol sample extract (Section 14.4.3.5) directly into the water in the syringe. Add additional methanol to obtain a total of 100 µL if less than 100 µL of extract is used.

14.4.4.4 Attach the syringe luerlock to the syringe valve on the purge and trap. Inject the sample into the purging chamber. Close the purge valve

before removing the syringe. Follow the conditions for the purge and trap system. After the trap has finished the bake cycle, remove and dispose of the purge tube. Rinse the purge needle with two 5 mL flushes of reagent water.

14.4.4.5 MS - At a minimum, 1 pair of MS samples per 20 samples should be analyzed.

14.4.4.5.1 Prepare the sample to be spiked as in Section 14.4.4.1 through Section 14.4.4.3.

14.4.4.5.2 Inject 5 µL of the MS solution (Section 10.13.4.1) directly into the water in the syringe.

14.4.4.5.3 Repeat Section 14.4.4.4. Disregarding any dilutions, this is equivalent to a concentration of 2500 µg/Kg of each MS compound.

14.4.4.5.4 Calculate recovery of each spiked compound as in Section 15.7.

14.4.4.5.5 Calculate the RPD as in Section 15.9.

14.4.4.5.6 Evaluate recovery and RPD as in Section 18.4.

14.4.4.6 LCS - One LCS must be prepared for every MS/MSD prepared.

14.4.4.6.1 Fill a 5 mL syringe barrel with reagent water until it overflows. Replace the syringe plunger. Adjust the volume to 5 mL.

14.4.4.6.2 Inject 5 µL of combined surrogate and IS solution (Section 10.13.3.1) directly into the water in the syringe.

14.4.4.6.3 Inject 95 µL of methanol directly into the water in the syringe.

14.4.4.6.4 Inject 5 µL of the MS solution (Section 10.13.4.1) directly into the water in the syringe.

14.4.4.6.5 Attach the syringe to the valve assembly of the purge and trap. Open the valve. Inject the sample into the purging tube. Close the valve. Start the purge and trap.

14.4.4.6.6 Calculate recovery of each spiked compound as in Section 15.8.

14.4.4.6.7 Evaluate recovery as in Section 18.4.

14.4.5 % total solids (%TS)

14.4.5.1 Complete a sediment preparation sheet (Attachment 22.21).

14.4.5.2 Assign a run number. Record the date, run number, and the log number in the %TS book.

14.4.5.3 Weigh a certified 20 g and 50 g standard weight. Record.

14.4.5.4 Record the temperature of the oven (over 105°C for volatiles).

14.4.5.5 Perform one or two blank aluminum weight boats (WBs).

14.4.5.6 Perform one sample duplicate (precision control) for every ten samples.

14.4.5.7 Weigh a WB. Do not tare. Record as tare weight.

14.4.5.8 Add the sample from the capped syringe (approximately 10 g). Record as wet weight.

14.4.5.9 Place the sample in an oven set at 105°C for several hours or overnight.

14.4.5.10 Remove the WB from the oven. Place in a dessicator to cool (approximately one hour).

14.4.5.11 Reweigh the 20 g and 50 g standard weights. Record the oven temperature.

14.4.5.12 Weigh the WB with dried sample. Record as dry weight.

14.4.5.13 Enter results in an Excel spreadsheet (p:\exeldata\ts_runskln).

14.4.5.14 Enter the spreadsheet results into LabVantage under %TS.

14.4.5.15 Submit a copy of the Excel results to the Inorganic Unit Manager. Place a copy in the %TS book.

14.4.5.16 Record any comments regarding the sample matrix or any relevant odor information while weighing the soil.

14.4.6 Solid sample preparation for use on an Aquatek 70 autosampler

14.4.6.1 Place 40 mL of reagent water into a 50 mL volumetric flask.

14.4.6.2 Inject up to 1 mL of methanol sample extract (Section 14.4.3.5) directly into the water in the volumetric flask. Add additional methanol to obtain a total of 1 mL if less than 1 mL of extract is used.

14.4.6.3 Dilute to the mark with reagent water. Cap. Invert three times to mix.

14.4.6.4 Transfer to a 40 mL volatile vial without headspace.

14.4.6.5 Place on the Aquatek 70 and analyze using the soil method.

14.4.6.6 MS - At a minimum, 1 pair of MS samples per 20 samples should be analyzed.

14.4.6.6.1 Prepare the sample to be spiked as in Section 14.4.6.1 through Section 14.4.6.2.

14.4.6.6.2 Inject 50 µL of the MS solution (Section 10.13.4.1) directly into the water in the volumetric flask.

14.4.6.6.3 Repeat Section 14.4.6.3 through Section 14.4.6.5. Disregarding any dilutions, this is equivalent to a concentration of 2500 µg/Kg of each MS compound.

14.4.6.6.4 Calculate recovery of each spiked compound as in Section 15.7.

14.4.6.6.5 Calculate the RPD as in Section 15.9.

14.4.6.6.6 Evaluate recovery and RPD as in Section 18.4.

14.4.6.7 LCS - One LCS must be prepared for every MS/MSD prepared.

14.4.6.7.1 Place 40 mL of reagent water into a 50 mL volumetric flask.

14.4.6.7.2 Inject 1 mL of methanol directly into the water.

14.4.6.7.3 Inject 50 µL of the MS solution used for the sample MS/MSD (Section 10.13.4.1) directly into the water.

14.4.6.7.4 Repeat Section 14.4.6.3 through Section 14.4.6.5. Disregarding any dilutions, this is equivalent to a concentration of 25000020µg/Kg of each LCS compound.

14.4.6.7.5 Calculate recovery of each spiked compound as in Section 15.8.

14.4.6.7.6 Evaluate recovery as in Section 18.4.

14.4.7 Oil sample preparation

14.4.7.1 Record all sample preparation in the oil dilution logbook - volatiles (Attachment 22.20).

14.4.7.2 Weigh 2.0 g of oil into a 40 mL glass VOA vial.

14.4.7.3 Pipet 40 mL of MeOH into the vial. Cap. Invert three times.

14.4.7.4 Proceed as in Section 14.4.4 or Section 14.4.6 except add combined surrogate and IS (Section 10.13.3.1) instead of only IS solution.

14.4.7.5 Calculate as in Section 15.5.2 or Section 15.13.2 where Vt is 40 mL and % S is 100. Divide the result obtained by 1000 since oil reporting units are in mg/kg.

14.4.8 Dilutions - If the on-column concentration of any compound in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and analyzed. Guidance in performing dilutions and exceptions to this requirement are given below.

14.4.8.1 Use the results of the original analysis to determine the approximate dilution factor (DF) required to get the largest analyte peak within the initial calibration range.

14.4.8.2 The DF chosen should keep the response of the largest analyte peak for a target compound in the upper half of the initial calibration range of the instrument.

14.5 Preventative maintenance

14.5.1 The septa, insert, and gold seal are changed as needed.

14.5.2 The pump oil is changed twice each year.

14.5.3 Sample ports on the AS2016's are rinsed with organic-free water after every sample and/or standard.

15.0 Calculations

15.1 RF – Tabulate the area response of the characteristic ions in the EICP against concentration for each compound and IS and calculate RFs for each compound as follows:

$$RF = \frac{A_x \times C_{is}}{A_{is} \times C_x}$$

A_x = area of the characteristic ion (EICP) for the analyte to be measured.
A_{is} = area of the characteristic ion (EICP) for the specific IS.
C_{is} = concentration of the IS.
C_x = concentration of the analyte to be measured.

NOTE: *For the m and p isomers of xylene, which coelutes in the capillary column, both isomers are present in the standards. Since the two isomers coelute, use the area of the coeluting ions and the total concentration of the two isomers in the standard to determine the RF.*

15.2 Average RF (aRF) – Calculate the aRF for each analyte in the initial calibration by adding up each RF and dividing by the number of RFs.

15.3 SD – Calculate the SD (population) of the RF for each analyte.

15.4 % RSD – Calculate the % RSD of the RF values over the working range of the curve. Record the % RSD for all compounds. The % RSD is calculated as follows:

$$\% \text{ RSD} = (\text{SD}/\text{aRF}) * 100$$

RSD = relative standard deviation.
ARF = average RF for each analyte.
SD = standard deviation of mean RF for each analyte (population).

15.5 Target analytes – Identified target analytes shall be calculated by the IS method and the average RF from the initial calibration curve.

15.5.1 Aqueous samples

$$\text{concentration } (\mu g/L) = \frac{(A_x)(Is)(Df)}{(A_{is})(aRF)(V)}$$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS
aRF = average RF from the initial calibration curve.
V = volume of water sample purged (mL).
Df = dilution factor.

15.5.2 Solid samples

$$\text{concentration } (\mu g/Kg \text{ dry}) = \frac{(A_x)(Is)(Vt)(1000)(Df)}{(A_{is})(aRF)(V)(W)(\%\ S)}$$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
ARF = average RF from the initial calibration curve.
V = volume of methanol extract purged (µL).
Vt = total volume of methanol extract (mL). **NOTE:** This is usually 10 mL.
Df = dilution factor.
W = weight of solid sample extracted (g).
% S = % solids/100 (see Section 15.10).

15.6 Surrogate compound recovery – Calculate the concentration of each surrogate compound as in Section 15.5. Calculate the recovery of each surrogate compound in all samples, blanks, MSs, MSDs, LCSs, continuing calibration verifications (CCSs), and ICVs as follows:

$$\% \text{ recovery} = \frac{\text{concentration found} \times 100}{\text{concentration spiked}}$$

15.7 MS/MSD recovery – Calculate the concentration of each MS or MSD analyte as in Section 15.5. Calculate the recovery of each MS or MSD analyte as follows:

$$\text{MS or MSD recovery} = \frac{(SSR - SR) \times 100}{SA}$$

SSR = analyte concentration in spike.
SR = analyte concentration in unspiked sample.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.8 LCS, CCS, reference sample, and ICV recovery – Calculate the concentration of each analyte as in Section 15.5. Calculate the recovery of each analyte as follows:

$$\text{recovery} = \frac{SSR \times 100}{SA}$$

SSR = analyte concentration in spike.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.9 RPD – Calculate the RPD of the recoveries of each compound in the MS and MSD as follows:

$$RPD = \frac{(MS - MSD) \times 100}{(1/2)(MS + MSD)}$$

MS = matrix spike recovery.
MSD = matrix spike duplicate recovery.

NOTE: *The formula above is the absolute value of the difference. Therefore, RPD is always expressed as a positive value.*

15.10 Percent total solids

$$\% \text{ solids} = \frac{(DS - WB) \times 100}{WS}$$

WB = weigh boat tare weight (g).
WS = wet sample (g).
DS = dry Sample (g).

15.11 % difference

$$\% \text{ difference} = \frac{(RF - aRF) \times 100}{aRF}$$

RF = response factor of analyte.
ARF = average RF of analyte from initial calibration.

15.12 Least square regression – Performed using a linear regression of the peak area response (y) versus the concentration of the standards (x).

$y = ax + b$
a = slope
b = intercept

NOTE: *This line should not be forced through the origin, should include at least five points, and should not include a blank.*

15.13 Target analytes – Identified target analytes may be calculated by the IS method and a least squares regression of the initial calibration curve.

15.13.1 Aqueous samples

$$\text{concentration } (\mu g/L) = [[[(A_x)(Is)/A_{is}]-b]Df] \div (a)(V)$$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
a = slope of curve.
b = intercept of curve.
Df = dilution factor.
V = volume of water purged (mL).

15.13.2 Solid samples

concentration (µg/kg dry) = $[[(A_x)(Is)/A_{is}]-b](Df)(1000)(Vt) \div (a)(V)(W)(\%\ S)$

A_x = area of the characteristic ion for the analyte being measured.
A_{is} = area of the characteristic ion for the IS (see Attachment 22.8).
Is = ng of IS.
a = slope of curve.
b = intercept of curve.
Df = dilution factor.
V = volume of methanol extract purged (µL).
Vt = total volume of methanol extract (mL). **NOTE:** This is usually 10 mL.
W = weight of solid sample extracted (g).
% S = % solids/100 (see Section 15.10).

16.0 Method Performance

16.1 Each MDL study must be labeled with the instrument number, analyst, and date.

17.0 Pollution Prevention

17.1 This method uses smaller quantities of organic solvents. The waste that is produced is collected for disposal as nonchlorinated waste.

17.2 For information concerning pollution prevention that may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, DC 20036.

18.0 Data Assessment

18.1 Qualitative analysis - All target analytes are identified by comparing the sample mass spectrum with the mass spectrum of a standard of the suspected analyte (standard reference spectrum) and elution of the sample component at the same GC relative retention time (RRT) as those of the standard analyte retention time.

18.1.1 Mass spectra - Mass spectra for the standard reference should be obtained on the user's GC/MS. These standard reference spectra are obtained through analysis of the calibration standards. All ions present in the standard mass spectra at a relative intensity greater than 30% (most abundant ion in the spectrum equals 100%) must be present in the sample spectrum. The relative intensities of these ions must agree within ±30% between the standard and sample spectrum. For example, an ion with an

abundance of 50% in the standard spectra must be between 20 and 80% abundance in the sample spectra.

18.1.2 Retention time (RT) - The sample peak RT must compare within 30 seconds of the RT of the standard peak.

18.1.3 Each analysis should be checked for saturation.

18.2 Initial calibration evaluation

18.2.1 System performance check compounds (SPCCs) - Five compounds are checked for a minimum mean RF:

chloromethane	0.10
1,1-dichloroethane	0.10
bromoform	0.10
chlorobenzene	0.30
1,1,2,2-tetrachloroethane	0.30

18.2.2 Continuing calibration compounds (CCCs) - The %RSD of the RF for these analytes must be less than or equal to 30%, or corrective action must take place:

1,1-dichloroethene
chloroform
1,2-dichloropropane
toluene
ethylbenzene
vinyl chloride

18.2.3 The % RSD of the RF must be less than or equal to 15% for each target analyte in order to employ the average RF for quantitation (<35% is acceptable for samples analyzed by Method 624). A least squares regression should be used (Section 15.11 and Section 15.12) for compounds with a %RSD above the acceptable level. The regression calculation will generate a correlation coefficient (r) that must be greater than or equal to 0.99 in order to employ the linear regression curve.

18.2.4 The RRT of each analyte should agree within 0.06 RRT units.

18.3 CCS and ICV evaluation

18.3.1 Each SPCC compound in the CCS and/or ICV must meet the minimum RF in Section 18.2.1.

18.3.2 Each CCC (Section 18.2.2) in the CCS and/or ICV must have a percent difference less than or equal to 20%, or corrective action must be taken. (See Section 15.11 for calculations).

18.3.3 The IS retention times must be evaluated in every CCS and ICV. If the retention time changes by more than 30 seconds from a mid-level standard in the current initial calibration, corrective action must be taken.

18.3.4 The IS EICP area must be evaluated in every CCS and ICV. The area must be in the range of -50% to +100% of a mid-level standard in the current initial calibration. If the IS area does not meet this requirement, corrective action must be taken.

18.3.5 The CCS and ICV should be evaluated as follows:

18.3.5.1 Do the peaks look normal (gaussian)?
18.3.5.2 Is the response comparable to previous calibrations?
18.3.5.3 Are any peaks tailing?

18.4 MS, MSD, and LCS evaluation - Recoveries for each spiked analyte are calculated as in Section 15 and must meet Michigan Department of Environmental Quality (MDEQ) laboratory generated limits except if the sample is for an NPDES permit (see Attachment 22.14). For compounds not listed in Attachment 22.14, use the MDEQ limits.

18.5 Quantitative analysis

18.5.1 Target analytes identified shall be quantified by the IS method. The IS used for quantitation should be nearest in retention time to the analyte of interest (see Attachment 22.8).

18.5.2 The EICP area of the characteristic ions of analytes listed in Attachment 22.9 and Attachment 22.10 are used.

18.5.3 IS responses and retention times in all standards must be evaluated during or immediately after data acquisition. If the retention time for any IS changes by more than 30 seconds from the most recent CCS (12-hour), the chromatographic system must be inspected for malfunctions and corrections made as required. For samples analyzed during the same 12-hour time period as the initial calibration standards, compare the IS responses and retention times against the 50 µg/L calibration standard. The extracted ion current profile (EICP) of the ISs must be monitored and evaluated for each sample, blank, MS, and MSD. The EICP area for the IS must be within 50% to 200% of the mid-range standard. The mass spectrometric system must be inspected for malfunction and corrections made as appropriate. Generate an IS/RT form from the software (Attachment 22.17). When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is necessary.

18.5.4 When target analytes are below RLs and the spectra meet the identification criteria, report the concentration as estimated (J code).

18.6 Tentatively identified compounds (TIC)

18.6.1 When requested, an estimated concentration for analytes not present in the calibration standard may be made. The formulas given in Section 15.1 will be used with the following modifications:

18.6.1.1 The areas Ax and Ais should be from the total ion chromatogram.
18.6.1.2 The IS used will be the closest in elution time to the unknown in the sample that is free of interferences.
18.6.1.3 The average RF will be 1.
18.6.1.4 The concentration obtained will be reported as an estimate.

18.6.2 National Institute of Standards and Technology (NIST) library searches - For samples containing components not associated with the calibration standards, a library search

may be made for the purpose of tentative identification. All target analytes are identified by comparison of the sample mass spectrum with the mass spectrum from the NIST library.

18.6.3 The relative intensities of major ions in the reference spectrum (ions >10% of the most abundant ion) should be present in the sample spectrum.

18.6.4 The relative intensities of the major ions should agree within ±20%.

18.6.5 Molecular ions present in the reference spectrum should be present in the sample spectrum.

18.6.6 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

18.6.7 Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies. Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

18.6.8 See Attachment 22.16 for more TIC criteria.

18.7 SB evaluation – The instrument blank must not contain target analytes above the RL.

18.8 MPB evaluation – The method blank should not contain target analytes above the RL.

18.9 Data review – All data is reviewed by a second person prior to release.

18.10 Surrogate evaluation – Recoveries for each surrogate compound are calculated as in Section 15.6 and must meet MDEQ Laboratory generated limits, or corrective action must be taken (Section 19.1). Generate a surrogate summary form from the software (Attachment 22.18).

18.11 Complete a volatile QC summary form for each batch (Attachment 22.19).

19.0 Corrective Actions

19.1 Surrogate recovery - All surrogate recoveries must fall within the specified laboratory generated windows. If any surrogate compound is out of control due to obvious matrix problems, the sample will not be re-run, and the sample result(s) will be qualified as estimated. If the sample has a surrogate that is out for no apparent reason, the sample will be reanalyzed. If the reanalysis is within limits, the first analysis will be discarded, and the second analysis reported. If the second analysis agrees with the first, the poor recovery is attributed to matrix interference and result(s) from the first analysis will be reported with the appropriate qualifier. If many samples are out of control for no apparent reason, the mass spectrometer needs to be inspected for malfunctions, and corrections must be made as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning are necessary. If the QC limits are outside the acceptance limits for analyses, any values obtained from any positively identified compound must be

reported as estimated (code J). Determine if the recovery is within limits. If the recovery of any one surrogate is not within limits, the following are required:

19.1.1 Check all calculations and instrument performance. Check the preparation of the surrogate spiking solution and IS solution for errors or degradation.

19.1.2 Reanalyze the sample unless a calculation error was found.

19.1.3 If an undiluted analysis with acceptable surrogate recoveries is being submitted, do not reanalyze diluted samples if the surrogate recoveries are outside the limits.

19.1.4 If the sample associated with the MS and MSD does not meet criteria, it should be reanalyzed only if the MS/MSD system monitoring compound recoveries are within the limits. If the sample and associated MS/MSD show the same pattern (i.e., outside the limits), the sample does not require reanalysis.

19.1.5 If the recovery of any one system monitoring compound in a method blank is outside the limits, the method blank and all associated samples must be reanalyzed.

19.1.6 If surrogate recoveries fall outside the acceptance limits and the sample is within the 14-day hold time, reextraction or reanalysis is performed if sample volume is sufficient.

19.2 MS/MSD/LCS recoveries - If any analyte percent recovery in the MS or MSD falls outside the acceptance windows, the laboratory must determine if there is a matrix effect or a laboratory performance problem. A matrix effect is indicated if the LCS data are within limits but the MS or MSD data exceeds the limits. If a matrix effect is determined, the report will be flagged as matrix interference. If recoveries of the analytes in the LCS are outside acceptance limits, the problem may lie with the extraction or analytical system. Corrective action may include reextraction and/or reanalysis of samples once the problem has been resolved.

19.3 %RPD - If the %RSD of any analyte is outside the acceptance range, evaluate the system to locate potential problems. Corrective action may include reextraction and/or reanalysis of samples once the problem has been resolved, or the data may flagged as estimated.

19.4 SB – SB results must be less than the RL for the target analyte. If the SB does not meet this criteria, action must be taken to locate and correct the source of the contamination prior to the analysis of samples, QA/QC samples, etc.

19.5 MPB - MPB results should be less than the RL for the analyte. If the MPB does not meet this criteria, action should be taken to locate and reduce the source of the contamination. Samples associated with the contaminated MPB should be reextracted and/or analyzed if at all possible. If MPB results do not meet criteria and reanalysis is not possible, the MPB must be reported to the client.

19.6 Hold times - All analysis dates must be within 14 days from the sampling date. If analysis is past the hold time, all data must be flagged as estimated.

20.0 Waste Management

20.1 The laboratory safety officer arranges for proper waste disposal.

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Appendix A and B.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency, Document SW-846, Third Edition 1986, Final Update III, December1996.

21.3 HP 5890 Gas Chromatograph Manual.

21.4 HP Enviroquant Software Manual.

21.5 P 6890 Gas Chromatograph Manual.

21.6 Tekmar Autosampler 223 Sample Changer Manual LT 1932, (2/98).

22.0 Attachments

22.1 Methanol MSDS.

22.2 Hydrochloric acid MSDS.

22.3 SS Logbook Page.

22.4 Volatile standard logbook page.

22.5 Total solids logbook page.

22.6 Maintenance logbook page.

22.7 Volatile organic run logbook page.

22.8 ISs with corresponding target analytes and surrogates.

22.9 Characteristic ions for target compounds.

22.10 Characteristic ions for surrogates and ISs.

22.11 Ultra Scientific part #CUS-3300.

22.12 Target analyte RLs and units.

22.13 57 component standard list part #92516 absolute standards.

22.14 Calibration QC acceptance criteria - Method 624.

22.15 Methanol extraction logbook.

22.16 MDEQ Laboratory TIC criteria.

22.17 IS and RT form (example).

22.18 Surrogate summary form (example).

22.19 Volatile QC summary form.

22.20 Oil dilution logbook - volatiles.

22.21 Sediment preparation worksheet.

23.0 Preventative Maintenance

23.1 Change pump oil every six months (Inland 40).

23.2 Change purge site every six months (Section 9.11.7).

MDEQ SOP# 501 REVISION # 1

APPROVED BY _____ DATE 12/04/02
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 12/3/02
COMPLIANCE OFFICER

APPROVED BY _____ DATE 11/26/02
QA OFFICER

APPROVED BY _____ DATE 11-22-02
UNIT MANAGER

APPROVED BY _____ DATE 11/21/02
ANALYST

Honeywell

Burdick & Jackson

MATERIAL SAFETY DATA SHEET

Methanol

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Methanol

OTHER/GENERIC NAMES: Methyl Alcohol, Carbinol, Wood Alcohol,

PRODUCT USE: Solvent

MANUFACTURER: Honeywell, Burdick & Jackson
1953 South Harvey Street
Muskegon, MI 49442

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-5:00pm)
1-800-368-0050

IN CASE OF EMERGENCY CALL:
(24 Hours/Day, 7 Days/Week)
1-800-707-4555 or Chemtrec 1-800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Methanol	67-56-1	100%

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Flammable liquid and vapor. Highly toxic by ingestion. Moderately toxic by other routes.

POTENTIAL HEALTH HAZARDS

SKIN: Irritant. Repeated or prolonged exposure can cause dermatitis.

EYES: Irritant. Redness, dryness, and itching can result from exposure.

INHALATION: Irritating to respiratory tract. Can cause drowsiness, disorientation, coughing and nausea.

INGESTION: Irritating to the gastro-intestinal tract. Can cause drowsiness, disorientation, coughing, nausea, vomiting, shortness of breath, coma, blindness and death.

DELAYED EFFECTS: None determined.

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST
No ingredients listed in this section.			

4. FIRST AID MEASURES

SKIN: Rinse affected area with plenty of water until no evidence of chemical remains.

EYES: Rinse eyes with plenty of water for at least 15 minutes. Contact a physician.

INHALATION: Remove from exposure area to fresh air. If victim is not breathing administer artificial respiration according to your level of training and obtain professional medical assistance immediately.

INGESTION: Get immediate EMERGENCY medical assistance. Do not induce vomiting unless instructed to do so by a physician.

ADVICE TO PHYSICIAN: Due to slow metabolism, the delayed effects (like blindness and acidosis) may occur after latent period of 24 hours or more.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	52°F (11°C)
FLASH POINT METHOD:	Closed Cup
AUTOIGNITION TEMPERATURE:	867°F (464°C)
UPPER FLAME LIMIT (volume % in air):	36%
LOWER FLAME LIMIT (volume % in air):	6%
FLAME PROPAGATION RATE (solids):	Not Applicable
OSHA FLAMMABILITY CLASS:	IB

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical or foam.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Can burn with an invisible flame. Mixtures with high water content are still flammable.

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS: Wear full protective clothing and self contained breathing apparatus. Containers in fire conditions will pressurize and may rupture. Do not allow run off from fire fighting effort to enter sewer or waterway.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment.)
Eliminate sources of ignition. Isolate the spill area. Stop leak in a safe and practical manner. (If leak cannot be stopped easily and safely, advise trained emergency response personnel of the situation.) Using inert material (such as ground corncobs) dike the spilled solvent to prevent it from running into drains or waterways.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (Always wear recommended personal protective equipment.)
Flammable liquid and vapors. Keep container closed. Do not breathe vapors. Avoid contact with skin, eyes and mucous membranes. Keep away from heat, sparks and flame. Electrically ground all handling equipment.

STORAGE RECOMMENDATIONS:
Store in an area designed for storage of flammable liquids. (OSHA 29 CFR 1910.106)
Protect from temperature extremes and sunlight, and store away from incompatible substances and in accordance with 29 CFR 1910.106.

Flammable liquid and vapor. Once liquid solvent has been completely dispensed, containers which appear "empty" should be handled in the same manner as when they were "full" of liquid solvent.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs . Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:
Wear chemically protective gloves, boots and aprons to prevent prolonged or repeated skin contact.

EYE PROTECTION:
Wear protective eyeglasses or chemical safety goggles, per OSHA eye and face protection regulations (*29 CFR 1910.133*). Contact lenses are not eye protective devices. Full face shield recommended for conditions where liquid contact is possible. Contact lens should not be worn when working with this chemical.

RESPIRATORY PROTECTION:
Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR1910.134) and, if necessary, wear a MSHA/NIOSH approved respirator. For emergency or non-routine operations (cleaning spills, reactor vessels or storage tanks), wear an SCBA. Warning! Air-purifying respirators do not protect workers in oxygen deficient atmospheres.

ADDITIONAL RECOMMENDATIONS:
Make emergency eyewash stations and washing facilities available in work area. Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Never eat, drink, or smoke in work areas. Practice good personal hygiene after use.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

EXPOSURE GUIDELINES

INGREDIENT NAME	ACGIH TLV	OSHA PEL	OTHER LIMIT
Methanol	200 ppm (Skin)	200 ppm (Skin)	None

* = Limit established by Honeywell International, Inc.
** = Workplace Environmental Exposure Level (AIHA).
*** = Biological Exposure Index (ACGIH).

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS: None

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Clear, Colorless
PHYSICAL STATE:	Liquid
MOLECULAR WEIGHT:	32.04
CHEMICAL FORMULA:	CH_4O
ODOR:	Slight alcoholic. Threshold 10 ppm (NSC) 2000 ppm (NIOSH)
SPECIFIC GRAVITY (water = 1.0):	0.792
SOLUBILITY IN WATER (weight %):	~100%
pH:	Not Applicable
BOILING POINT:	64.7°C
MELTING POINT:	-97.68°C
VAPOR PRESSURE:	97 mm Hg
VAPOR DENSITY (air = 1.0):	1.11
EVAPORATION RATE:	~5 **COMPARED TO:** Butyl Acetate = 1
% VOLATILES:	~100%
FLASH POINT:	52°F (11°C)

(Flash point method and additional flammability data are found in Section 5.)

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):
Material is stable under normal handling and storage conditions. Can react vigorously with oxidizing materials.

INCOMPATIBILITIES:
Incompatible with metals (e.g. potassium , magnesium, aluminum).

CONDITIONS TO AVOID:
Heat, open flame, oxidizers, alkali and alkaline earth metals.

HAZARDOUS DECOMPOSITION PRODUCTS:
Incomplete combustion can generate toxic vapors of carbon monoxide and other toxic fumes such as formaldehyde.

HAZARDOUS POLYMERIZATION:
Not expected to occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:

Oral-Rat LD_{50}:5628 mg/kg
Oral-Mouse LD_{50}:7300 mg/kg
Oral-Monkey LD_{50} :7000 mg/kg
Inhalation-Rat LC_{50}:64,000 ppm/4H
Skin-Rabbit LD_{50}: 15,800 mg/kg

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
Repeated inhalation exposure to rats caused CNS and behavioral effects, and changes to spleen.
Repeated oral exposures to rats caused liver toxicity, CNS effects and behavioral changes.

OTHER DATA:
Developmental and reproductive effects:
Female rats exposed during pregnancy to very high exposure levels by inhalation caused fetotoxic effects (10,000 ppm) and birth defects (20,000 ppm) as well as maternal toxicity. Female rats exposed during pregnancy to very high oral doses (20 - 35 g/kg) caused fetotoxic effects as well as maternal toxicity.

12. ECOLOGICAL INFORMATION

LC_{50} Pimephales promelas (fathead minnows 28-29 days old) 29.4 g/L/96 hr. Will produce high BOD.

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes
If yes, the RCRA ID number is: U154, D001

OTHER DISPOSAL CONSIDERATIONS:
Dispose of material in accordance with all applicable local, state, and federal regulations.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT PROPER SHIPPING NAME:	Methanol *or Methyl Alcohol*
US DOT HAZARD CLASS:	3, Flammable Liquid
US DOT ID NUMBER:	UN1230
US DOT PACKING GROUP:	II
NA EMERGENCY RESPONSE GUIDE:	131

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: Listed on TSCA Inventory.

OTHER TSCA ISSUES: None

SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)
Methanol	5000 Lbs.	Not listed

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Acute, Chronic, Fire

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

INGREDIENT NAME	COMMENT
Methanol	

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

INGREDIENT NAME	WEIGHT %	COMMENT
No ingredients listed in this section.		

ADDITIONAL REGULATORY INFORMATION:

WHMIS CLASSIFICATION (CANADA):
Class B, Division 2 and Class D, Division 2a

FOREIGN INVENTORY STATUS:

16. OTHER INFORMATION

CURRENT ISSUE DATE:	June, 2000
PREVIOUS ISSUE DATE:	February, 1997, March, 1998

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:

Update to ANSI Standard. New header and footer information.

NFPA Classification	
Health:	1
Flammability:	3
Reactivity:	0

OHS11155

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER:
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: HYDROCHLORIC ACID, CONCENTRATED (36-37%)

TRADE NAMES/SYNONYMS:
CHLOROHYDRIC ACID; HYDROCHLORIDE; MURIATIC ACID; SPIRITS OF SALT; HYDROCHLORIC ACID, CONCENTRATED; HYDROGEN CHLORIDE; HYDROCHLORIC ACID; UN 1789; OHS11155; RTECS MW4025000

CHEMICAL FAMILY: acids, inorganic

CREATION DATE: Apr 30 1985
REVISION DATE: Mar 18 2002

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: HYDROGEN CHLORIDE, ANHYDROUS
CAS NUMBER: 7647-01-0
EC NUMBER (EINECS): 231-595-7
PERCENTAGE: 37.0

COMPONENT: WATER
CAS NUMBER: 7732-18-5
EC NUMBER (EINECS): 231-791-2
PERCENTAGE: 63.0

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=1

EMERGENCY OVERVIEW:
COLOR: colorless or yellow
PHYSICAL FORM: fuming liquid
ODOR: pungent odor
MAJOR HEALTH HAZARDS: respiratory tract burns, skin burns, eye burns, mucous

membrane burns
PHYSICAL HAZARDS: May react on contact with water. Releases toxic, corrosive, flammable or explosive gases.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation (possibly severe), headache, lung congestion, lung damage
LONG TERM EXPOSURE: digestive disorders
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation (possibly severe), frostbite
LONG TERM EXPOSURE: same as effects reported in short term exposure
EYE CONTACT:
SHORT TERM EXPOSURE: irritation (possibly severe), frostbite, blindness
LONG TERM EXPOSURE: same as effects reported in short term exposure
INGESTION:
SHORT TERM EXPOSURE: burns, nausea, vomiting, diarrhea
LONG TERM EXPOSURE: same as effects reported in short term exposure

CARCINOGEN STATUS:
OSHA: No
NTP: No
IARC: No

SECTION 4 FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. Give large amounts of water or milk. Allow vomiting to occur. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For inhalation, consider oxygen. Avoid gastric lavage or emesis.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Negligible fire hazard.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks.

FLASH POINT: No data available.

SECTION 6 ACCIDENTAL RELEASE MEASURES

AIR RELEASE:
Reduce vapors with water spray. Stay upwind and keep out of low areas. Collect runoff for disposal as potential hazardous waste. Reduce vapors with water spray. Stay upwind and keep out of low areas. Collect runoff for disposal as potential hazardous waste.

SOIL RELEASE:
Trap spilled material at bottom in deep water pockets, excavated holding areas or within sand bag barriers. Dike for later disposal. Absorb with sand or other non-combustible material. Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash). Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material. Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash).

WATER RELEASE:
Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash). Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash).

OCCUPATIONAL RELEASE:
Do not touch spilled material. Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Small dry spills: Move containers away from spill to a safe area. Large spills: Dike for later disposal. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response

Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

SECTION 7 HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store in a cool, dry place. Store in well-ventilated area. Keep separated from incompatible substances.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
HYDROGEN CHLORIDE, ANHYDROUS:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
5 ppm (7 mg/m3) OSHA ceiling
5 ppm ACGIH ceiling
5 ppm (7 mg/m3) NIOSH recommended ceiling
7.6 mg/m3 (5 ml/m3) DFG MAK (peak limitation category - I, with excursion factor of 1)
10 ppm (15 mg/m3) EC MAK STEL
5 ppm (8 mg/m3) EC MAK TWA
5 ppm (8 mg/m3) UK OES STEL (gas) (mist)
1 ppm (2 mg/m3) UK OES TWA (gas) (mist)

MEASUREMENT METHOD: Silica gel tube; Sodium bicarbonate/Sodium carbonate; Ion chromatography; NIOSH IV # 7903, Inorganic Acids

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.
10 ppm
Any chemical cartridge respirator with cartridge(s) providing protection

against this substance.
Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.
Any powered, air-purifying respirator with cartridge(s) providing protection against this substance.
Any supplied-air respirator.
Any self-contained breathing apparatus with a full facepiece.
Escape -
Any air-purifying respirator with a full facepiece and an acid gas canister.
Any appropriate escape-type, self-contained breathing apparatus.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.
Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
COLOR: colorless or yellow
PHYSICAL FORM: fuming liquid
ODOR: pungent odor
MOLECULAR WEIGHT: 36.46
MOLECULAR FORMULA: H-Cl
BOILING POINT: 385 F (196 C)
FREEZING POINT: Not available
VAPOR PRESSURE: Not available
VAPOR DENSITY (air=1): 1.3
SPECIFIC GRAVITY (water=1): 1.2
WATER SOLUBILITY: soluble
PH: 1.1 (0.1 N solution)
VOLATILITY: Not available
ODOR THRESHOLD: Not available
EVAPORATION RATE: Not available
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: May react with evolution of heat on contact with water. Releases toxic, corrosive, flammable or explosive gases.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Dangerous gases may accumulate in confined spaces. May ignite or explode on contact with combustible materials.

INCOMPATIBILITIES: cyanides, metals, amines, bases, metal carbide, oxidizing materials, acids, halo carbons, combustible materials, halogens, metal salts

HYDROGEN CHLORIDE (HYDROCHLORIC ACID):
ACETIC ANHYDRIDE: Violent reaction.
ALCOHOLIC HYDROGEN CYANIDE: Explosive reaction.
ALUMINUM: Explosion.
ALUMINUM-TITANIUM ALLOYS: Ignites or incandesces when heated.
2-AMINOETHANOL: Violent reaction.
AMMONIUM HYDROXIDE: Violent reaction.
BASES: Violent reaction.
BRASS: Corrodes.
BRONZE: Corrodes.
CALCIUM CARBIDE: Reacts with incandescence.
CALCIUM HYPOCHLORITE: Ignition.
CESIUM ACETYLIDE: Ignites on contact.
CHLORINE + DINITROANILINES: Vigorous reaction with release of flammable hydrogen gas fumes.
CHLOROSULFONIC ACID: Violent reaction.
1,1-DIFLUOROETHYLENE: Extremely exothermic decomposition reaction.
DOWICIL 100: Decomposes.
ETHYLENE DIAMINE: Violent reaction.
ETHYLENE IMINE: Violent reaction.
FLUORINE: Ignites on contact.
LITHIUM DISILICIDE: Incandescesent.
IRON: Corrodes with evolution of flammable hydrogen gas.
MAGNESIUM BORIDE: Produces a spontaneously flammable gas.
MERCURIC SULFATE: Violent reaction at 125 C.
METAL ACETYLIDES: Violent reaction.
METALS: Severe corrosion with evolution of flammable hydrogen gas.
OLEUM: Violent reaction.
OXIDIZERS (STRONG): Violent reaction.
OXYGEN + PLATINUM: Ignites on contact.
PERCHLORIC ACID: Violent reaction.
PLASTICS, RUBBER, COATINGS: Attacks.
POTASSIUM PERMANGANATE: Explosion hazard.
BETA-PROPIOLACTONE: Violent reaction.
PROPYLENE OXIDE: Violent reaction.
RUBIDIUM ACETYLIDE: Ignites on contact.
SILICA (GEL): Incompatible.
SODIUM: Vigorous or explosive reaction.
SULFURIC ACID: Explosive reaction with release of toxic hydrogen chloride gas.
TETRASELENIUM TETRANITRIDE: Explodes on contact.
VINYL ACETATE: Violent reaction.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: acid halides

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

HYDROCHLORIC ACID, CONCENTRATED (36-37%):
IRRITATION DATA:
5 mg/30 second(s) rinsed eyes-rabbit mild
TOXICITY DATA:
2857 ug/kg oral-man LDLo; 420 ul/kg oral-woman LDLo; 1300 ppm/30 minute(s) inhalation-human LCLo; 3000 ppm/5 minute(s) inhalation-human LCLo; 81 mg/kg unreported-man LDLo; 3124 ppm/1 hour(s) inhalation-rat LC50; 1108 ppm/1 hour(s) inhalation-mouse LC50; 40142 ug/kg intraperitoneal-mouse LD50; 900 mg/kg oral-rabbit LD50; 4413 ppm/30 minute(s) inhalation-rabbit LCLo; 4413 ppm/30 minute(s) inhalation-guinea pig LCLo; 685 ug/m3/24 hour(s)-84 day(s) continuous inhalation-rat TCLo
ACUTE TOXICITY LEVEL:
Moderately Toxic: inhalation, ingestion
MUTAGENIC DATA:
DNA repair - Escherichia coli 25 ug/well; sex chromosone loss and non disjunction - Drosophila melanogaster inhalation 100 ppm 24 hour(s); sex chromosone loss and non disjunction - Drosophila melanogaster oral 100 ppm; cytogenetic analysis - grasshopper parenteral 20 mg; cytogenetic analysis - hamster lung 30 mmol/L; cytogenetic analysis - hamster ovary 8 mmol/L
REPRODUCTIVE EFFECTS DATA:
450 mg/m3 inhalation-rat TCLo/1 hour(s) 1 day(s) pre pregnancy continuous

HYDROGEN CHLORIDE, ANHYDROUS:
IRRITATION DATA:
5 mg/30 second(s) rinsed eyes-rabbit mild
TOXICITY DATA:
2857 ug/kg oral-man LDLo; 420 ul/kg oral-woman LDLo; 1300 ppm/30 minute(s) inhalation-human LCLo; 3000 ppm/5 minute(s) inhalation-human LCLo; 81 mg/kg unreported-man LDLo; 3124 ppm/1 hour(s) inhalation-rat LC50; 1108 ppm/1 hour(s) inhalation-mouse LC50; 40142 ug/kg intraperitoneal-mouse LD50; 900 mg/kg oral-rabbit LD50; 4413 ppm/30 minute(s) inhalation-rabbit LCLo; 4413 ppm/30 minute(s) inhalation-guinea pig LCLo; 685 ug/m3/24 hour(s)-84 day(s) continuous inhalation-rat TCLo
CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Inadequate Evidence, Group 3
LOCAL EFFECTS:
Corrosive: inhalation, skin, eye, ingestion
ACUTE TOXICITY LEVEL:
Moderately Toxic: inhalation, ingestion
MUTAGENIC DATA:

DNA repair - Escherichia coli 25 ug/well; sex chromosone loss and non disjunction - Drosophila melanogaster inhalation 100 ppm 24 hour(s); sex chromosone loss and non disjunction - Drosophila melanogaster oral 100 ppm; cytogenetic analysis - grasshopper parenteral 20 mg; cytogenetic analysis - hamster lung 30 mmol/L; cytogenetic analysis - hamster ovary 8 mmol/L

REPRODUCTIVE EFFECTS DATA:
450 mg/m3 inhalation-rat TCLo/1 hour(s) 1 day(s) pre pregnancy continuous

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Inhalation of gas or fumes at levels of 5-35 ppm may cause irritation and burning of the throat, coughing and choking; 50-100 ppm may be barely tolerable for 1 hour. High levels may cause inflammation and occasionally ulceration of the nose, throat or larynx, bronchitis, pneumonia, palpitations and headache. Higher concentrations may cause necrosis of the tracheal and bronchial epithelium, nasoseptal perforation, atelectasis, emphysema, damage to pulmonary blood vessels and lesions of the liver and other organs. Death may be due to laryngeal spasm, bronchopneumonia or pulmonary edema. 1300-2000 ppm may be dangerous, even on brief exposures. An environmental exposure to hydrochloric acid has resulted in chronic neurobehavioral dysfunction. Reproductive effects have been reported in animals.

CHRONIC EXPOSURE:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Repeated or prolonged exposure may cause erosion and discoloration of exposed teeth, chronic bronchitis and gastritis.

SKIN CONTACT:

ACUTE EXPOSURE:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Contact may cause severe irritation, inflammation, ulceration, necrosis and chemical burns. Shock symptoms may develop including rapid pulse, sweating and collapse. Photosensitization reactions may occur in persons previously exposed. Contact with a compressed gas may cause frostbite.

CHRONIC EXPOSURE:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Repeated or prolonged contact with vapors or dilute solutions may cause dermatitis. Photosensitization may occur.

EYE CONTACT:

ACUTE EXPOSURE:

HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Contact may cause severe irritation, conjunctivitis, corneal necrosis and burns with impairment or permanent loss of vision. A drop of hydrochloric acid splashed in the eye and immediately washed out has produced a white coagulation of the corneal

and conjunctival epithelium. Animals exposed to vapor concentrations of 1350 ppm for one and a half hours showed clouding of the cornea and 300 ppm for 6 hours showed slight erosion of the corneal epithelium. Contact with a compressed gas may cause frostbite.

CHRONIC EXPOSURE:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Animals exposed to vapor at 100 ppm for 6 hours daily for 50 days showed only slight unrest and irritation of the eyes, but no ocular injury. Effects are dependent upon concentration and duration of exposure. Conjunctivitis or effects similar to those for acute exposure may occur.

INGESTION:
ACUTE EXPOSURE:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): Ingestion of the acid may cause burns of the mouth, throat, esophagus and stomach with consequent pain, uneasiness, nausea, salivation, vomiting, diarrhea, chills, shock and intense thirst. Nephritis, fever and perforation of the intestinal tract, and circulatory collapse may occur. Death may be due to esophageal or gastric necrosis.

CHRONIC EXPOSURE:
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): No data available.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY DATA:
FISH TOXICITY: 21900 ug/L 96 hour(s) LC50 (Mortality) Fathead minnow (Pimephales promelas)

INVERTEBRATE TOXICITY: 560 ug/L 48 hour(s) EC50 (Immobilization) Water flea (Daphnia magna)

ALGAL TOXICITY: 800 ug/L 1600 week(s) EC50 (Population Size Reduction) Green algae (Chlorella pyrenoidosa)

PHYTOTOXICITY: 1000 ug/L 4-48 week(s) (Residue) Water-hyacinth (Eichhornia crassipes)

FATE AND TRANSPORT:
BIOCONCENTRATION: 1000 M 24 week(s) BCF (Residue) Blue-green algae (Coccochloris sp) 1E-6.5 M

SECTION 13 DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D002. Dispose in accordance with all applicable regulations.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:
PROPER SHIPPING NAME: Hydrochloric acid
ID NUMBER: UN1789
HAZARD CLASS OR DIVISION: 8
PACKING GROUP: II

CANADIAN TRANSPORTATION OF DANGEROUS GOODS: No classification assigned.

LAND TRANSPORT ADR/RID:
PROPER SHIPPING NAME: Hydrochloric acid
UN NUMBER: UN1789
ADR/RID CLASS: 8
CLASSIFICATION CODE: C1
PACKING GROUP: II

AIR TRANSPORT IATA/ICAO:
PROPER SHIPPING NAME: Hydrochloric acid/Hydrochloric acid solution
UN/ID NUMBER: UN1789
IATA/ICAO CLASS: 8
PACKING GROUP: II

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Hydrochloric acid
UN NUMBER: UN1789
IMDG CLASS: 8
PACKING GROUP: II

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): 5000 LBS RQ (liquid)

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): 500 LBS TPQ (gas)

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): 5000 LBS RQ (gas)

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):
ACUTE: Yes
CHRONIC: No
FIRE: No
REACTIVE: Yes
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): except non-aerosol forms

OSHA PROCESS SAFETY (29CFR1910.119):
HYDROGEN CHLORIDE (HYDROCHLORIC ACID): 5000 LBS TQ (gas)

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:
EC CLASSIFICATION (ASSIGNED):
T Toxic
C Corrosive

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:
T Toxic

EC RISK AND SAFETY PHRASES:

R 23	Toxic by inhalation.
R 35	Causes severe burns.
S 1/2	Keep locked-up and out of reach of children.
S 9	Keep container in a well-ventilated place.
S 26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36/37/39	Wear suitable protective clothing, gloves and eye/face protection.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

CONCENTRATION LIMITS:

C>=5%	T; C	R 23-35
1%<=C<5%	C	R 20-35
0.5%<=C<1%	C	R 20-34
0.2%<=C<0.5%	C	R 34

0.02%<=C<0.2% Xi R 36/37/38

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: VwVwS
CLASSIFICATION UNDER HAZARD TO WATER: 1

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

SECTION 16 OTHER INFORMATION

MSDS SUMMARY OF CHANGES
SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION
SECTION 3 HAZARDS IDENTIFICATION

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MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
EL-									
EL-									
EL-									
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EL-									
EL-									

ATTACHMENT 22.3

FILE ST-STD
[illegible]0/98

MDEQ-ENVIRONMENTAL LAB
VOLATILE ORGANIC STANDARDS

VOC Tracking Number	Date Prepared	EL or VOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
VE-											
VE-											
VE-											
VE-											
VE-											
VE-											
VE-											
VE-											
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VE-											
VE-											
VE-											
VE-											
VE-											
VE-											
VE-											
VE-											

ATTACHMENT 22.4

FILE:V-STD
12/30/98

*INCLUDE UNITS

MDEQ-Environmental Lab
% Total Solids Logbook

Date____________
Analyst____________

ATTACHMENT 22.5

Sample ID	"T" Dish Tare Weight (g)	"W" Wet Weight of Sample (g)	"D" Dry Weight of Dish & Sample (g)	"%TS" % Total Solids

Comments.

%TS= [(D-T)/(W)] x 100

MDEQ-ENVIRONMENTAL LAB
MAINTENANCE LOGBOOK
INSTRUMENT # 10

Date	Analyst/ Repair Person	Changed Septa	Changed Injection Insert	Helium Tank Changed	Changed Filament	Cleaned Source	Problem	Maintenance Performed

ATTACHMENT 22.6

Page 1 of 1

MDEQ-Environmental Lab
Volatile Organic Runlog
Instrument # 10

Date____________
Analyst____________
Method 8260/624

ATTACHMENT 22.7

Initial Calibration Date or ID		Internal Standard #		MeOH #
Vial/Site #	Sample ID	Dilution	Standard Tracking #	Comments

ATTACHMENT 22.8

INTERNAL STANDARDS WITH CORRESPONDING TARGET COMPOUNDS AND SURROGATE COMPOUNDS ASSIGNED FOR QUANTITATION

Pentafluorobenzene
Dichlorodifluoromethane
Chloromethane
Bromomethane
Vinyl chloride
Chloroethane
Trichlorofluoromethane
Acetone
Diethylether
1,1-Dichloroethene
Acrylonitrile
Methyl Iodide
Methylene chloride
Carbon disulfide
trans-1,2-Dichloroethene
Tetrahydrofuran
Methyl Tertiary Butyl Ether
1,1-Dichloroethane
Chloroform
2-Butanone (MEK)
cis-1,2-Dichloroethene

1,4-Dichlorobenzene-d4
trans-1,4-Dichloro-2-Butene
1,2,3-Trichloropropane
4-BFB (sur)
Bromobenzene
2-Methylnaphthalene
1,3,5-Trimethylbenzene
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
Hexachloroethane
1,2-Dibromo-3-chloropropane
1,2,4-Trichlorobenzene
Naphthalene
n-Propylbenzene
iso-Propylbenzene
tert-Butylbenzene
sec-Butylbenzene
p-Isopropyl Toluene
n-Butylbenzene
1,2,3-Trichlorobenzene

1,4-Difluorobenzene
Dibromofluoromethane (sur)
1,1,1-Trichloroethane
1,2-Dichloroethane
Carbon Tetrachloride
1,2-Dichloropropane
Trichloroethene
Dibromomethane
Bromodichloromethane
4-Methyl-2-Pentanone
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Benzene
Bromochloromethane

Chlorobenzene-d5
2-Hexanone
Toluene-d8 (sur)
1,1,2-Trichloroethane
Toluene
o-Xylene
Dibromochloromethane
Bromoform
1,2-Dibromoethane
Tetrachloroethene
Styrene
Chlorobenzene
1,1,2,2-Tetrachloroethane
1,1,1,2-Tetrachloroethane
Ethylbenzene
m-Xylene
p-Xylene

(sur) = surrogate

ATTACHMENT 22.9

CHARACTERISTIC IONS FOR TARGET COMPOUNDS

Analyte	Primary Ion*	Secondary Ion(s)
Dichlorodifluoromethane	85	87
Chloromethane	50	52
Bromomethane	94	96
Vinyl chloride	62	64
Chloroethane	64	66
Trichlorofluoromethane	151	101,153
Acetone	58	43
Diethylether	74	45,59
1,1-Dichloroethene	96	61,63
Acrylonitrile	53	52,51
Methyl Iodide	142	127,141
Methylene chloride	84	49,86
Carbon disulfide	76	78
trans-1,2-Dichloroethene	96	61,96
Methyl Tertiary Butyl Ether	73	57
1,1-Dichloroethane	63	65,83
2-Butanone (MEK)	72	43
cis-1,2-Dichloroethene	96	61,98
Bromochloromethane	128	130,49
Chloroform	83	85
1,1,1-Trichloroethane	97	99,61
1,2-Dichloroethane	62	98
Benzene	78	-
Carbon tetrachloride	117	119
1,2-Dichloropropane	63	112
Trichloroethene	95	97,132,130
Dibromomethane	93	174,95
Bromodichloromethane	83	85,127
2-Hexanone	43	58,57,100
cis-1,3-Dichloropropene	75	77,39
trans-1,3-Dichloropropene	75	77,39
1,1,2-Trichloroethane	83	97,85
Toluene	92	91
4-Methyl-2-pentanone	100	43,85
Dibromochloromethane	129	208,206
1,2-Dibromoethane	107	109,188
Tetrachloroethene	164	129,131,166
Chlorobenzene	112	114,77
1,1,1,2-Tetrachloroethane	131	133,119
Ethyl benzene	91	106
m/p-Xylenes	106	91
Styrene	104	78
Bromoform	173	175,254
o-Xylene	106	91

ATTACHMENT 22.9 (CONT.)

CHARACTERISTIC IONS FOR TARGET COMPOUNDS

Analyte	Primary Ion*	Secondary Ion(s)
1,1,2,2-Tetrachloroethane	83	85,131
1,2,3-Trichloropropane	75	77
trans-1,4-Dichloro-2-butene	53	88,75
Isopropylbenzene	105	120
n-Propylbenzene	91	120
1,3,5-Trimethylbenzene	105	120
1,2,4-Trimethylbenzene	105	120
1,3-Dichlorobenzene	146	148,111
1,4-Dichlorobenzene	146	148,111
1,2-Dichlorobenzene	146	148,111
Hexachloroethane	201	166,199,203
1,2-Dibromo-3-chloropropane	75	155,157
1,2,4-Trichlorobenzene	180	182,145
Naphthalene	128	-
2-Methylnaphthalene	142	141,115
Bromobenzene	156	77,158
n-Butylbenzene	91	92,134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91,134
p-Isopropyltoluene	119	134,91
1,2,3-Trichlorobenzene	180	182,145

The primary ion should be used unless interferences are present in which case a secondary ion may be used.

ATTACHMENT 22.10

CHARACTERISTIC IONS FOR SURROGATES AND INTERNAL STANDARDS

Compound	Primary Ion*	Secondary Ion(s)
Surrogate Compounds:		
4-BFB	95	174, 176
Toluene-d_8	98	70, 100
Dibromofluoromethane	13	111, 192
IS's:		
Pentafluorobenzene	168	137, 99
1,4-Difluorobenzene	114	63, 88
Chlorobenzene-d_5	117	82, 119
1,4-Dichlorobenzene-d4	152	115, 150

The primary ion should be used unless interferences are present in which case a secondary ion may be used.

ATTACHMENT 22.11

Quotation for Custom Standard

Custom Volatile Standard
Michigan DEQ / Sandra Buchner
Quote Number - 011200MQ

Product # CUS-3300

Components

acetone	trichlorofluoromethane
diethyl ether	1,1-dichloroethene
methylene chloride	carbon disulfide
trans-1,2-dichloroethene	MTBE
1,1-dichloroethane	2-butanone
cis-1,2-dichloroethene	chloroform
1,1,1-trichloroethane	1,2-dichloroethane
benzene	carbon tetrachloride
1,2-dichloropropane	trichloroethene
bromodichloromethane	2-hexanone
cis-1,3-dichloropropene	trans-1,3-dichloropropene
toluene	1,1,2-trichloroethane
4-methyl-2-pentanone	dibromochloromethane
1,2-dibromoethane	tetrachloroethene
chlorobenzene	ethylbenzene
*m-xylene (1000 µg/mL)	*p-xylene (1000 µg/mL)
o-xylene	bromoform
styrene	1,1,2,2-tetrachloroethane
1,2-dichlorobenzene	1,3-dichlorobenzene
1,4-dichlorobenzene	hexachloroethane
acrylonitrile	methyl iodide
bromochloromethane	dibromomethane
trans-1,4-dichloro-2-butene	1,2-dibromo-3-chloropropane
1,2,3-trichloropropane	2-methylnaphthalene
1,1,1,2-tetrachloroethane	1,2,4-trichlorobenzene
naphthalene	1,2,4-trimethylbenzene
isopropylbenzene	N- propylbenzene
1,3,5-trimethylbenzene	bromobenzene
n-butyl benzene	p-isopropyl toluene
sec-butyl benzene	tetrahydrofuran
tert-butyl benzene	1,2,3-trichlorobenzene

Solvent: Methanol
Concentration: 2000 µg/mL (except where noted *)
Quantity: 10 x 2 mL

PRICE / SHIP DATE FROM RECEIPT OF ORDER:

GRAVIMETRIC	$ 1698.00	7-10 BUSINESS DAYS
QUANTITATIVE	$ 3696.00	12-15 BUSINESS DAYS

Your signature below indicates your approval of this custom quote and your authorization to proceed to manufacture the product as described. Please sign with your purchase order number and fax back to my attention. Orders cannot be processed for custom solutions until this quote acceptance has been returned with your signature.

Signature: [signature] Date: 02/01/00

PO # 7610000702 Quantity ordered 1 EA (Gravimetric only)

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Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

VOLATILE ORGANICS Method 624/8260	Water/TCLP/SPLP Reporting Limits (ug/L)	MeOH Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
1,1,1,2-Tetrachloroethane	1.0	50	1.0	2 - 40mL glass vial	40mL tared glass	5mL of sample
1,1,1-Trichloroethane	1.0	50	1.0	w/Teflon Septum	vial	in glass
1,1,2,2-Tetrachloroethane	1.0	50	1.0	seal	10grams sample	"
1,1,2-Trichloroethane	1.0	50	1.0	14 days HT	in 10mL MeOH	"
1,1-Dichloroethane	1.0	50	1.0	"	w/teflon seal	"
1,1-Dichloroethylene	1.0	50	1.0	"	14 days HT	"
1,2,3-Trichlorobenzene	5.0	250	5.0	"	"	"
1,2,3-Trichloropropane	1.0	50	1.0	"	"	"
1,2,4-Trichlorobenzene	5.0	250	5.0	"	"	"
1,2,4-Trimethylbenzene	1.0	50	1.0	"	"	"
1,2-Dibromo-3-chloropropane	5.0	250	5.0	"	"	"
1,2-Dibromoethane	1.0	50	1.0	"	"	"
1,2-Dichlorobenzene	1.0	50	1.0	"	"	"
1,2-Dichloroethane	1.0	50	1.0	"	"	"
1,2-Dichloroethylene (cis)	1.0	50	1.0	"	"	"
1,2-Dichloroethylene (trans)	1.0	50	1.0	"	"	"
1,2-Dichloropropane	1.0	50	1.0	"	"	"
1,3,5-Trimethylbenzene(Mesitylene)	1.0	50	1.0	"	"	"
1,3-Dichlorobenzene	1.0	50	1.0	"	"	"
1,3-Dichloropropene (cis)	1.0	50	1.0	"	"	"
1,3-Dichloropropene (trans)	1.0	50	1.0	"	"	"
1,4-Dichloro-2-butene(trans)	5.0	250	5.0	"	"	"
1,4-Dichlorobenzene	1.0	50	1.0	"	"	"
2-Butanone (MEK)	5.0	250	5.0	"	"	"
2-Hexanone	5.0	250	5.0	"	"	"
2-Methylnaphthalene	5.0	250	5.0	"	"	"
Acetone (2-Propanone)	20	1,000	20	"	"	"
4-Methyl-2-Pentanone (MIBK)	5.0	250	5.0	"	"	"
Acrylonitrile	5.0	250	5.0	"	"	"
Benzene	1.0	50	1.0	"	"	"
Bromobenzene	1.0	50	1.0	"	"	"
Bromochloromethane	1.0	50	1.0	"	"	"
Bromodichloromethane	1.0	50	1.0	"	"	"
Bromoform	1.0	50	1.0	"	"	"
Bromomethane	5.0	250	5.0	"	"	"
Carbon disulfide	1.0	50	1.0	"	"	"
Carbon tetrachloride	1.0	50	1.0	"	"	"
Chlorobenzene	1.0	50	1.0	"	"	"
Chloroethane	5.0	250	5.0	"	"	"
Chloroform	1.0	50	1.0	"	"	"
Chloromethane	5.0	250	5.0	"	"	"
Dibromochloromethane	1.0	50	1.0	"	"	"
Dibromomethane	1.0	50	1.0	"	"	"
Dichlorodifluoromethane	5.0	250	5.0	"	"	"
Diethyl ether	5.0	250	5.0	"	"	"
Ethylbenzene	1.0	50	1.0	"	"	"
Hexachloroethane	5.0	250	5.0	"	"	"
Isopropylbenzene	1.0	50	1.0	"	"	"
m&p-Xylene	2.0	100	2.0	"	"	"
Methyl Iodide (Iodomethane)	1.0	50	1.0	"	"	"
Methyl Tertiary Butyl Ether (MTBE)	1.0	50	1.0	"	"	"
Methylene chloride	5.0	250	5.0	"	"	"
Naphthalene	5.0	250	5.0	"	"	"
n-Butylbenzene	1.0	50	1.0	"	"	"
n-Propylbenzene	1.0	50	1.0	"	"	"
o-Xylene	1.0	50	1.0	"	"	"
p-Isopropyl Toluene (p-Cymene)	1.0	50	1.0	"	"	"
sec-Butylbenzene	1.0	50	1.0	"	"	"
Styrene	1.0	50	1.0	"	"	"
tert- Butylbenzene	1.0	50	1.0	"	"	"
Tetrachloroethylene	1.0	50	1.0	"	"	"
Tetrahydrofuran	5.0	250	5.0	"	"	"
Toluene	1.0	50	1.0	"	"	"
Trichloroethylene	1.0	50	1.0	"	"	"
Trichlorofluoromethane	1.0	50	1.0	"	"	"
Vinyl chloride	1.0	50	1.0	"	"	"

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QLS ANSI-RAB Accredited

...WEIGHT REPORT: Uncertainty < +,-0.5% Stated Values.

Part Number: 92516
Lot Number: 032100
Description: Volatile Mix
57 Components
Expiration Date: 032105 Solvent(s): Lot#
Methanol BV851
Nominal Concentration(ug/mL): 2000

Formulated By:
032100
Vincent K. Criscio, Jr. DATE
Reviewed By:
032100
Pedro L. Reritas DATE

...Weight(s) & Volume(s) shown below were combined and diluted to 100 mL

MSDS Information (Solvent Safety Info. On Attached pg.)

Compound	(RM#) Part Number	Lot Number	Df Factor	Initial Vol (mL)	Initial Conc (ug/mL)	Nominal Conc (ug/mL)	Purity (%)	Max Target Weight(g)	*Actual Weight(g)	*Actual Conc (ug/mL)	CAS#	OSHA PEL (TWA)	LD50
Acrylonitrile	(00071)	03114LX	na	na	na	2000	99	0.20202	0.20215	2001.3			
Carbon disulfide	(00060)	03311TW	na	na	na	2000	99	0.20202	0.20220	2001.8			
trans-1,4-Dichloro-2-butene	(04486)	07710CZ	na	na	na	2000	98	0.20408	0.20410	2000.2			
Diethyl ether (Ethyl ether)	(01153)	00521PX	na	na	na	2000	99	0.20202	0.20240	2003.3			
...xachloroethane	(01391)	026248W	na	na	na	2000	99	0.20202	0.20218	2001.6			
...omethane (Methyl iodide)	(04489)	12909DQ	na	na	na	2000	99	0.20202	0.20225	2002.3			
...Methylnaphthalene	(02141)	01928MV-1	na	na	na	2000	96	0.20833	0.20839	2000.5			
...thyl tert-butyl ether (MTBE)	(02091)	AU 011347B	na	na	na	2000	99	0.20202	0.20230	2002.8			
...ranydrofuran	(03901)	13501JY	na	na	na	2000	99	0.20202	0.20216	2001.4			
Bromodichloromethane	30159	052599	0.10	10.00	20078.2	2000	na	na	na	2007.8			
Dibromochloromethane	30159	052599	0.10	10.00	20072.8	2000	na	na	na	2007.3			
1,1-Dichloroethene	30159	052599	0.10	10.00	20025.8	2000	na	na	na	2002.6			
cis-1,2-Dichloroethene	30159	052599	0.10	10.00	20000.5	2000	na	na	na	2000.0			
trans-1,2-Dichloroethene	30159	052599	0.10	10.00	20094.0	2000	na	na	na	2009.4			
Methylene chloride	30159	052599	0.10	10.00	20048.8	2000	na	na	na	2004.9			
Bromochloromethane	92517	032100	0.10	10.00	20014.3	2000	na	na	na	2001.4			
Bromoform	92517	032100	0.10	10.00	20013.6	2000	na	na	na	2001.4			
Carbon tetrachloride	92517	032100	0.10	10.00	20012.5	2000	na	na	na	2001.3			
Chloroform	92517	032100	0.10	10.00	20007.9	2000	na	na	na	2000.8			
Dibromomethane	92517	032100	0.10	10.00	20013.8	2000	na	na	na	2001.4			
1,1-Dichloroethane	92517	032100	0.10	10.00	20001.7	2000	na	na	na	2000.2			
Tetrachloroethene	92517	032100	0.10	10.00	20005.7	2000	na	na	na	2000.6			
...richloroethane	92517	032100	0.10	10.00	20001.8	2000	na	na	na	2000.2			
...romo-2-chloropropane	92518	032100	0.10	10.00	20009.8	2000	na	na	na	2001.0			
...Dibromoethane	92518	032100	0.10	10.00	20007.2	2000	na	na	na	2000.7			
1,2-Dichloroethane	92518	032100	0.10	10.00	20010.0	2000	na	na	na	2001.0			
1,2-Dichloropropane	92518	032100	0.10	10.00	20005.1	2000	na	na	na	2000.5			
cis-1,3-Dichloropropene	92518	032100	0.10	10.00	20009.8	2000	na	na	na	2001.0			
trans-1,3-Dichloropropene	92518	032100	0.10	10.00	20006.6	2000	na	na	na	2000.7			
1,1,1,2-Tetrachloroethane	92518	032100	0.10	10.00	20003.3	2000	na	na	na	2000.3			
1,1,2,2-Tetrachloroethane	92518	032100	0.10	10.00	20007.8	2000	na	na	na	2000.8			
...1,2-Trichloroethane	92518	032100	0.10	10.00	20000.7	2000	na	na	na	2000.1			
...ichloroethene	92518	032100	0.10	10.00	20010.6	2000	na	na	na	2001.1			
...2,3-Trichloropropane	92518	032100	0.10	10.00	20011.7	2000	na	na	na	2001.2			
Benzene	30162	072799	0.10	10.00	20035.4	2000	na	na	na	2003.5			
...romobenzene	30162	072799	0.10	10.00	20018.3	2000	na	na	na	2001.8			
...Butyl benzene	30162	072799	0.10	10.00	20061.2	2000	na	na	na	2006.1			
Ethyl benzene	30162	072799	0.10	10.00	20063.3	2000	na	na	na	2006.3			
p-Isopropyl toluene	30162	072799	0.10	10.00	20025.8	2000	na	na	na	2002.6			
Naphthalene	30162	072799	0.10	10.00	20026.2	2000	na	na	na	2002.6			
Styrene	30162	072799	0.10	10.00	20038.5	2000	na	na	na	2003.9			
Toluene	30162	072799	0.10	10.00	20020.1	2000	na	na	na	2002.0			
1,2,3-Trichlorobenzene	30162	072799	0.10	10.00	20061.8	2000	na	na	na	2006.2			
1,2,4-Trichlorobenzene	30162	072799	0.10	10.00	20056.7	2000	na	na	na	2005.7			
1,2,4-Trimethylbenzene	30162	072799	0.10	10.00	20077.4	2000	na	na	na	2007.7			
1,3,5-Trimethylbenzene	30162	072799	0.10	10.00	20022.4	2000	na	na	na	2002.2			
m-Xylene	30162	072799	0.10	10.00	20032.9	2000	na	na	na	2003.3			
...ert-Butyl benzene	92519	032100	0.10	10.00	20006.5	2000	na	na	na	2000.6			
...sec-Butyl benzene	92519	032100	0.10	10.00	20006.8	2000	na	na	na	2000.7			
Chlorobenzene	92519	032100	0.10	10.00	20006.3	2000	na	na	na	2000.6			
1,2-Dichlorobenzene	92519	032100	0.10	10.00	20003.3	2000	na	na	na	2000.3			
1,3-Dichlorobenzene	92519	032100	0.10	10.00	20005.3	2000	na	na	na	2000.5			
1,4-Dichlorobenzene	92519	032100	0.10	10.00	20004.0	2000	na	na	na	2000.4			
Isopropylbenzene	92519	032100	0.10	10.00	20008.8	2000	na	na	na	2000.9			
n-Propylbenzene	92519	032100	0.10	10.00	20006.6	2000	na	na	na	2000.7			
o-Xylene	92519	032100	0.10	10.00	20004.4	2000	na	na	na	2000.4			
p-Xylene	92519	032100	0.10	10.00	20008.7	2000	na	na	na	2000.9			

Calibration and QC Acceptance Criteria - Method 624 [a]

	X' (Accuracy)			S' (Precision)			Range in %	
Benzene	0.93	2.00	48.50	0.25	-1.33	10.80	44.32	149.68
Bromodichloromethane	1.03	-1.58	49.92	0.20	1.13	11.11	45.60	154.08
Bromoform	1.18	-2.35	56.65	0.17	1.38	11.01	59.57	167.03
Bromomethane	1.00		50.00	0.58		29.00	D	241.52
Carbon Tetrachloride	1.10	-1.68	53.32	0.11	0.37	6.24	76.21	137.07
Chlorobenzene	0.98	2.28	51.28	0.26	-1.92	11.41	46.87	158.25
Chloroethane	1.18	0.81	59.81	0.29	1.75	19.09	26.44	212.80
2-Chloroethylvinyl ether	1.00		50.00	0.84		42.00	D	304.96
Chloroform	0.93	0.33	46.83	0.18	0.16	8.59	51.74	135.58
Chloromethane	1.03	0.81	52.31	0.58	0.43	30.77	D	254.78
Dibromochloromethane	1.01	-0.03	50.47	0.17	0.49	9.07	56.68	145.20
1,2-Dichlorobenzene	0.94	4.47	51.47	0.30	-1.20	14.24	33.44	172.44
1,3-Dichlorobenzene	1.06	1.68	54.68	0.18	-0.82	9.02	65.33	153.39
1,4-Dichlorobenzene	0.94	4.47	51.47	0.30	-1.20	14.24	33.44	172.44
1,1-Dichloroethane	1.05	0.36	52.86	0.16	0.47	8.93	62.15	149.29
1,2-Dichloroethane	1.02	0.45	51.45	0.21	-0.38	10.42	52.03	153.77
1,1-Dichloroethene	1.12	0.61	56.61	0.43	-0.22	24.12	D	230.94
trans-1,2-Dichloroethene	1.05	0.03	52.53	0.19	0.17	10.15	55.52	154.60
1,2-Dichloropropane	1.00		50.00	0.45		22.50	D	209.80
cis-1,3-Dichloropropene	1.00		50.00	0.52		26.00	D	226.88
trans-1,3-Dichloropropene	1.00		50.00	0.34		17.00	17.04	182.96
Ethyl Benzene	0.98	2.48	51.48	0.26	-1.72	11.66	46.04	159.88
Methylene Chloride	0.87	1.88	45.38	0.32	4.00	18.52	0.37	181.15
1,1,2,2-Tetrachloroethane	0.93	1.76	48.26	0.20	0.41	10.06	47.42	145.62
Tetrachloroethene	1.06	0.60	53.60	0.16	-0.45	8.13	67.55	146.85
Toluene	0.98	2.03	51.03	0.22	-1.71	9.52	55.62	148.50
1,1,1-Trichloroethane	1.06	0.73	53.73	0.21	-0.39	10.89	54.30	160.62
1,1,2-trichloroethane	0.95	1.71	49.21	0.18	0.00	8.86	55.19	141.65
Trichloroethene	1.04	2.27	54.27	0.12	0.59	7.10	73.88	143.20
Trichlorofluoromethane	0.99	0.39	49.89	0.34	-0.39	16.57	18.91	180.65
Vinyl Chloride	1.00		50.00	0.65		32.50	D	258.60

D = Detected; result must be greater than zero.

[a] Criteria were calculated assuming a QC check sample concentration of 50ug/L.

ATTACHMENT 22.14

MDEQ-Environmental Lab
Methanol Extraction Logbook

Date___________
Analyst___________
Method 5035

ATTACHMENT 22.15

Surrogate Tracking #		Total Weight of Vial includes 10 or 25 mL of MeOH	W=TW-T-7.95 (10mL) or W=TW-T-19.8 (25mL)	MeOH Tracking #	
Sample ID	"T" Vial Tare Weight (g)	"TW" Total Weight of Vial & Contents (g)	"W" Weight of Sample (g)	Additional MeOH Added (mL)	Volume of Surrogate Added (uL)

Comments

Tentatively Identified Compounds

Criteria used by the MDEQ lab.

1. Q or probability factor criteria.
   >90% is a good match
   <50% should be investigated.
2. Spectra for all peaks must be evaluated, regardless of the Q factor.
3. We will report up to 30 peaks as TICs per sample. (The largest 30)
4. Isomer reporting:
   Report all isomers individually using the word "isomer". Example:
   1,2,4-Trimethylbenzene becomes Trimethylbenzene isomer.
   1,3,5-Trimethylbenzene becomes Trimethylbenzene isomer.
5. Minimum reporting limits:

Water volatiles:	10 ug/L	Water semivolatiles:	10 ug/L
Soil Volatiles:	500 ug/Kg(dry)	Soil Base/Neutrals:	500 ug/Kg(dry)
Oil volatiles:	5 mg/Kg	Soil Phenols:	1000 ug/Kg(dry)
		Oil semivolatiles:	50 mg/Kg

   Air Canister: 1 ppbv
6. Use the "LSC Detailed Report".
7. Use the following statement when a sample is clean or the peaks are below the minimum reporting concentration or the peaks are target compounds on another list reported out:
   A library search found no reportable compounds
8. When a peak does not meet the minimum criteria for identification but is greater than the minimum reporting concentration put the following narrative: **Peaks(s) were found that did not meet identification criteria.**
9. Units. Use the same units that are on the report (ug/L, ug/Kg, mg/Kg, or ppbv)
10. Use the area of the total ion chromatogram and areas from the nearest internal standard with a response factor of one to calculate concentration of a TIC. If a large interference is present then the areas from the mass chromatograms should be used.
11. Statement, which is hardcoded into LIMS for library searches: **Reported library search compounds are tentative identifications with estimated concentrations.**
12. Report concentrations to two significant figures.
13. Target compounds as TICs. Any peak originally ID'd by the computer as a target compound which does not meet the target compound identification criteria should be considered as a TIC and reported if TIC criteria is met.
14. TICs identified as target compounds. Double check the quant report to ensure that the target compound was reported correctly. (RT may have been off or the detector may have been saturated) Fix the quant report if necessary. IF the quant report was correct and this TIC is a different peak than the target peak, then choose the next spectrum that meets criteria. If none meet the criteria report as in #8.
15. Multiple peaks...same compound
    If more than one peak is identified as the same compound, report the compound once at the highest concentration (unless it is an isomer, then see #4)
16. Statements for hydrocarbons:
    Fraction of hydrocarbons similar to _____ present in sample. (Diesel fuel, gasoline, etc)
    Fraction of hydrocarbons from C ____ to C____ present in sample.
17. HP Chemstation settings for PBM Search:

U + A = 4	Low report MW = 40 (38 for canisters)
Tilting = on	High report MW = 9999
Flag Threshold = 3%	Max hits = 20
Cross-correlation sort = off	Remove duplicate CAS numbers = on
Minimum estimated purity = 50%	

18. Method blanks should be evaluated to verify that TIC peaks present in the sample are not found in the blank. Common laboratory contaminants and some sources:
    - Siloxanes (m/z 73) from column bleed.

- Carbon Dioxide (m/z 44), diethyl ether, hexane, freons, methylene chloride, acetone. These may be found in VOC analysis.
- Phthalates from plastics. These may be found in SVOC analysis.
- Solvent preservatives such as cyclohexene which is a MeCl preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene,and chlorocyclohexanol. These may be found in SVOC analysis.
- Aldol condensation reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone. These may be found in SVOC analysis of soil samples due to the extraction process.

19. Library searches should **NOT** be performed on internal standards or surrogates.
20. Do not report non-organic compounds as TICs.
21. Do not report sulfur compounds as TICs.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

DRINKING WATER AND RADIOLOGICAL PROTECTION DIVISION - ENVIROMENTAL LAB.

VOLATILE ANALYSIS INTERNAL STANDARD AREA AND RT SUMMARY

DATE OF RUN: 1 Mar 2001 6:56 am

DATA PATH: D:\HPCHEM\1\DATA\030101\

ANALYST: 5972-12

	DATA FILE	PFB AREA	PFB RT	DFB AREA	DFB RT	CBZ AREA	CBZ RT	DCB AREA	DCB RT
12 HR STD	0201003.D	537547	12.60	866901	13.97	750325	19.08	639609	23.33
LOWER LIMIT		268774	12.10	433451	13.47	375163	18.58	319805	22.83
UPPER LIMIT		1075090	13.10	1733800	14.47	1500650	19.58	1279220	23.83
BLANK	0101002.D	639166	12.61	1037750	13.98	847459	19.07	628556	23.32
CC	0201003.D	537547	12.60	866901	13.97	750325	19.08	639609	23.33
LCS	0301004.D	528627	12.61	853115	13.98	738269	19.08	567737	23.32
BLANK	0401005.D	504529	12.61	808646	13.98	696087	19.08	536160	23.33
S02132-01 TB 100UL	0501006.D	499893	12.61	809606	13.98	710761	19.09	545884	23.33
S02132-02 FB 100UL	0601007.D	519158	12.61	847274	13.98	743200	19.09	571281	23.33
S02132 -03 9.37/10ML 100UL	0701008.D	519733	12.61	852153	13.98	739047	19.09	572896	23.33
S02132-04 9.06/10ML 100UL	0801009.D	483632	12.61	804275	13.98	709018	19.09	551924	23.33
S02132-05 9.84/10ML 100U	0901010.D	518542	12.61	846690	13.99	740800	19.09	568343	23.33
S02132-06 9.14G/10ML 10UL	1001011.D	551563	12.61	898595	13.99	750725	19.09	568023	23.33
S02132-07 9.39/10ML 100UL	1101012.D	515386	12.62	823880	13.99	721108	19.10	545895	23.34
S02132-08 9.81/10ML 100UL	1201013.D	605174	12.61	989121	13.99	858820	19.09	645691	23.34

INTERNAL STANDARDS

(PFB)=PENTAFLUOROBENZENE

(DFB)=1,4-DIFLUOROBENZENE

(CBZ)=CHLOROBENZENE-d5

(DCB)=1,4-DICHLOROBENZENE-d4

AREA UPPER/LOWER CONTROL LIMIT= +100/-50% OF INTERNAL STANDARD

=INDICATES VALUES OUTSIDE OF QC LIMITS.

Example

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

DRINKING WATER AND RADIOLOGICAL PROTECTION DIVISION - ENVIROMENTAL LABORATORY

VOLATILE ANALYSIS SURROGATE SUMMARY

DATE OF RUN: 1 Mar 2001 6:56 am

DATA PATH: D:\HPCHEM\1\DATA\030101\

ANALYST: 5972-12

	DATA FILE	SMC1 (DBFM)	SMC2 (TOL)	SMC3 (BFB)	Time Acquired
QC LIMITS :	WATER	81-122	89-110	72-130	
	SEDIMENT	71-117	74-122	63-133	
BFB TUNE FILE	9901001.D				1 Mar 2001 6:56 am
BLANK	0101002.D	99.46	103.45	101.55	1 Mar 2001 7:28 am
CC	0201003.D	100.12	100.06	92.37	1 Mar 2001 8:07 am
LCS	0301004.D	97.94	99.86	101.46	1 Mar 2001 8:47 am
BLANK	0401005.D	98.06	99.59	100.86	1 Mar 2001 9:27 am
S02132-01 TB 100UL	0501006.D	106.65	106.67	108.39	1 Mar 2001 10:06 am
S02132-02 FB 100UL	0601007.D	100.43	100.58	101.37	1 Mar 2001 10:45 am
S02132 -03 9.37/10ML 100UL	0701008.D	98.07	99.72	100.55	1 Mar 2001 11:24 am
S02132-04 9.06/10ML 100UL	0801009.D	92.85	91.51	95.40	1 Mar 2001 12:04 pm
S02132-05 9.84/10ML 100U	0901010.D	96.34	96.19	98.71	1 Mar 2001 12:44 pm
S02132-06 9.14G/10ML 10UL	1001011.D	8.78#	9.42#	10.99#	1 Mar 2001 1:24 pm
S02132-07 9.39/10ML 100UL	1101012.D	95.16	95.66	97.61	1 Mar 2001 2:05 pm
S02132-08 9.81/10ML 100UL	1201013.D	77.30#	78.10#	82.49	1 Mar 2001 3:08 pm

SYSTEM MONITORING COMPOUNDS

SMC1 (DBFM) =DIBROMOFLUOROMETHANE

SMC2 (TOL) =TOLUENE-d8

SMC3 (BFB) =4-BROMOFLUOROBENZENE

= INDICATES VALUES OUTSIDE QC LIMITS.

Example

ATTACHMENT 22.19

QC SUMMARY

INSTRUMENT:									ANALYST:				RUN DATE:	
SITE QA/QC									METHOD:				LAST CALIBRATION:	
	BFB	PASS			FAIL :				ion					
	BFB	PASS			FAIL :				ion					
	INIT.CAL.	flag >15%												
		I1	I2	I3	I4	S1	S2	S3						
	CAL.VER.								flag >20%					
	BLANK								flag>RDL					
	LCS								#=flag	dce	ben	tce	tol	chl
	MS								#=flag	dce	ben	tce	tol	chl
	MSD								#=flag	dce	ben	tce	tol	chl
	rsd													
	SAMPLES	I1	I2	I3	I4	S1	S2	S3	DILUTION	REPEAT	COMMENTS/CODES			

Method: 5035

MDEQ-Environmental Lab
Oil Dilution Logbook - Volatiles

#	Date	Analyst	Sample Number	Sample Weight (g)	Final Volume (mL)	MeOH #	Comments
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

ATTACHMENT 22.21

SEDIMENT PREPARATION (%TOTAL SOLID & DRYING)

Oven Temperature
Initial Temp. (105 ± 5°C) _____
Final Temp. (105 ± 5°C) _____

Calibration Weights
Initial 20 g _____ Initial 50 g _____
Final 20 g _____ Final 50 g _____
Balance Centered Y N

Run # _____
Date _____
Analyst _____

WORK ORDER #	MS	OS	DRY & GRIND	TARE WT.	WET WT.	DRY WT	%TS	COMMENTS
BLANK							#DIV/0!	
BLANK							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
							#DIV/0!	
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							#DIV/0!	
							#DIV/0!	
							#DIV/0!	

	SAMPLE	SAMPLE DUPLICATE	RPD
PC			#DIV/0!
PC			#DIV/0!
PC			#DIV/0!
PC			#DIV/0!
PC			#DIV/0!

ENVIRONMENTAL LAB

MDEQ SOP # 502 REVISION #_____

EFFECTIVE DATE 02/04

RELEASED BY _____ DATE 2/09/2004
COMPLIANCE OFFICER

Organochlorine Pesticides, Polychlorinated Biphenyls (PCBs), and Chlorinated Hydrocarbons by Gas Chromatography (GC)

1.0 Applicable Analytical Methods

1.1 Organochlorine Pesticides by Gas Chromatography, U.S. Environmental Protection Agency, Method 8081A, SW846, Revision 1, December 1996.

1.2 Polychlorinated Biphenyls (PCBs) By Gas Chromatography, U.S. Environmental Protection Agency, Method 8082, SW846, Revision 0, December 1996.

1.3 Determinative Chromatographic Separations, U.S. Environmental Protection Agency, Method 8000B, SW846, Revision 2, December 1996.

1.4 Quality Control, U.S. Environmental Protection Agency, Chapter 1, SW846, Revision 1, July 1992.

1.5 Organic Extraction and Sample Preparation, U.S. Environmental Protection Agency, Method 3500B, SW846, Revision 2, December 1996.

1.6 Cleanup, U.S. Environmental Protection Agency, Method 3600C, SW846, Revision 3, December 1996.

1.7 Organochlorine Pesticides and PCBs, U.S. Environmental Protection Agency, Method 608, 40CFR, Part 136, Appendix A.

1.8 Chlorinated Hydrocarbons, U.S. Environmental Protection Agency, Method 612, 40 CFR, Part 136, Appendix A.

2.0 Matrix or Matrices

2.1 Aqueous.

PCB

2.2 Soil.

2.3 Sediment.

2.4 Sludge.

2.5 Clay.

2.6 Oil.

2.7 Solid or liquid waste.

3.0 Method Detection Limits (MDLs) and Reporting Limits (RLs)

3.1 All MDLs shall be performed according to the Code of Federal Regulations 40 CFR, Part 136, Appendix B. See internal procedure SOP 103.

3.2 Every individual analyte to be quantitated by this method must have an MDL study performed for it. The MDL results for Aroclors 1016 and 1260 are used to determine MDLs for the rest of the PCBs. Results obtained for analytes that have not had an MDL calculated by this method must be considered estimated. MDLs are analyzed annually or whenever major instrument changes occur. MDLs are carried through the same extraction and cleanup procedures as samples are. (Refer to SOP 405, SOP 400, and SOP 403 for details.) Some compounds may need to be prepared at multiple levels. A Method Preparation Blank (MPB) is run with each batch.

3.2.1 Water MDLs – MDLs will be done for every pesticide analyte, for a combination of Aroclors 1016 and 1260 to cover all of the PCBs, and for toxaphene. Each of these sets may have to be done at multiple concentration levels to get the MDLs within the proper range.

3.2.2 Soil MDLs – MDLs will be done for every pesticide analyte, for a combination of Aroclors 1016 and 1260 to cover all of the PCBs, and for toxaphene. Each of these sets may have to be done at multiple concentration levels to get the MDLs within the proper range.

3.2.2.1 Due to the number of Accelerated Solvent Extraction (ASE) units and gel permeation chromatography (GPC) units used in the preparation steps for PCB/pesticide soil samples, the MDLs should be prepared in the following manner:

3.2.2.1.1 Six spiked replicates and three MPBs for each set of analytes per concentration level will be extracted on each ASE (a total of 12 spiked replicates and 6 MPBs per concentration level).

3.2.2.1.2 Two replicates and one MPB from each ASE at each concentration level will be placed on each of the three GPCs.

3.2.2.1.3 All of the spiked replicates (12) and all of the MPBs (6) will be analyzed on each GC.

3.3 A RL will be used as the minimum quantification limit for all analytes reported unless otherwise specified. The RL will always be routinely achievable and greater than the MDL. (Refer to internal procedure SOP 103 for further details.)

4.0 Scope and Application

4.1 This method provides for the GC/electron capture detector (ECD) determination of organochlorine pesticides and PCBs in aqueous, oil, and solid matrices. This method is restricted to use by (or under the supervision of) analysts who are experienced in the use of GC and who are skilled in the interpretation of chromatograms and their uses as a quantitative tool. The RLs for solid samples are reported on a dry-weight basis (Attachment 22.6).

4.2 The following compounds are analyzed by this method:

Analyte	Chem. Abstract Services Registry No.
Aldrin	309-00-2
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5
Aroclor 1262	37324-23-5
Aroclor 1268	11100-14-4
a-BHC	319-84-6
b-BHC	319-85-7
g-BHC (Lindane)	58-89-9
d-BHC	319-86-8
2,2',4,4',5,5'-Hexabromobiphenyl(BP-6)(PBB)	59080-40-9
a-Chlordane	5103-71-9
g-Chlordane	5103-74-2
4,4'-DDD	72-54-8
4,4'-DDE	72-55-9
4,4'-DDT	50-29-3
Dieldrin	60-57-1
Endosulfan I	959-98-8
Endosulfan II	33213-65-9
Endosulfan Sulfate	1031-07-8
Endrin	72-20-8

Endrin Aldehyde	7421-93-4
Endrin Ketone	53494-70-5
Heptachlor	76-44-8
Heptachlor Epoxide	1024-57-3
Hexabromobenzene	87-82-1-M
*Hexachlorobenzene	118-74-1
*Hexachlorobutadiene	87-68-3
*Hexachlorocyclopentadiene	77-47-4
Mirex	2385-85-5
Methoxychlor	72-43-5
*Pentachlorobenzene	608-93-5
* Pentachloronitrobenzene	82-68-8
Toxaphene	8001-35-2
*1,2,3,4-Tetrachlorobenzene	634-66-2
*1,2,4,5-Tetrachlorobenzene	9594-3

*Scan 3 water analysis only for NPDES permits

5.0 Method Summary

5.1 Water samples are extracted as in SOP 405. Water samples are cleaned up as in SOP 400 and SOP 403.

5.2 Solid samples are extracted as in SOP 401. Solid samples are cleaned up as in SOP 400.

5.3 Oil samples are prepared as in SOP 404. Oil samples are cleaned up as in SOP 400 and SOP 402.

5.4 The sample extracts are then injected onto a GC. The GC is temperature programmed to separate the analytes, which are then detected with an ECD.

5.5 The pesticide compounds are analyzed by GC/ECD with dual capillary columns. When unknown samples are analyzed by this method, a second capillary column of different stationary phase polarity confirms the identification of any single peak compound. Interpretations are performed by analyzing samples under the same conditions used for standards and by comparing retention times (RTs) of the unknown peaks to standards on each column. Quantitation is accomplished by comparing the response of the unknown to the initial calibration curve. Confirmation of the analysis may be done by GC/mass spectrometry (MS) provided the samples are sufficiently concentrated.

5.6 Multi-component compounds (PCBs and toxaphene) are analyzed by GC on a single capillary column and GC/ECD. Interpretations are performed by analyzing samples under the same conditions used for standards and comparing chromatographic patterns and RTs of the unknown peaks to standards on each column. Quantitation is accomplished by comparing the response of the unknown to the initial calibration curve.

Confirmation of the analysis may be done by GC/MS provided the samples are sufficiently concentrated.

6.0 Definitions

6.1 MDL - The minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero.

6.2 Surrogate Analyte (SA) - A pure analyte that is extremely unlikely to be found in any sample. The SA is added to a sample aliquot in known amounts before extraction or other processing and is measured with the same procedures used to measure other sample components. The purpose of the SA is to monitor method performance with each sample.

6.3 MPB - An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and surrogates that are used with samples. The MPB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

6.4 Laboratory Control Sample (LCS) - An aliquot of reagent water or other blank matrix to which known quantities of the target analytes are added in the laboratory. The LCS is analyzed and prepared exactly as a sample. Its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements.

6.5 Matrix Spike (MS) - An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MS is analyzed and prepared exactly as a sample. Its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS corrected for background concentrations.

6.6 Matrix Spike Duplicate (MSD) – An aliquot of a sample to which known quantities of the target analytes are added in the laboratory. The MSD is analyzed and prepared exactly as a sample and as the MS. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MSD corrected for background concentrations. Analyses of the MS and MSD indicate precision associated with laboratory procedures.

6.7 Initial Calibration Verification (ICV) – Second source standards used to check the accuracy of the calibration standards (CALs). This standard includes all target analytes and should be from a different vendor or a different lot number than the CALs.

6.8 Continuing Calibration Standard (CCS) – A mid-range standard to check the overall instrument performance.

6.9 Stock Standard (SS) – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

6.10 Working Standard (WS) – A solution of an analyte(s) prepared in the laboratory from SSs and diluted as needed to prepare calibration solutions and other needed analyte solutions.

6.11 System Blank (SB) – An aliquot of hexane that has not undergone any preparation and is analyzed under the same analytical conditions as a sample. The purpose of the SB is to check for instrument contamination.

7.0 Interferences

7.1 Contamination by carryover can occur whenever high-level samples and low-level samples are sequentially analyzed. The sample syringe is rinsed with solvent between sample analysis to reduce carryover. Whenever an unusually high sample is encountered, the sample following it must be evaluated for contamination and rerun if carryover is suspected.

7.2 Interference from contaminants can occur from solvents, glassware, and other sample processing equipment. Use of pesticide quality solvents or better and solvent rinsing of all glassware should help minimize contaminants.

7.3 Compounds co-extracted with the analytes of interest can cause interference. Samples should be cleaned up to avoid interference whenever possible.

7.4 Some interference may still exist after this cleanup. This interference is identified through the analysis with the alternate column and/or GC/MS confirmation. The initial results are then reevaluated with the interference taken into consideration. When data is suspect for interference, it will be qualified.

7.5 The presence of elemental sulfur causes broad peaks that can interfere with the detection of early eluting pesticides. Sulfur can be removed by optimizing the collection window from the GPC column to eliminate collection of sulfur (SOP 400).

7.6 Oily sample matrices will often cause a raised baseline, RT shifts, and/or surrogate failure. Samples will usually need a dilution performed to minimize this interference. RLs will then be elevated appropriately. A silica gel clean-up (SOP 402) can also be effective at removing interferences.

8.0 Safety

8.1 Safety glasses are required in all designated laboratory areas.

8.2 Be familiar with the Laboratory Chemical Hygiene Plan.

8.3 Be familiar with the Laboratory Safety Policy (internal procedure SOP 100).

8.4 Gas cylinders must be secured to a wall or to a countertop.

8.5 Hexane material safety data sheets (MSDSs) are attached (Attachment 22.1).

8.6 Protective gloves must be worn when handling solvents.

9.0 **Equipment and Supplies**

9.1 Microsyringes – Various sizes.

9.2 Volumetric flasks - Class A, with ground-glass stoppers.

9.3 Vials - 2 mL autosampler vials, with crimp caps.

9.4 Pipettes - Class A.

9.5 Pasteur pipettes – Disposable.

9.6 Pipette bulbs.

9.7 Refrigerator and freezer.

9.8 GC

9.8.1 Hewlett Packard model 5890 or 6890 GC - Equipped with an autosampler and split/splitless capillary injector. The instrument may have an electronic pressure controller also. The electronic pressure controller maintains constant flow as the GC temperature increases during programming.

9.8.2 Typical operating conditions can be found in Attachment 22.7. Changes or deviations can be found in the GC maintenance logbooks.

9.9 ECD – Because of its high sensitivity, the ECD should never be used without moisture and chemical traps that are in good condition installed in the carrier and make-up gas lines. It is important to create calibrations for all compounds and evaluate detector response on a regular basis.

9.9.1 Agilent ECD - For model 5890 GC.
9.9.2 Agilent micro-ECD - For model 6890 GC.

9.10 GC interface

9.10.1 The capillary column in the GC is directly interfaced into the ECD.

9.10.2 Capillary columns

9.11.1 Narrow bore capillary column – Phenomenex Zebron ZB-5, 30 m long x 0.25 mm ID x 0.25 – 1.0 µm film thickness or equivalent.

9.11.2 Narrow bore capillary column – Phenomenex Zebron ZB-35, 30 m long x 0.25 mm ID x 0.25 -1.0 µm film thickness or equivalent.

9.11 Data system - A personal computer is interfaced to the GC system. The computer system is equipped with an assortment of disk drives and a hard drive and is installed on a network with CD back-up capabilities. The software (Turbochrom Workstation) is made by P.E. Nelson and is multitasking and window driven. The software has a function for the comparison of chromatograms (Attachment 22.8).

10.0 Reagents and Standards

10.1 All reagents, solvents, and standards must be traceable to the stock inventory tracking log.

10.2 All reagents, solvents, and standards must be labeled with: date received, date opened, expiration date, tracking number, and receiver's initials.

10.3 All prepared reagents and standards must be labeled with: date prepared, expiration date, preparer's initials, tracking number, diluent, and description.

10.4 All standard logbooks must be completely filled out.

10.5 All certificates of analysis must include the stock inventory tracking number that was assigned to the standard. The Laboratory's Quality Assurance/Quality Control (QA/QC) Officer keeps original certificates.

10.6 Hydrogen (carrier gas) – Ultra-high purity.

10.7 Nitrogen (make-up gas) - Ultra-high purity.

10.8 Hexane - Pesticide grade demonstrated to be free of analytes (Attachment 22.1).

10.9 SSs - All standards must be certified reference materials. Manufacturers' certificates of analysis are retained by the Laboratory and kept as part of the overall QA/QC requirements. All SSs must be given a unique lab tracking number and logged into the SS tracking logbook (Attachment 22.3).

10.9.1 SSs are purchased as mixes in sealed ampules and are stored in a freezer at a temperature lower than -10°C.

10.9.2 CALs

10.9.2.1 Pesticide and chlorinated hydrocarbon mixes (1000 µg/mL) in hexane - Absolute Standards, part #93238 and part #93237 or equivalent. (Refer to Attachment 22.2 for compound lists.)

10.9.2.2 PCB mix (1000 µg/mL) in hexane - Absolute Standards, part #20064 or equivalent.
Aroclor 1016
Aroclor 1260

10.9.2.3 Surrogate mix (200 µg/mL) in acetone - Absolute Standards, part #20023 or equivalent.
2,4,5,6–tetrachloro-m-xylene
decachlorobiphenyl

10.9.2.4 Individual Aroclor standards (1000 µg/mL) in hexane

Aroclor	Absolute Standards Part #
1221	90124
1232	90125
1242	90126
1248	90127
1254	90128
1262	EPC00728 (EM Science)
1268	EPC00994 (EM Science)

10.9.2.5 Toxaphene standard (1000 µg/mL) in hexane - EM Science, part #EPP00388 or equivalent.

10.9.3 ICV

10.9.3.1 Pesticide mix (1000 µg/mL) - Absolute Standards, part #93238 and part #93237 or equivalent. (Refer to Attachment 22.2 for compound lists.) Different vendor or lot number than CALs.

10.9.3.2 PCB (1000 ug/mL) - Absolute Standards, part #20064 or equivalent.
Aroclor 1016
Aroclor 1260
Different vender or lot number than CALs.

10.9.4 DDT/endrin breakdown standard – Endrin 1000 µg/L, DDT 2000 µg/L in hexane from Ultra Scientific part #ISM-450 or equivalent.

10.10 Intermediate and WSs - All prepared standards must be given a unique laboratory tracking number and must be logged into the semivolatile standards logbook (Attachment 22.4). Store intermediate and working solutions at -10°C to -20°C in amber bottles with teflon-lined caps. The intermediate standards must be checked frequently for signs of degradation or evaporation. Fresh standards should be prepared if a check standard evaluation exceeds a 15% drift. All standards are good for up to six months.

10.10.1 Intermediate and working CALs – Place approximately 50 mL of hexane into the appropriate volumetric flask. Inject the SS or intermediate listed directly into the hexane. Bring to volume with hexane. Cap. Mix. Transfer into an amber bottle. Cap each bottle securely. Label. Store in a freezer at <-10°C.

		SS or Intermediate	mL	Final Volume (mL)	Final Conc (µg/L)
10.10.1.1	PESTICIDE WSs	10.9.2.1 (each)	0.125	500	250
		250 µg/L	100	200	125
		250 µg/L	40	200	50
		250 µg/L	12	100	30
		250 µg/L	8	200	10
		250 µg/L	2	100	5
		250 µg/L	1	100	2.5

		SS or Intermediate	mL	Final Volume (mL)	Final Conc (µg/L)
10.10.1.2	PCB WSs	10.9.2.2/10.9.2.3	1/.625	500	2000/250
		2000/250	100	200	1000/125
		2000/250	50	200	500/62.5
		2000/250	20	200	200/25
		2000/250	10	200	100/12.5
		2000/250	5	200	50/6.25
		1000/125	5	200	25/3.12

		SS or Intermediate	mL	Final Volume (mL)	Final Conc (µg/L)
10.10.1.3	TOXAPHENE WSs	10.9.2.5	0.2	100	2000
		10.9.2.5	0.1	100	1000
		2000	25	100	500
		2000	10	100	200
		2000	5	100	100
		1000	5	100	50
		500	5	100	25

10.10.2 ICV WSs – ICV WSs are stored in amber bottles with teflon–lined caps at less than -10°C.

10.10.2.1 100 µg/L pesticide ICV – Place 20 µL each of pesticide and chlorinated hydrocarbon ICV SSs (Section 10.9.3.1) into a 200 mL volumetric flask containing approximately 100 mL of hexane. Bring to volume with hexane. Mix. Transfer to an amber bottle. Label. Store in a freezer.

10.10.2.2 500 µg/L PCB ICV – Place 100 µL of stock (Section 10.9.3.2) into a 200 mL volumetric flask containing approximately 100 mL of hexane. Bring to volume with hexane. Mix. Transfer to an amber bottle. Label. Store in a freezer.

10.10.3 DDT/endrin (100 µg/L /50 µg/L) breakdown WS - Place 2.5 mL (Section 10.9.4) into a 50 mL volumetric flask containing 25 mL of hexane. Bring to volume with hexane. Mix. Transfer to an amber bottle. Label. Store in a freezer.

10.10.4 Single point Aroclor WSs – Place approximately 50 mL of hexane into the appropriate volumetric flask. Inject the SS or intermediate listed into the hexane. Dilute to the mark. Cap. Mix. Transfer into an amber bottle. Cap. Label. Store in a freezer at <-10°C.

10.10.4.1 Aroclor 1221/1262 mix (2000 µg/L) – Place 200 µL of Aroclor 1221 and 200 µL of Aroclor 1262 (Section 10.9.2.4) into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.1.1 Aroclor 1221/1262 WS (500 µg/L) – Place 25 mL of the mixture from Section 10.10.4.1 into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.2 Aroclor 1232/1268 mix (2000 µg/L) – Place 200 µL of Aroclor 1232 and 200 µL of Aroclor 1262 (Section 10.9.2.4) into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.2.1 Aroclor 1232/1268 WS (500 µg/L) – Place 25 mL of the mixture from Section 10.10.4.2 into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.3 Aroclor 1242 (2000 µg/L) – Place 200 µL of Aroclor 1242 (Section 10.9.2.4) into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.3.1 Aroclor 1242 WS (500 µg/L) – Place 25 mL of the mixture from Section 10.10.4.3 into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.4 Aroclor 1248 (2000 µg/L) – Place 200 µL of Aroclor 1248 (Section 10.9.2.4) into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.4.1 Aroclor 1248 WS (500 µg/L) – Place 25 mL of the mixture from Section 10.10.4.4 into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.5 Aroclor 1254 (2000 µg/L) - Place 200 µL of Aroclor 1254 (Section 10.9.2.4) into a 100 mL volumetric flask. Dilute. Mix.

10.10.4.5.1 Aroclor 1254 WS (500 µg/L) – Place 25 mL of the mixture from Section 10.10.4.5 into a 100 mL volumetric flask. Dilute. Mix.

11.0 Sample Collection, Preservation, and Handling

11.1 Aqueous samples – Refer to SOP 405.

11.2 Solid samples – Refer to SOP 401.

11.3 Waste samples – Refer to SOP 404.

11.4 Holding times – Sample extracts may be analyzed for up to 40 days from the extraction date.

11.5 Storage – Sample extracts must be stored in a freezer, protected from light, in crimp cap vials or test tubes with teflon-lined caps, until analysis.

12.0 Quality Control (QC)

12.1 DDT/endrin breakdown analysis - Prior to the analyses of any samples, blanks, CALs, or QA/QC samples for pesticides, the GC system must meet the acceptance criteria for the instrument performance check solution containing DDT/endrin. GC injector ports can be of critical concern, especially in the analysis of DDT and endrin. Injectors that are contaminated, chemically active, or too hot can cause the degradation (breakdown) of the analytes. Endrin and DDT break down to endrin aldehyde and/or endrin ketone and DDD and/or DDE respectively. If the DDT or endrin compounds in the CCV are low, excessive breakdown should be suspected. When such breakdown is observed, corrective actions are to clean and deactivate the injector port and/or break off up to 30 cm of the column and remount it. The injector temperature should be checked and lowered if indicated.

12.1.1 Inject 2 µL of a solution containing DDT at 100 µg/L and endrin at 50 µg/L (Section 10.10.3) into the GC.

12.1.2 See Section 15.9 for calculation of breakdown.

12.1.3 Analysis of the DDT/endrin breakdown solution must show the breakdown of DDT and endrin to be less than 15% for each component.

12.2 Extracted sample batches

12.2.1 Extracted sample batches consist of a maximum of 20 samples, 1 MPB, 1 MS, 1 MSD, and 1 LCS. If a MS/MSD is not available, a LCSD must be analyzed.

12.2.2 All 20 samples and the QC samples are spiked with known surrogate concentrations. The recoveries for these compounds are used as indicators of possible problems that may occur during extraction of individual samples.

12.2.3 The MS, MSD, LCS, and LCSD are spiked at a known concentration with either pesticides or PCBs.

12.3 Initial CALs

12.3.1 A set of five or more calibration levels (Section 10.10.1.1) is analyzed for pesticides. (Refer to Section 15 for calculations and to Section 18.2 for acceptance criteria.) A minimum of five standard levels is used to determine the calibration of a linear curve. A minimum of six levels is used to determine the calibration of a quadratic curve.

12.3.2 Multiple component analytes (PCBs and toxaphene) use five or more CAL levels for the mixture of Aroclors 1016 and 1260 (Section 10.10.1.2) and for toxaphene (Section 10.10.1.3). A single point calibration WS is used for other Aroclors (Section 10.10.4) unless it is known that a certain Aroclor is present. In this situation, a multiple-point calibration curve may be analyzed.

12.3.3 Samples may be analyzed within the 12-hour time frame following completion of the initial calibration and providing that the ICV passes.

12.4 CCS – A check of the calibration curve must be performed once every 12 hours. It is not necessary to analyze a CCS within the 12-hour time period in which the initial calibration was performed. The check must include at least two standards, one for pesticides and one for PCBs (Aroclors 1016 and 1260). If the criteria in Section 18.3.1 are met, the initial calibration curves are still valid.

12.5 Blanks – A SB or MPB must be analyzed after the CCS. A blank must be analyzed every 12 hours to show that the analytical system is free from interferences and contamination. A blank will be run more frequently if contamination is a concern. If the criteria in Section 18.6 or in Section 18.7 are met, the analysis of samples can begin.

12.6 Replicates

12.6.1 The laboratory analyzes a MS/MSD or a LCS/LCSD pair at a minimum of once every extraction batch to assess precision and accuracy.

12.6.2 If the sample associated with the MS and MSD does not meet surrogate acceptance criteria, Section 19.1.4 should be followed.

12.7 LCS/LCSD

12.7.1 One LCS must be prepared for every batch of samples. A LCSD must be prepared if a MS/MSD is not available.

12.7.2 Refer to Section 18.4 for acceptance criteria.

12.8 RT windows

12.8.1 Three sets of standards are analyzed over a 72-hour period. The standard deviation (SD) is determined and the RT window is the larger of 3X the SD or +/- 0.03 min. from the RT of a mid-point initial CAL.

12.8.2 Drifting of the surrogate compound RTs is used as an indicator of possible matrix induced drifting. Oil samples tend to have drifting RTs. The analyst's experience is depended upon in this situation.

12.9 ICV – The ICV is analyzed after every initial calibration and at least once per quarter. The ICV may be analyzed in place of the CCS. Refer to Section 18.3 for acceptance criteria.

12.10 Initial demonstration of accepability - Each analyst must demonstrate initial proficiency with this method by generating data of acceptable accuracy and precision for the target analytes. This is accomplished by preparing and analyzing four aliquots of a reference sample for each scan.

12.10.1 Reference sample preparation - Five aliquots of reagent water or sand are extracted using SOP 401 or SOP 405. One of these aliquots is a MPB. The other four are spiked at a mid-range concentration with all of the pesticide single compound analytes listed in Section 4.1. This is repeated for the Aroclor mix of 1016 and 1260 and for toxaphene.

12.10.2 The normal sample cleanup methods are used for sample extracts.

12.10.3 Calculate the recovery of each compound (Section 15.5). Compare to the laboratory generated limits.

12.10.4 Calculate the SD of each compound and compare them to laboratory generated limits.

12.11 Surrogate compounds are added to all samples, MPBs, and QC samples during extraction. Surrogate recovery data is compared to DEQ Laboratory generated limits.

13.0 Calibration and Standardization

13.1 Initial calibration curve - The GC system is calibrated prior to the analysis of samples. The WSs prepared in Section 10.10.1 are analyzed. A minimum of five levels are used for each calibration curve for pesticides and toxaphene and for the mixture of Aroclors 1016 and 1260. Single-point calibrations are normally used for the rest of the Aroclors. A mixture of Aroclors 1016 and 1260 will include many of the peaks found in the other Aroclors. A calibration of 1016/1260 with 5 concentration levels should be sufficient to determine the linearity of the detector response. Single-point standards at the linear range midpoint of the detector for the other Aroclors can be used to determine the calibration factor of those Aroclors. All standards, blanks, samples, and QC are injected at the same volume (usually 2 µL). The initial calibration is performed whenever the CCS, which is run every 12 hours, fails to meet acceptance criteria or when major instrument repairs are made.

13.1.1 Evaluate the initial calibration (Section 18.2). If the criteria are met, analysis of the ICV may proceed. If the criteria are not met, evaluate the calibration using the linear curve or the quadratic curve or perform instrument maintenance and repeat.

13.2 ICV - The ICV is analyzed after every acceptable initial calibration to verify the accuracy of the initial CALs. The ICV is prepared as described in Section 10.10.2.

13.2.1 Calculate the recovery of each analyte (Section 15.5).

13.2.2 Evaluate the ICV (Section 18.3). If the ICV meets the criteria, proceed with Section 14. If the ICV does not meet the criteria, maintenance should be performed as needed.

13.3 SB - A SB is analyzed after every calibration curve to ensure that the system is contamination free.

13.3.1 Place 1 mL of hexane into a crimp cap vial. Cap. Inject onto the GC.
13.3.2 Evaluate the data (Section 18.6).

14.0 Procedure

14.1 Blank – A MPB or a SB is analyzed once every 12-hour shift in which samples are analyzed.

14.1.1 Evaluate the data (Section 18.6 or Section 18.7).

14.2 CCS - The CCS verifies that the initial calibration curve is still valid. It is analyzed once every 12-hour shift. The concentration may alternate between a high standard and a low standard. The concentration is prepared as described in Section 10.10.1.

14.2.1 Calculate the % difference from the initial calibration (Section 15.7).
14.2.2 Evaluate the data (Section 18.3). If the criteria are met, proceed with Section 14.3. If the criteria are not met, maintenance should be performed as needed, or a new calibration should be performed.

14.3 Sample analysis

14.3.1 Load the samples onto the autosampler. (See Attachment 22.5 for an example). Analyze.
14.3.2 Evaluate each target compound (Section 18.1) and chromatogram (Section 18.5).
14.3.3 Calculate target analyte concentrations (Section 15.1 and/or Section 15.2).
14.3.4 Calculate the recovery of each spiked compound (Section 15.4 and Section 15.5).
14.3.5 Calculate the relative percent difference (RPD) of the MS/MSD or LCS/LCSD pair (Section 15.6).
14.3.6 Evaluate the recovery and RPD (Section 18.4).

14.4 Preventative maintenance

14.4.1 The septa, insert, and gold seal are changed as needed.
14.4.2 The injection port is cleaned as needed.
14.4.3 The injection end of the capillary column is clipped as needed.
14.4.4 The autosampler syringe is changed as needed.

15.0 Calculations

15.1 Single peak target analytes – Identified target analytes should be calculated by the external calibration method.

15.1.1 Aqueous samples

$$\text{concentration } \mu g/L = \frac{(A_{ini})(Df)(M)(Vt)}{V}$$

A_{ini} = initial analyte concentration (mg/L).
Df = dilution factor.
M = multiplier (usually 2 due to GPC cleanup).
V = volume of water sample extracted (mL).
Vt = total volume of final extract (mL).

15.1.2 Solid samples

$$\text{concentration } (\mu g/Kg) \text{ dry} = \frac{(A_{ini})(Df)(M)(Vt)(1000)}{(W)(\%S)}$$

A_{ini} = initial analyte concentration (mg/L).
Df = dilution factor.
Vt = total volume of final extract (mL).
M = multiplier (usually two from GPC cleanup).
W = weight of sample extracted (grams).
%S = %solids/100.

15.1.3 Oil or liquid waste samples

$$\text{concentration } (mg/Kg) = \frac{(A_{ini})(Df)(M)(Vt)}{W}$$

A_{ini} = initial analyte concentration (mg/L).
Df = dilution factor.
Vt = total volume of final extract (mL).
M = multiplier (usually two from GPC cleanup).
W = weight of sample extracted (grams).

Note: *Oil samples are usually diluted 0.5 g to 2 mL. If GPC is performed, 2 mL are diluted to 10 mL by the GPC unit. Five mL of this are actually injected onto the GPC column. The final extract is concentrated to 1 mL after silica gel clean up.*

15.2 Multiple peak target compound calculations.

15.2.1 The analyst must be experienced in recognizing the peak pattern of the compounds prior to calculation.

15.2.2 A number of major peaks (usually ten) are selected from the standard and calibrated. If no interferences are apparent, a minimum of three of these peaks is used for

quantitation. The average concentration of the usable peaks represents the concentration of the PCB in the sample. For questionable patterns, the closest representative PCBs are quantitated, and a % relative standard deviation (RSD) of the peaks used is figured. Analyst experience and the %RSD will determine the specific PCB calibration to be used for quantitation. If multiple PCBs are present, the analyst chooses peaks from each PCB that are not significant peaks in the other PCBs. At least three peaks should be used for quantitation of each PCB. Analyst experience is important in recognition and reporting of multiple PCBs.

15.3 Surrogate compound recovery - Calculate the concentration of each surrogate compound (Section 15.1). Calculate the recovery of each surrogate compound in all samples, blanks, MSs, MSDs, LCSs, LCSDs, CCSs, and ICVs as follows:

$$\%\text{recovery} = \frac{\text{concentration found} \times 100}{\text{concentration spiked}}$$

15.4 MS/MSD %recovery - Calculate the concentration of each MS or MSD analyte (Section 15.1). Calculate the recovery of each MS or MSD analyte as follows:

$$\text{MS or MSD \%recovery} = \frac{(SSR - SR) \times 100}{SA}$$

SSR = analyte concentration in spike.
SR = analyte concentration in unspiked sample.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.5 LCS, LCSD, CCS, reference sample, and ICV %recovery - Calculate the concentration of each analyte (Section 15.1). Calculate the recovery of each analyte as follows:

$$\%\text{recovery} = \frac{SSR \times 100}{SA}$$

SSR = analyte concentration in spike.
SA = spike added.

NOTE: *Make sure that all units are the same.*

15.6 RPD - Calculate the RPD of the recoveries of each compound in the MS/MSD or LCS/LCSD as follows:

$$RPD = \frac{(MS - MSD) \times 100}{(1/2)(MS + MSD)} \quad \text{or} \quad RPD = \frac{(LCS - LCSD) \times 100}{(1/2)(LCS + LCSD)}$$

MS = matrix spike recovery.
MSD = matrix spike duplicate recovery.

LCS = laboratory control sample recovery.
LCSD = laboratory control samples duplicate recovery.

NOTE: *The formula above is the absolute value of the difference. RPD is always expressed as a positive value.*

15.7 Percent difference

$$\% \text{ difference} = \frac{(\text{Concentration of CAL} - \text{Concentration of CCS}) \times 100}{\text{Concentration of CAL}}$$

15.8 Least squares regression for linear and quadratic calibrations.

15.8.1 The equation is as follows when using a linear regression of the peak area response (y) versus the concentration of the standards (x):

$y = ax + b$.
a = slope.
b = intercept.

15.8.2 The equation is as follows when using a quadratic fit:

$Y = c_0 + c_1x + c_2x^2$ where the c's are the curve coefficients in the method

NOTE: *This line should not be forced through the origin, should include at least five points for linear calibrations, should include at least six points for quadratic calibrations, and should not include a blank.*

15.9 DDT/endrin breakdown calculation – Use area counts in all calculations.

$$\text{DDT breakdown} = \frac{(\text{DDE} + \text{DDD})}{(\text{DDE} + \text{DDD} + \text{DDT})} \times 100$$

$$\text{Endrin breakdown} \frac{(\text{EA} + \text{EK})}{(\text{EA} + \text{EK} + \text{E})} \times 100$$

EA = endrin aldehyde.
EK = endrin ketone.
E = endrin.

16.0 Method Performance

16.1 Each MDL must be labeled with: the instrument number, the analyst's name(s), the dates of extraction and analysis, the GPC number, the ASE number, and the extraction technician's name(s).

17.0 Pollution Prevention

17.1 This method uses small quantities of organic solvents. The waste that is produced is collected for disposal as chlorinated waste.

17.2 For information concerning pollution prevention that may be applicable to laboratory operations, consult Less is Better: Laboratory Chemical Management for Waste Reduction available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street NW, Washington, DC 20036.

18.0 Data Assessment

18.1 Qualitative analysis - All target analytes are identified by comparing the RT of that component to the RT of that compound in the standard on both columns (Attachment 22.9).

18.1.1 RT - The RT must be within the established RT window of the standard peak.

18.1.2 Multiple component compounds (Aroclors and toxaphene) are analyzed on one column. The pattern of the compound is compared to a standard on that column. Both RT and pattern must match for confirmation of these analytes (Attachment 22.8).

18.2 Initial calibration evaluation - The correlation coefficient for the linear calibration using a least squares regression must be 0.99 or greater. The coefficient of determination for a quadratic calibration must be 0.99 or greater. For a linear calibration using the average calibration factor, the RSD has to be less than or equal to 20% to assume linearity through the origin. If a reporting level standard does not quantitate an appropriate number with a linear calibration, the quadratic calibration should be used.

18.3 ICV and CCS evaluation

18.3.1 ICV/CCS - Individual analytes that exceed the 15% limit must be coded as estimated (Section 15.7).

18.4 MS, MSD, LCS, and LCSD evaluation - Recoveries for each spiked analyte are calculated as in Section 15 and must meet DEQ Laboratory generated limits, or appropriate coding is necessary.

18.5 Target analyte evaluation

18.5.1 Responses and RTs in all standards should be evaluated during or immediately after data acquisition. If the RTs change by more than 30 seconds from the most recent CCS (12-hour), the chromatographic system must be inspected for malfunctions and corrections made as required. For samples analyzed during the same 12-hour time period as the initial CALs, compare the responses and RTs against the mid-range CAL. If target analytes are reported below the RL, they must meet the identification

criteria and results estimated (J code). Aroclors and DDT, DDD, and DDE are usually the only analytes reported below the RL.

18.5.2 Multiple peak target compounds are analyzed on the primary column (ZB-5 or equivalent). When a PCB or toxaphene is suspected, the PCB or toxaphene pattern and the RTs of individual peaks are compared to a standard on that column. Correct RTs and similar patterns must be present to confirm the multiple peak analytes. A second column pattern match may also be used as additional confirmation.

18.6 SB evaluation – The SB must not contain target analytes above the RL.

18.7 MPB evaluation – The method blank should not contain target analytes above the RL. A note reporting the level found in the MPB must accompany any positive hits in samples if these analytes are found.

18.8 Data review – All data is reviewed by a second person prior to release.

18.9 Surrogate evaluation – Recoveries for each surrogate compound are calculated as in section 15.3. They must meet DEQ Laboratory generated limits, or corrective action must be taken (Section 19.1). Dilutions of 1:10 or greater dilute the surrogate recovery. No value is reported in this situation.

19.0 Corrective Actions

19.1 Surrogate recovery - All surrogate recoveries must fall within the specified laboratory generated windows. If any surrogate compound is out of control due to obvious matrix problems, the sample is not re-run, and the sample result(s) will be qualified as estimated. If the sample has a surrogate that is out of control for no apparent reason, the sample will be re-extracted if additional sample is available. If the reanalysis is within limits, the first analysis will be discarded, and the second analysis reported. If the second analysis agrees with the first, the poor recovery is attributed to matrix interference. Results and RLs from the first analysis will be reported with the appropriate qualifier. If numerous samples are out of control for no apparent reason, all instrumentation used in extraction, cleanup, and analysis should be inspected for malfunctions. Corrections must be made as needed. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is necessary. If the recovery is outside of acceptance limits for samples, any values obtained from any positively identified compounds must be reported as estimated (J code). If the recovery of any one surrogate is not within limits, the following are required:

19.1.1 Check all calculations and instrument performance. Check the preparation of the surrogate spiking solution for errors or degradation.

19.1.2 Reanalyze the sample unless a calculation error was found.

19.1.3 If an undiluted analysis with acceptable surrogate recoveries is being submitted, do not reanalyze diluted samples if the surrogate recoveries are outside the limits.

19.1.4 If the sample associated with the MS/MSD does not meet the criteria, it should be reanalyzed only if the MS/MSD surrogate recoveries are within the limits. If the

sample and associated MS/MSD show the same pattern (i.e., outside the limits), the sample does not require reanalysis.

19.1.5 If surrogate recoveries still fall outside the acceptance limits and if additional sample is available, re-extraction and reanalysis should be performed. If the results are the same, the first analysis may be used. If results are not the same and if the second extraction is out of hold time, the sample must be coded H.

19.2 MS/MSD/LCS/LCSD recoveries - If any analyte percent recovery in the MS or in the MSD falls outside the acceptance windows, the laboratory must determine if there is a matrix effect or a laboratory performance problem. A matrix effect is indicated if the LCS data are within limits but the MS or MSD data exceeds the limits. If a matrix effect is determined, the report will be flagged as matrix interference. If recoveries of the analytes in the LCS are outside acceptance limits, the problem may be with the extraction or analytical system. Once the problem has been resolved, corrective action may include reextraction and/or reanalysis of samples.

19.3 RPD - If the RPD of any analyte is outside the acceptance range, the system should be evaluated in order to locate potential problems. Once the problem has been resolved, corrective action may include reextraction and/or reanalysis of samples, or the data may be flagged as estimated.

19.4 SB – SB results must be less than the RL for the target analyte. If the SB does not meet this criteria, action should be taken to locate and correct the source of the contamination prior to the analysis of samples, QA/QC samples, etc.

19.5 MPB – MPB results should be less than the RL for each analyte. If the MPB does not meet this criteria, action should be taken to locate and reduce the source of the contamination. Samples that contain positive hits of analytes found in the MPB should be re-extracted and/or reanalyzed if possible. If the MPB results do not meet criteria and reanalysis is not possible, the MPB results must be reported.

19.6 Hold times - All analysis dates must be within 40 days of the extraction date. If analysis is past the hold time, all data must be flagged as estimated.

20.0 Waste Management

20.1 The DEQ Laboratory Safety Officer arranges for proper waste disposal. All waste should put in the proper containers (i.e., glass in metal cans for glass disposal, etc.).

21.0 References

21.1 United States Code of Federal Regulations, Title 40, U.S. Government Printing Office, Washington, DC, Appendix A and B, Part 136.

21.2 Test Methods for Evaluating Solid Waste, U.S. Environmental Protection Agency. Document SW-846, Third Edition 1986, Final Update III, December1996.

21.3 HP 5890 Gas Chromatograph Manual.

21.4 Perkin Elmer Turbochrom Workstation Software Manual.

21.5 HP 6890 Gas Chromatograph Manual.

21.6 Analytical Chemistry of PCBs, 2nd Edition, by Mitchell D. Erikson, Lewis Publishers, N.Y., 1997

22.0 Attachments

22.1 Hexane MSDS.

22.2 25 component pesticide standard, part # 93238, Absolute Standards, 7 component VOC standard, part #93237, Absolute Standards.

22.3 Stock standard logbook page.

22.4 Semivolatile standard logbook page.

22.5 Pesticide/PCB run logbook page.

22.6 Target analyte RLs and units.

22.7 GC operating conditions.

22.8 Chromatogram comparisons.

22.9 RT differences – Channels A and B.

MDEQ SOP# 502 REVISION #

APPROVED BY _____ DATE 2/05/04
CHIEF, LABORATORY SERVICES SECTION

APPROVED BY _____ DATE 2/02/04
COMPLIANCE OFFICER

APPROVED BY _____ DATE 1/26/04
QA OFFICER

APPROVED BY _____ DATE 1-16-04
UNIT MANAGER

APPROVED BY _____ DATE 1/16/04
ANALYST

ATTACHMENT 22.1

Please reduce your browser font size for better viewing and printing.

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Rod School Lane
Phillipsburg, NJ 08865

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 202-483-7616

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANES

MSDS Number: H2379 --- *Effective Date: 04/15/99*

1. Product Identification

Synonyms: Normal Hexane; Hexyl Hydride
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9277, 9306, 9309, N169

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	> 95%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
2-Methylpentane	107-83-5	1 - 2%	No
3-Methylpentane	96-14-0	1 - 2%	No
Pentane	109-66-0	0 - 2%	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

ATTACHMENT 22.1

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention

immediately.
Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

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5. Fire Fighting Measures

Fire:
Flash point: -21C (-6F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.1; uel: 7.5
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel

attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. This substance has poor warning properties.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

The following properties are for n-hexane, the major component.
Appearance:
Clear, colorless liquid.
Odor:
Gasoline-like odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
150 @ 25C (77F)
Evaporation Rate (BuAc=1):
9

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

ATTACHMENT 22.1

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
2-Methylpentane (107-83-5)	No	No	None
3-Methylpentane (96-14-0)	No	No	None
Pentane (109-66-0)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES
Hazard Class: 3.1
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 215L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Hexane (110-54-3)	Yes	Yes	Yes	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	Yes	Yes
3-Methylpentane (96-14-0)	Yes	Yes	Yes	Yes
Pentane (109-66-0)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hexane (110-54-3)	Yes	Yes	No	Yes
Methylcyclopentane (96-37-7)	Yes	Yes	No	Yes
2-Methylpentane (107-83-5)	Yes	Yes	No	Yes
3-Methylpentane (96-14-0)	Yes	Yes	No	Yes
Pentane (109-66-0)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hexane (110-54-3)	No	No	Yes	No
Methylcyclopentane (96-37-7)	No	No	No	No
2-Methylpentane (107-83-5)	No	No	No	No
3-Methylpentane (96-14-0)	No	No	No	No
Pentane (109-66-0)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hexane (110-54-3)	5000	No	No
Methylcyclopentane (96-37-7)	No	No	No
2-Methylpentane (107-83-5)	No	No	No
3-Methylpentane (96-14-0)	No	No	No
Pentane (109-66-0)	No	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 3[Y]E
Poison Schedule: No information found.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8. Updated the ACGIH part of the Airborne section of TAB 8.
Disclaimer:
****

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****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

7/23/02

CERTIFIED WEIGHT REPORT

Lot #

Part Number: 93237 **Solvent(s):** V34E62 Acetone
Lot Number: 071602
Description: VOC Standard
7 components
Expiration Date: 071607

Nominal Concentration (µg/mL): 1000

5E-05 Balance Uncertainty

Weight(s) shown below were combined and diluted to : 100.1 0.031 Flask Uncertainty

Lawrence Barry	071602
Formulated By: Lawrence Barry	DATE
Pedro L. Rentas	071602
Reviewed By: Pedro L. Rentas	DATE

MSDS Information
(Solvent Safety Info. On Attached pg.)

	Compound	RM#	Lot Number	Nominal Conc (µg/mL)	Purity	Uncertainty: Purity	Target Weight(g)	Actual Weight(g)	*Actual Conc (µg/mL)	Expanded Uncertainty	CAS#	OSHA PEL (TWA)	LD50
1.	Hexachlorobenzene	195	051697	1000	99	0.2	0.10107	0.10126	1001.9	0.0042	00118-74-1	N/A	orl-rat 10g/kg
2.	Hexachlorobutadiene	197	08917HV	1000	98	0.2	0.10210	0.10240	1002.9	0.0042	00087-68-3	0.02 ppm (0.24mg/m3/8H)	orl-rat 90mg/kg
3.	Hexachlorocyclopentadiene	198	07424DT	1000	98	0.2	0.10210	0.10233	1002.3	0.0042	00077-47-4	0.01 ppm (0.1mg/m3/8H)	orl-rat 1300mg/kg
4.	Pentachlorobenzene	321	062627	1000	98	0.2	0.10210	0.10234	1002.4	0.0042	00608-93-5	N/A	orl-rat 1080mg/kg
5.	Pentachloronitrobenzene (PCNB)	242	06505MW	1000	99	0.2	0.10107	0.10140	1003.3	0.0042	00082-68-8	N/A	orl-rat 1100mg/kg
6.	1,2,3,4-Tetrachlorobenzene	318	FBW01	1000	97.3	0.2	0.10283	0.10302	1001.8	0.0043	00634-66-2	N/A	orl-rat 1167mg/kg
7.	1,2,4,5-Tetrachlorobenzene	274	10408AS	1000	98	0.2	0.10210	0.10230	1002.0	0.0042	00095-94-3	N/A	orl-rat 1500mg/kg
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ATTACHMENT 22.2

Page 1 of 2

P#93237 L#071602
Revision No.: 1, Date Issued 091599

Printed on 7/16/02, 1:15 PM

ABSOLUTE STANDARDS, INC · 44 Rasotto Drive · Hamden, CT · 06514 · (800)-368-1131

ISO 9001 Quality System Registered
DLS ANSI-RAB Accredited

7/23/02

CERTIFIED WEIGHT REPORT: Uncertainty < +,-0.5% Stated Values.

Part Number: 93238
Lot Number: 071602
Description: Pesticide Standard
25 components
Expiration Date: 071607

Solvent(s): Lot#
Y43E34 Hexane (50%)
Nominal Concentration(ug/mL): 1000 Y14417 Toluene (50%)

Weight(s) & Volume(s) shown below were combined and diluted to 10 mL

Formulated By:
071602
Vincent K. Criscio, Jr. DATE

Reviewed By:
071602
Pedro L. Rentas DATE

MSDS Information

Compound	(RM#) Part Number	Lot Number	Dil. Factor	Initial Vol.(mL)	Initial Conc(ug/mL)	Nominal Conc(µg/mL)	Purity (%)	Max Target Weight(g)	*Actual Weight(g)	*Actual Conc(µg/mL)	CAS#	(Solvent Safety Info. On Attached pg.) OSHA PEL(TWA)	LD50
1. 2,2',4,4',5,5'-Hexabromobiphenyl	(1173)	NT01257	na	na	na	1000	97	0.01031	0.01032	1001.0	59080409	N/A	N/A
2. a-Chlordane	93240	071602	1.00	10.00	1000.9	1000	na	na	na	1000.9	05103719	0.5mg/m3 [skin]	orl rat 500mg/kg
3. g-Chlordane	93240	071602	1.00	10.00	1001.5	1000	na	na	na	1001.5	05103742	0.5mg/m3 [skin]	orl rat 500mg/kg
4. Decachlorobiphenyl (209)	93240	071602	1.00	10.00	1001.5	1000	na	na	na	1001.5	02051243	N/A	N/A
5. Hexabromobenzene	93240	071602	1.00	10.00	1001.0	1000	na	na	na	1001.0	00087821	N/A	N/A
6. Mirex	93240	071602	1.00	10.00	1001.7	1000	na	na	na	1001.7	02385855	N/A	orl rat 308mg/kg
7. 2,4,5,6-Tetrachloro-m-xylene	93240	071602	1.00	10.00	1001.7	1000	na	na	na	1001.7	00877096	N/A	N/A
8. Aldrin	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	00309002	0.25mg/m3 [skin]	orl rat 39mg/kg
9. a-BHC	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	00319846	N/A	orl rat 177mg/kg
10. b-BHC	93240	071602	1.00	10.00	1000.7	1000	na	na	na	1000.7	00319857	N/A	orl rat 6000mg/kg
11. d-BHC	93240	071602	1.00	10.00	1000.8	1000	na	na	na	1000.8	00319868	N/A	orl rat 1000mg/kg
12. g-BHC (Lindane)	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	00058899	0.5mg/m3 [skin]	orl rat 76mg/kg
13. 4,4'-DDD	93240	071602	1.00	10.00	1000.5	1000	na	na	na	1000.5	00072548	N/A	orl rat 113mg/kg
14. 4,4'-DDE	93240	071602	1.00	10.00	1000.4	1000	na	na	na	1000.4	00072559	N/A	orl rat 880mg/kg
15. 4,4'-DDT	93240	071602	1.00	10.00	1000.9	1000	na	na	na	1000.9	00050293	N/A	orl rat 87mg/kg
16. Dieldrin	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	00060571	0.25mg/m3 [skin]	orl rat 38.00ug/kg
17. Endosulfan I	93240	071602	1.00	10.00	1000.5	1000	na	na	na	1000.5	00959988	0.1mg/m3 [skin]	orl rat 18mg/kg
18. Endosulfan II	93240	071602	1.00	10.00	1000.3	1000	na	na	na	1000.3	33213659	0.1mg/m3 [skin]	orl rat 18mg/kg
19. Endosulfan sulfate	93240	071602	1.00	10.00	1000.7	1000	na	na	na	1000.7	01031078	N/A	orl rat 18mg/kg
20. Endrin	93240	071602	1.00	10.00	1000.8	1000	na	na	na	1000.8	00072208	0.1mg/m3 [skin]	orl rat 7mg/kg
21. Endrin aldehyde	93240	071602	1.00	10.00	1000.8	1000	na	na	na	1000.8	07421934	N/A	N/A
22. Endrin ketone	93240	071602	1.00	10.00	1000.8	1000	na	na	na	1000.8	53494705	N/A	N/A
23. Heptachlor	93240	071602	1.00	10.00	1000.4	1000	na	na	na	1000.4	00076448	0.5mg/m3 [skin]	orl rat 40mg/kg
24. Heptachlor epoxide	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	01024573	N/A	orl rat 47mg/kg
25. 4,4'-Methoxychlor	93240	071602	1.00	10.00	1000.6	1000	na	na	na	1000.6	00072435	10mg/m3	orl rat 5000mg/kg

Absolute Standards Inc. 203-281-2922 07/23/02 10:27 AM 2/2

MDEQ-ENVIRONMENTAL LAB
STOCK TRACKING LOG

Environmental Lab Tracking Number	QTY (each)	Filley Tracking Number	Date Received (at lab)	Receiver Initials	Chemical,Analyte, Reagent or Solvent	Vendor and Catalog #	PO #	Manufacturer and Lot Number	Expiration Date
EL-									
EL-									
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ATTACHMENT 22.3

FILE:ST-STD
12/30/98

MDEQ-ENVIRONMENTAL LAB
SEMI-VOLATILE ORGANIC STANDARDS

SVOC Tracking Number	Date Prepared	EL or SVOC Tracking Number	Analyte or Mix	Preparers Initials	Solvent	Solvent Tracking Number	Initial Concentration*	Initial Volume/Wt Standard*	Final Volume*	Final Concentration*	Expiration Date
SE-											
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ATTACHMENT 22.4

FILE S'

*INCLUDE U... S

Turbochrom Sequence File D:\TCWS Data\sequence\C-0624-2002.seq
Printed by : tcws40 on: 6/25/02 8:57:45 AM
Created by : tcws40 on: 6/24/02 2:19:10 PM
Edited by : tcws40 on: 6/25/02 8:57:19 AM
Number of Times Edited : 2
Description:

Sequence File Header Information:

Number of Rows : 119
Instrument Type : 900 Series Intelligent Interface
Injection Type : SINGLE

Sequence Sample Descriptions - Channel A

Row	Type	Name	Number	Study name	Sample Amt	Int Std Amt	Sample Vol	Dil Factor	Multiplier	Divisor
1	Sample	COLUMN PRIME	001	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
2	Sample	HEX	002	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
3	Sample	HEX	003	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
4	Sample	HEX	004	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
5	Sample	DDT/ENDRIN BREAKDOWN	005	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
6	Sample	AR 1016/1260 SE-665 25 PPB	006	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
7	Sample	AR 1016/1260 SE-664 50 PPB	007	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
8	Sample	AR 1016/1260 SE-663 100 PPB	008	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
9	Sample	AR 1016/1260 SE-662 200PPB	009	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
10	Sample	AR 1016/1260 SE-658 500 PPB	010	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
11	Sample	AR 1016/1260 SE-657 1000 PPB	011	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
12	Sample	AR 1016/1260 SE-656 2000 PPB	012	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
13	Sample	HEX	013	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
14	Sample	AR 1221/1262 500ppb SE-701	014	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
15	Sample	AR 1232/1268 500ppb SE-703	015	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
16	Sample	AR 1242 500ppb SE-566	016	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
17	Sample	AR 1248 500ppb SE-567	017	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
18	Sample	AR 1254 500ppb SE-568	018	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
19	Sample	PCB ICV 1660 500ppb SE-719	019	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
20	Sample	HEX	020	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
21	Sample	PEST 2.5 SE-739	021	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
22	Sample	PEST 5.0 SE-740	022	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
23	Sample	PEST 10 SE-741	023	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
24	Sample	PEST 30 SE-742	024	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
25	Sample	PEST 50 SE-743	025	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
26	Sample	PEST 125 SE-744	026	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
27	Sample	PEST 250 SE-738	027	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
28	Sample	ICV 100 PPB SE-680	028	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
29	Sample	PEST 10 SE-741	029	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
30	Sample	PEST 50 SE-743	030	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
31	Sample	AR 1016/1260 SE-664 50 PPB	031	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
32	Sample	AR 1016/1260 SE-658 500 PPB	032	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
33	Sample	TOX STD 500ppb SE-695	033	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
34	Sample	SYSTEM BLANK SE-1133	034	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
35	Sample	MPB 1530	035	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
36	Sample	LCS 1530	036	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
37	Sample	MS 1530	037	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
38	Sample	MSD 1530	038	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
39	Sample	06 184 01	039	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
40	Sample	06 184 02	040	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
41	Sample	06 184 03	041	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
42	Sample	06 184 04	042	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
43	Sample	06 184 05	043	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
44	Sample	AR 1016/1260 SE-664 50 PPB	044	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
45	Sample	AR 1016/1260 SE-658 500 PPB	045	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
46	Sample	PEST 10 SE-741	046	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
47	Sample	PEST 50 SE-743	047	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
48	Sample	SYSTEM BLANK SE-1133	048	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
49	Sample	06 184 06	049	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
50	Sample	06 184 07	050	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
51	Sample	06 184 08	051	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
52	Sample	06 184 09	052	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
53	Sample	06 184 10	053	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
54	Sample	06 184 11	054	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
55	Sample	06 184 12	055	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
56	Sample	06 165 01	056	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
57	Sample	06 132 01	057	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
58	Sample	HEX	058	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
59	Sample	AR 1016/1260 SE-664 50 PPB	059	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
60	Sample	AR 1016/1260 SE-658 500 PPB	060	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
61	Sample	PEST 10 SE-741	061	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
62	Sample	PEST 50 SE-743	062	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
63	Sample	SYSTEM BLANK SE-1133	063	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
64	Sample		064	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
65	Sample		065	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
66	Sample		066	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
67	Sample		067	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
68	Sample		068	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
69	Sample		069	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
70	Sample		070	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
71	Sample		071	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
72	Sample		072	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000

Sequence Sample Descriptions - Channel A

Row	Type	Name	Number	Study name	Sample Amt	Int Std Amt	Sample Vol	Dil Factor	Multiplier	Divisor
73	Sample		073	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
74	Sample		074	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
75	Sample		075	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
76	Sample		076	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
77	Sample		077	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
78	Sample		078	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
79	Sample		079	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
80	Sample		080	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
81	Sample		081	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
82	Sample		082	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
83	Sample		083	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
84	Sample		084	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
85	Sample		085	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
86	Sample		086	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
87	Sample		087	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
88	Sample		088	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
89	Sample		089	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
90	Sample		090	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
91	Sample		091	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
92	Sample		092	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
93	Sample		093	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
94	Sample		094	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
95	Sample		095	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
96	Sample		096	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
97	Sample		097	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
98	Sample		098	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
99	Sample		099	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
100	Sample		100	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
101	Sample		101	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
102	Sample		102	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
103	Sample		103	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
104	Sample		104	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
105	Sample		105	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
106	Sample		106	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
107	Sample		107	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
108	Sample		108	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
109	Sample		109	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
110	Sample		110	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
111	Sample		111	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
112	Sample		112	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
113	Sample		113	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
114	Sample		114	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
115	Sample		115	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
116	Sample		116	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
117	Sample		117	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
118	Sample		118	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000
119	Sample		119	PEST/PCB	1.000000	1.000000	1.000	1.000000	1.000000	1.000000

Row	Addend	Norm Factor
1	0.000000	100.000
2	0.000000	100.000
3	0.000000	100.000
4	0.000000	100.000
5	0.000000	100.000
6	0.000000	100.000
7	0.000000	100.000
8	0.000000	100.000
9	0.000000	100.000
10	0.000000	100.000
11	0.000000	100.000
12	0.000000	100.000
13	0.000000	100.000
14	0.000000	100.000
15	0.000000	100.000
16	0.000000	100.000
17	0.000000	100.000
18	0.000000	100.000
19	0.000000	100.000
20	0.000000	100.000
21	0.000000	100.000
22	0.000000	100.000
23	0.000000	100.000
24	0.000000	100.000
25	0.000000	100.000
26	0.000000	100.000
27	0.000000	100.000
28	0.000000	100.000
29	0.000000	100.000
30	0.000000	100.000
31	0.000000	100.000
32	0.000000	100.000
33	0.000000	100.000
34	0.000000	100.000
35	0.000000	100.000
36	0.000000	100.000

Sequence Sample Descriptions - Channel A

Row	Addend	Norm Factor
37	0.000000	100.000
38	0.000000	100.000
39	0.000000	100.000
40	0.000000	100.000
41	0.000000	100.000
42	0.000000	100.000
43	0.000000	100.000
44	0.000000	100.000
45	0.000000	100.000
46	0.000000	100.000
47	0.000000	100.000
48	0.000000	100.000
49	0.000000	100.000
50	0.000000	100.000
51	0.000000	100.000
52	0.000000	100.000
53	0.000000	100.000
54	0.000000	100.000
55	0.000000	100.000
56	0.000000	100.000
57	0.000000	100.000
58	0.000000	100.000
59	0.000000	100.000
60	0.000000	100.000
61	0.000000	100.000
62	0.000000	100.000
63	0.000000	100.000
64	0.000000	100.000
65	0.000000	100.000
66	0.000000	100.000
67	0.000000	100.000
68	0.000000	100.000
69	0.000000	100.000
70	0.000000	100.000
71	0.000000	100.000
72	0.000000	100.000
73	0.000000	100.000
74	0.000000	100.000
75	0.000000	100.000
76	0.000000	100.000
77	0.000000	100.000
78	0.000000	100.000
79	0.000000	100.000
80	0.000000	100.000
81	0.000000	100.000
82	0.000000	100.000
83	0.000000	100.000
84	0.000000	100.000
85	0.000000	100.000
86	0.000000	100.000
87	0.000000	100.000
88	0.000000	100.000
89	0.000000	100.000
90	0.000000	100.000
91	0.000000	100.000
92	0.000000	100.000
93	0.000000	100.000
94	0.000000	100.000
95	0.000000	100.000
96	0.000000	100.000
97	0.000000	100.000
98	0.000000	100.000
99	0.000000	100.000
100	0.000000	100.000
101	0.000000	100.000
102	0.000000	100.000
103	0.000000	100.000
104	0.000000	100.000
105	0.000000	100.000
106	0.000000	100.000
107	0.000000	100.000
108	0.000000	100.000
109	0.000000	100.000
110	0.000000	100.000
111	0.000000	100.000
112	0.000000	100.000
113	0.000000	100.000
114	0.000000	100.000
115	0.000000	100.000
116	0.000000	100.000
117	0.000000	100.000
118	0.000000	100.000
119	0.000000	100.000

6/25/02 8:57:45 AM Sequence: D:\TCWS Data\sequence\C-0624-2002.seq

Sequence Process Information - Channel A

Row	Vial	Inst Method	Proc Method	Calib Method
1	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
2	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
3	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
4	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
5	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
6	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
7	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
8	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
9	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
10	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
11	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
12	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
13	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
14	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
15	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
16	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
17	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
18	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
19	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
20	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
21	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
22	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
23	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
24	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
25	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
26	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
27	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
28	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
29	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
30	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
31	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
32	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
33	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
34	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
35	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
36	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
37	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
38	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
39	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
40	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
41	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
42	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
43	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
44	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
45	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
46	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
47	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
48	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
49	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
50	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
51	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
52	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
53	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
54	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
55	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
56	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
57	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
58	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
59	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
60	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
61	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
62	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
63	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
64	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
65	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
66	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
67	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
68	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
69	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
70	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
71	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
72	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
73	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
74	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
75	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
76	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
77	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
78	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
79	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
80	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
81	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
82	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
83	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
84	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
85	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426

6/25/02 8:57:45 AM Sequence: D:\TCWS Data\sequence\C-0624-2002.seq

Sequence Process Information - Channel A

Row	Vial	Inst Method	Proc Method	Calib Method
86	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
87	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
88	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
89	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
90	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
91	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
92	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
93	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
94	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
95	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
96	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
97	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
98	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
99	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
100	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
101	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
102	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
103	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
104	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
105	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
106	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
107	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
108	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
109	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
110	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
111	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
112	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
113	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
114	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
115	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
116	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
117	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
118	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426
119	-	d:\tcws data\method\40-c5short	d:\tcws data\method\40-c5so-02-0426	d:\tcws data\method\40-c5so-02-0426

Row	Rpt Fmt File	Raw Data File	Result File	Baseline	Modified	Calib Rpt	Cal Level	Update RT	Printer	Plotter
1	d:\tcws data\method\a-c5short	CAL0624a001	CAL0624a001			-	-	-	Default	Default
2	d:\tcws data\method\a-c5short	CAL0624a002	CAL0624a002			-	-	-	Default	Default
3	d:\tcws data\method\a-c5short	CAL0624a003	CAL0624a003			-	-	-	Default	Default
4	d:\tcws data\method\a-c5short	CAL0624a004	CAL0624a004			-	-	-	Default	Default
5	d:\tcws data\method\a-c5short	CAL0624a005	CAL0624a005			-	-	-	Default	Default
6	d:\tcws data\method\a-c5short	CAL0624a006	CAL0624a006			-	-	-	Default	Default
7	d:\tcws data\method\a-c5short	CAL0624a007	CAL0624a007			-	-	-	Default	Default
8	d:\tcws data\method\a-c5short	CAL0624a008	CAL0624a008			-	-	-	Default	Default
9	d:\tcws data\method\a-c5short	CAL0624a009	CAL0624a009			-	-	-	Default	Default
10	d:\tcws data\method\a-c5short	CAL0624a010	CAL0624a010			-	-	-	Default	Default
11	d:\tcws data\method\a-c5short	CAL0624a011	CAL0624a011			-	-	-	Default	Default
12	d:\tcws data\method\a-c5short	CAL0624a012	CAL0624a012			-	-	-	Default	Default
13	d:\tcws data\method\a-c5short	CAL0624a013	CAL0624a013			-	-	-	Default	Default
14	d:\tcws data\method\a-c5short	CAL0624a014	CAL0624a014			-	-	-	Default	Default
15	d:\tcws data\method\a-c5short	CAL0624a015	CAL0624a015			-	-	-	Default	Default
16	d:\tcws data\method\a-c5short	CAL0624a016	CAL0624a016			-	-	-	Default	Default
17	d:\tcws data\method\a-c5short	CAL0624a017	CAL0624a017			-	-	-	Default	Default
18	d:\tcws data\method\a-c5short	CAL0624a018	CAL0624a018			-	-	-	Default	Default
19	d:\tcws data\method\a-c5short	CAL0624a019	CAL0624a019			-	-	-	Default	Default
20	d:\tcws data\method\a-c5short	CAL0624a020	CAL0624a020			-	-	-	Default	Default
21	d:\tcws data\method\a-c5short	CAL0624a021	CAL0624a021			-	-	-	Default	Default
22	d:\tcws data\method\a-c5short	CAL0624a022	CAL0624a022			-	-	-	Default	Default
23	d:\tcws data\method\a-c5short	CAL0624a023	CAL0624a023			-	-	-	Default	Default
24	d:\tcws data\method\a-c5short	CAL0624a024	CAL0624a024			-	-	-	Default	Default
25	d:\tcws data\method\a-c5short	CAL0624a025	CAL0624a025			-	-	-	Default	Default
26	d:\tcws data\method\a-c5short	CAL0624a026	CAL0624a026			-	-	-	Default	Default
27	d:\tcws data\method\a-c5short	CAL0624a027	CAL0624a027			-	-	-	Default	Default
28	d:\tcws data\method\a-c5short	CAL0624a028	CAL0624a028			-	-	-	Default	Default
29	d:\tcws data\method\a-c5short	CAL0624a029	CAL0624a029			-	-	-	Default	Default
30	d:\tcws data\method\a-c5short	CAL0624a030	CAL0624a030			-	-	-	Default	Default
31	d:\tcws data\method\a-c5short	CAL0624a031	CAL0624a031			-	-	-	Default	Default
32	d:\tcws data\method\a-c5short	CAL0624a032	CAL0624a032			-	-	-	Default	Default
33	d:\tcws data\method\a-c5short	CAL0624a033	CAL0624a033			-	-	-	Default	Default
34	d:\tcws data\method\a-c5short	CAL0624a034	CAL0624a034			-	-	-	Default	Default
35	d:\tcws data\method\a-c5short	CAL0624a035	CAL0624a035			-	-	-	Default	Default
36	d:\tcws data\method\a-c5short	CAL0624a036	CAL0624a036			-	-	-	Default	Default
37	d:\tcws data\method\a-c5short	CAL0624a037	CAL0624a037			-	-	-	Default	Default
38	d:\tcws data\method\a-c5short	CAL0624a038	CAL0624a038			-	-	-	Default	Default
39	d:\tcws data\method\a-c5short	CAL0624a039	CAL0624a039			-	-	-	Default	Default
40	d:\tcws data\method\a-c5short	CAL0624a040	CAL0624a040			-	-	-	Default	Default
41	d:\tcws data\method\a-c5short	CAL0624a041	CAL0624a041			-	-	-	Default	Default
42	d:\tcws data\method\a-c5short	CAL0624a042	CAL0624a042			-	-	-	Default	Default
43	d:\tcws data\method\a-c5short	CAL0624a043	CAL0624a043			-	-	-	Default	Default
44	d:\tcws data\method\a-c5short	CAL0624a044	CAL0624a044			-	-	-	Default	Default
45	d:\tcws data\method\a-c5short	CAL0624a045	CAL0624a045			-	-	-	Default	Default
46	d:\tcws data\method\a-c5short	CAL0624a046	CAL0624a046			-	-	-	Default	Default
47	d:\tcws data\method\a-c5short	CAL0624a047	CAL0624a047			-	-	-	Default	Default
48	d:\tcws data\method\a-c5short	CAL0624a048	CAL0624a048			-	-	-	Default	Default
49	d:\tcws data\method\a-c5short	CAL0624a049	CAL0624a049			-	-	-	Default	Default

Sequence Process Information - Channel A

Row	Rpt Fmt File	Raw Data File	Result File	Baseline	Modified	Calib Rpt	Cal Level	Update RT	Printer	Plotter
50	d:\tcws data\method\a-c5short	CAL0624a050	CAL0624a050			-	-	-	Default	Default
51	d:\tcws data\method\a-c5short	CAL0624a051	CAL0624a051			-	-	-	Default	Default
52	d:\tcws data\method\a-c5short	CAL0624a052	CAL0624a052			-	-	-	Default	Default
53	d:\tcws data\method\a-c5short	CAL0624a053	CAL0624a053			-	-	-	Default	Default
54	d:\tcws data\method\a-c5short	CAL0624a054	CAL0624a054			-	-	-	Default	Default
55	d:\tcws data\method\a-c5short	CAL0624a055	CAL0624a055			-	-	-	Default	Default
56	d:\tcws data\method\a-c5short	CAL0624a056	CAL0624a056			-	-	-	Default	Default
57	d:\tcws data\method\a-c5short	CAL0624a057	CAL0624a057			-	-	-	Default	Default
58	d:\tcws data\method\a-c5short	CAL0624a058	CAL0624a058			-	-	-	Default	Default
59	d:\tcws data\method\a-c5short	CAL0624a059	CAL0624a059			-	-	-	Default	Default
60	d:\tcws data\method\a-c5short	CAL0624a060	CAL0624a060			-	-	-	Default	Default
61	d:\tcws data\method\a-c5short	CAL0624a061	CAL0624a061			-	-	-	Default	Default
62	d:\tcws data\method\a-c5short	CAL0624a062	CAL0624a062			-	-	-	Default	Default
63	d:\tcws data\method\a-c5short	CAL0624a063	CAL0624a063			-	-	-	Default	Default
64	d:\tcws data\method\a-c5short	CAL0624a064	CAL0624a064			-	-	-	Default	Default
65	d:\tcws data\method\a-c5short	CAL0624a065	CAL0624a065			-	-	-	Default	Default
66	d:\tcws data\method\a-c5short	CAL0624a066	CAL0624a066			-	-	-	Default	Default
67	d:\tcws data\method\a-c5short	CAL0624a067	CAL0624a067			-	-	-	Default	Default
68	d:\tcws data\method\a-c5short	CAL0624a068	CAL0624a068			-	-	-	Default	Default
69	d:\tcws data\method\a-c5short	CAL0624a069	CAL0624a069			-	-	-	Default	Default
70	d:\tcws data\method\a-c5short	CAL0624a070	CAL0624a070			-	-	-	Default	Default
71	d:\tcws data\method\a-c5short	CAL0624a071	CAL0624a071			-	-	-	Default	Default
72	d:\tcws data\method\a-c5short	CAL0624a072	CAL0624a072			-	-	-	Default	Default
73	d:\tcws data\method\a-c5short	CAL0624a073	CAL0624a073			-	-	-	Default	Default
74	d:\tcws data\method\a-c5short	CAL0624a074	CAL0624a074			-	-	-	Default	Default
75	d:\tcws data\method\a-c5short	CAL0624a075	CAL0624a075			-	-	-	Default	Default
76	d:\tcws data\method\a-c5short	CAL0624a076	CAL0624a076			-	-	-	Default	Default
77	d:\tcws data\method\a-c5short	CAL0624a077	CAL0624a077			-	-	-	Default	Default
78	d:\tcws data\method\a-c5short	CAL0624a078	CAL0624a078			-	-	-	Default	Default
79	d:\tcws data\method\a-c5short	CAL0624a079	CAL0624a079			-	-	-	Default	Default
80	d:\tcws data\method\a-c5short	CAL0624a080	CAL0624a080			-	-	-	Default	Default
81	d:\tcws data\method\a-c5short	CAL0624a081	CAL0624a081			-	-	-	Default	Default
82	d:\tcws data\method\a-c5short	CAL0624a082	CAL0624a082			-	-	-	Default	Default
83	d:\tcws data\method\a-c5short	CAL0624a083	CAL0624a083			-	-	-	Default	Default
84	d:\tcws data\method\a-c5short	CAL0624a084	CAL0624a084			-	-	-	Default	Default
85	d:\tcws data\method\a-c5short	CAL0624a085	CAL0624a085			-	-	-	Default	Default
86	d:\tcws data\method\a-c5short	CAL0624a086	CAL0624a086			-	-	-	Default	Default
87	d:\tcws data\method\a-c5short	CAL0624a087	CAL0624a087			-	-	-	Default	Default
88	d:\tcws data\method\a-c5short	CAL0624a088	CAL0624a088			-	-	-	Default	Default
89	d:\tcws data\method\a-c5short	CAL0624a089	CAL0624a089			-	-	-	Default	Default
90	d:\tcws data\method\a-c5short	CAL0624a090	CAL0624a090			-	-	-	Default	Default
91	d:\tcws data\method\a-c5short	CAL0624a091	CAL0624a091			-	-	-	Default	Default
92	d:\tcws data\method\a-c5short	CAL0624a092	CAL0624a092			-	-	-	Default	Default
93	d:\tcws data\method\a-c5short	CAL0624a093	CAL0624a093			-	-	-	Default	Default
94	d:\tcws data\method\a-c5short	CAL0624a094	CAL0624a094			-	-	-	Default	Default
95	d:\tcws data\method\a-c5short	CAL0624a095	CAL0624a095			-	-	-	Default	Default
96	d:\tcws data\method\a-c5short	CAL0624a096	CAL0624a096			-	-	-	Default	Default
97	d:\tcws data\method\a-c5short	CAL0624a097	CAL0624a097			-	-	-	Default	Default
98	d:\tcws data\method\a-c5short	CAL0624a098	CAL0624a098			-	-	-	Default	Default
99	d:\tcws data\method\a-c5short	CAL0624a099	CAL0624a099			-	-	-	Default	Default
100	d:\tcws data\method\a-c5short	CAL0624a100	CAL0624a100			-	-	-	Default	Default
101	d:\tcws data\method\a-c5short	CAL0624a101	CAL0624a101			-	-	-	Default	Default
102	d:\tcws data\method\a-c5short	CAL0624a102	CAL0624a102			-	-	-	Default	Default
103	d:\tcws data\method\a-c5short	CAL0624a103	CAL0624a103			-	-	-	Default	Default
104	d:\tcws data\method\a-c5short	CAL0624a104	CAL0624a104			-	-	-	Default	Default
105	d:\tcws data\method\a-c5short	CAL0624a105	CAL0624a105			-	-	-	Default	Default
106	d:\tcws data\method\a-c5short	CAL0624a106	CAL0624a106			-	-	-	Default	Default
107	d:\tcws data\method\a-c5short	CAL0624a107	CAL0624a107			-	-	-	Default	Default
108	d:\tcws data\method\a-c5short	CAL0624a108	CAL0624a108			-	-	-	Default	Default
109	d:\tcws data\method\a-c5short	CAL0624a109	CAL0624a109			-	-	-	Default	Default
110	d:\tcws data\method\a-c5short	CAL0624a110	CAL0624a110			-	-	-	Default	Default
111	d:\tcws data\method\a-c5short	CAL0624a111	CAL0624a111			-	-	-	Default	Default
112	d:\tcws data\method\a-c5short	CAL0624a112	CAL0624a112			-	-	-	Default	Default
113	d:\tcws data\method\a-c5short	CAL0624a113	CAL0624a113			-	-	-	Default	Default
114	d:\tcws data\method\a-c5short	CAL0624a114	CAL0624a114			-	-	-	Default	Default
115	d:\tcws data\method\a-c5short	CAL0624a115	CAL0624a115			-	-	-	Default	Default
116	d:\tcws data\method\a-c5short	CAL0624a116	CAL0624a116			-	-	-	Default	Default
117	d:\tcws data\method\a-c5short	CAL0624a117	CAL0624a117			-	-	-	Default	Default
118	d:\tcws data\method\a-c5short	CAL0624a118	CAL0624a118			-	-	-	Default	Default
119	d:\tcws data\method\a-c5short	CAL0624a119	CAL0624a119			-	-	-	Default	Default

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

Pesticides Method 608/8081	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
Aldrin	0.02	20	0.2	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
a-BHC	0.02	20	0.2	amber bottles	14 days HT	"
b-BHC	0.02	20	0.2	7 days HT	"	"
d-BHC	0.02	20	0.2	"	"	"
g-BHC (lindane)	0.02	20	0.2	"	"	"
BP-6 (PPB)	0.05	250	0.7	"	"	"
a-Chlordane	0.02	50	0.2	"	"	"
g-Chlordane	0.02	50	0.2	"	"	"
4,4'-DDD	0.02	20	0.2	"	"	"
4,4'-DDE	0.02	20	0.2	"	"	"
4,4'-DDT	0.02	20	0.2	"	"	"
Dieldrin	0.02	20	0.2	"	"	"
Endosulfan I	0.02	20	0.2	"	"	"
Endosulfan II	0.05	20	0.4	"	"	"
Endosulfan Sulfate	0.05	20	0.4	"	"	"
Endrin	0.02	20	0.2	"	"	"
Endrin Aldehyde	0.05	20	0.4	"	"	"
Endrin Ketone	0.05	20	0.4	"	"	"
Heptachlor	0.02	20	0.4	"	"	"
Heptachlor epoxide	0.02	20	0.4	"	"	"
Hexabromobenzene	0.02	100	0.2	"	"	"
Methoxychlor	0.05	50	0.4	"	"	"
Mirex	0.02	50	0.2	"	"	"
Toxaphene	0.1	170	10	"	"	"

PCBs Method 608/8082	Water Reporting Limits (ug/L)	Sediment/Soil Reporting Limits (ug/Kg)	Oil Reporting Limits (mg/Kg)	Water Containers & Hold Times	Sediment/Soil Containers & Hold Times	Oil Containers
PCB-1016	0.1	100	1.0	2 - 1000mL glass	1 - 8 ounce glass	10mL in glass
PCB-1221	0.1	100	1.0	amber bottles	14 days HT	"
PCB-1232	0.1	100	1.0	7 days HT	"	"
PCB-1242	0.1	100	1.0	"	"	"
PCB-1248	0.1	100	1.0	"	"	"
PCB-1254	0.1	100	1.0	"	"	"
PCB-1260	0.1	100	1.0	"	"	"
PCB-1262	0.1	100	1.0	"	"	"
PCB-1268	0.1	100	1.0	"	"	"

Table 1: ENVIRONMENTAL REPORTING LIMITS (RL) FOR DEQ-DWRP LABORATORY SECTION

NPDES Scan 3 Method 608	Water Reporting Limits (ug/L)	Water Containers & Hold Times
Aldrin	0.01	2 - 1000mL glass
a-BHC	0.01	amber bottles
b-BHC	0.01	7 days HT
d-BHC	0.01	"
g-BHC (lindane)	0.01	"
BP-6 (PBB)	0.05	"
a-Chlordane	0.01	"
g-Chlordane	0.01	"
4,4'-DDD	0.05	"
4,4'-DDE	0.01	"
4,4'-DDT	0.01	"
Dieldrin	0.01	"
Endosulfan I	0.01	"
Endrin	0.01	"
Heptachlor	0.01	"
Heptachlor epoxide	0.01	"
Hexabromobenzene	0.01	"
Hexachlorobenzene	0.01	"
Hexachlorobutadiene	0.01	"
Hexachlorocyclopentadiene	0.01	"
Methoxychlor	0.05	"
Mirex	0.01	"
PCB 1016	0.1	"
PCB 1221	0.1	"
PCB 1232	0.1	"
PCB 1242	0.1	"
PCB 1248	0.1	"
PCB 1254	0.1	"
PCB 1260	0.1	"
PCB 1262	0.1	"
PCB 1268	0.1	"
Pentachlorobenzene	0.01	"
Pentachloronitrobenzene	0.01	"
Toxaphene	0.1	"
1,2,3,4-Tetrachlorobenzene	0.01	"
1,2,4,5-Tetrachlorobenzene	0.01	"

This scan is available for NPDES samples only.

Gas Chromatograph Operating Conditions for Pest/PCB

6890 GC #07

Inlet
Mode-Splitless
Purge time -0.9 min
Purge flow- 50ml/min
Total flow- 60.5ml/min
Pulsed pressure- 16.3
Pulse time- 1.0 min
Temp- 190 deg

Column
30 meter, .25mm, .25 um
Flow- 4.5ml/min
Velocity- varies
Mode- constant flow

Detectors- microECD
Make-up gas- N2
Flow- 25 ml/min
Temp- 325 deg.

Temp Program
Start Temp- 60 deg for 1 min.
Init. rate- 20 deg/min to 200deg for 1 min.
Rate 2- 4.5 deg/min to 270deg for 0 min.
Rate 3- 25 deg/min to 300 for 3 min.
Run time - 29 min.

Pressure at 60 deg- 7.3
Range- 6
Attn- 0

5890 GC #05

Inlet
Mode-Splitless
Purge time - 2.0 min
Purge flow- 50ml/min
Total flow- 61ml/min
Temp- 190 deg

Column
30 meter, .25mm, .25 um
Flow- 4.7ml/min
Velocity- varies
Mode- constant flow

Detectors-ECD
Make-up gas- N2
Flow- 56 ml/min
Temp- 325 deg.

Temp Program
Start Temp- 80 deg for 1 min.
Init. rate- 4 deg/min to 225deg for 0 min.
Rate 2- 10 deg/min to 290deg for 3 min.
Run time - 45 min

Range- col A is 1, col B is 3
Attn- 0

6890 GC #40

Inlet
Mode-Splitless
Purge time -0.9 min
Purge flow- 50ml/min
Total flow- 61.7ml/min
Pulsed pressure- 16.3
Pulse time- 1.0 min
Temp- 190 deg

Column
30 meter, .25mm, .25 um
Flow- 4.2ml/min
Velocity- varies
Mode- constant flow

Detectors- microECD
Make-up gas- N2
Flow- 25 ml/min
Temp- 325 deg.

Temp Program
Start Temp-80 deg for 0 min.
Init. rate-4 deg/min to 225deg for 0 min.
Rate 2- 10 deg/min to 300deg for4 min.
Run time - 33.2 min.

Range- 7
Attn- 0

5890 GC #04

Inlet
Mode-Splitless
Purge time - 1.0 min
Head Pressure - 13psig
Temp- 190 deg

Column
30 meter, .25mm, .25 um
Flow- variable
Mode- constant pressure

Detectors-ECD
Make-up gas- N2
Flow- 50 ml/min
Temp- 350 deg.

Temp Program
Start Temp- 80 deg for 0.5 min.
Init. rate-10deg/min to 200deg for1 min.
Rate 2- 4 deg/min to 300deg for 2.5 min.
Run time - 41 min

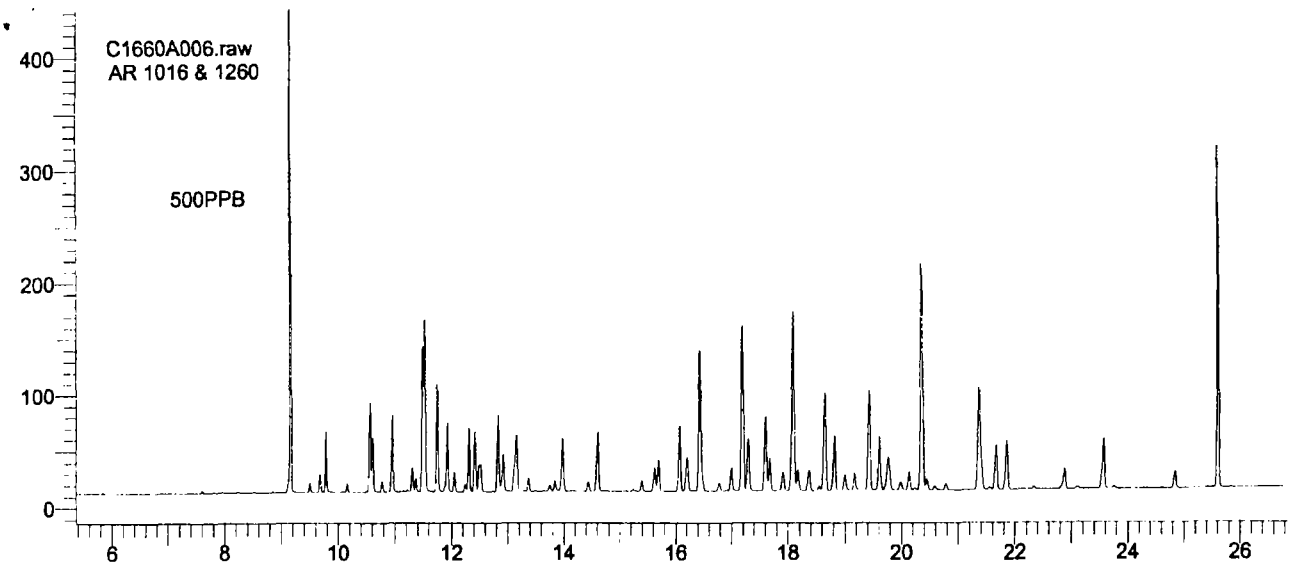
Range- col A is 0, col B is 2
Attn- 0

6890 GC #40

Inlet	Column	Temp Program
Mode-Splitless	30 meter, .25mm, .25 um	Start Temp-80 deg for 0 min.
Purge time -0.9 min	Flow- 4.2ml/min	Init. rate-4 deg/min to 225deg for 0 min.
Purge flow- 50ml/min	Velocity- varies	Rate 2- 10 deg/min to 300deg for4 min.
Total flow- 61.7ml/min	Mode- constant flow	Run time - 33.2 min.
Pulsed pressure- 16.3		
Pulse time- 1.0 min	**Detectors- microECD**	
Temp- 190 deg	Make-up gas- N2	
	Flow- 25 ml/min	Range- 7
	Temp- 325 deg.	Attn- 0

5890 GC #04

Inlet	Column	Temp Program
Mode-Splitless	30 meter, .25mm, .25 um	Start Temp- 80 deg for 0.5 min.
Purge time - 1.0 min	Flow- variable	Init. rate-10deg/min to 200deg for1 min.
Head Pressure - 13psig		Rate 2- 4 deg/min to 300deg for 2.5 min.
	Mode- constant pressure	Run time - 41 min
Temp- 190 deg		
	Detectors-ECD	
	Make-up gas- N2	
	Flow- 50 ml/min	Range- col A is 0, col B is 2
	Temp- 350 deg.	Attn- 0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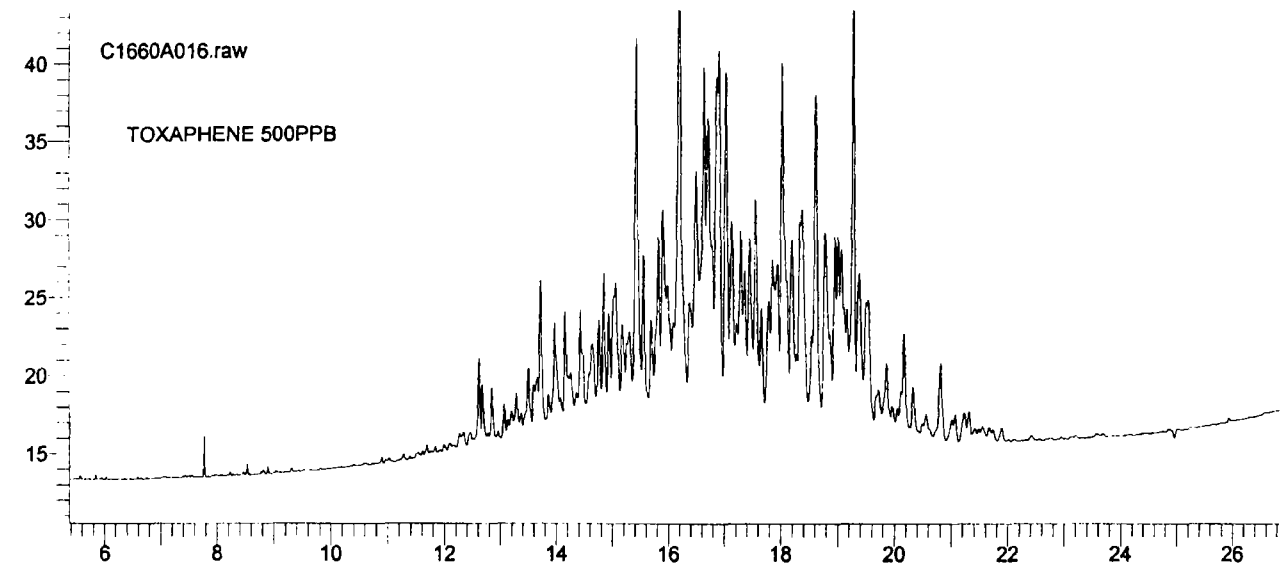
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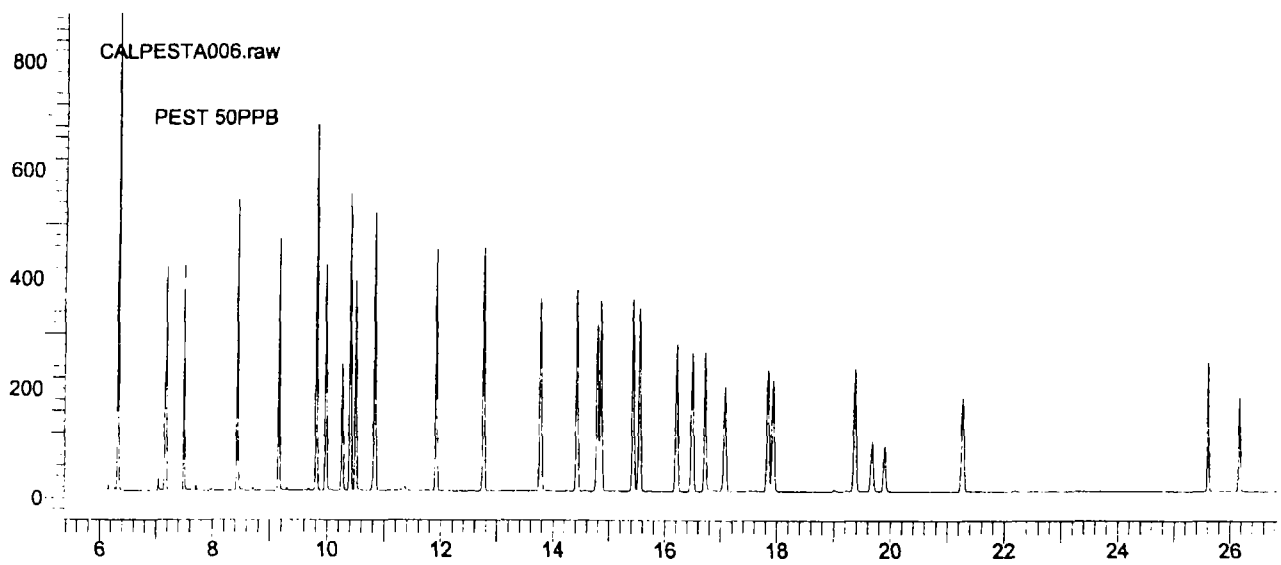
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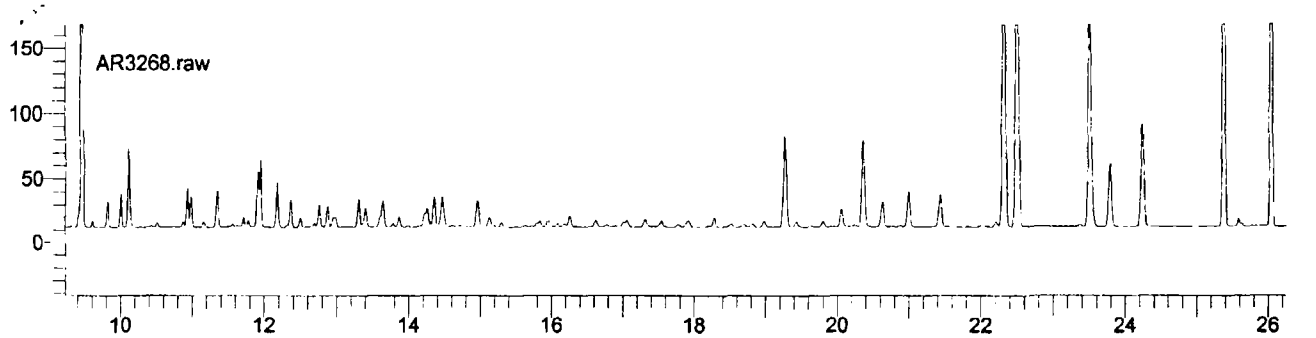
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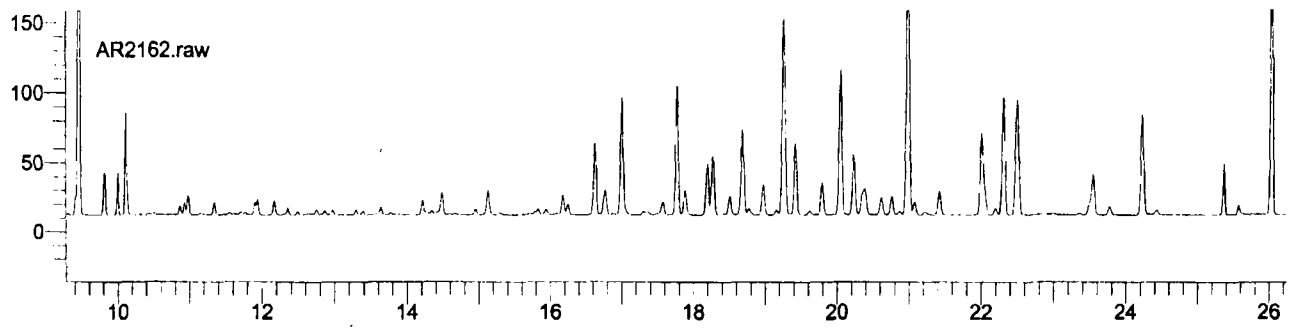
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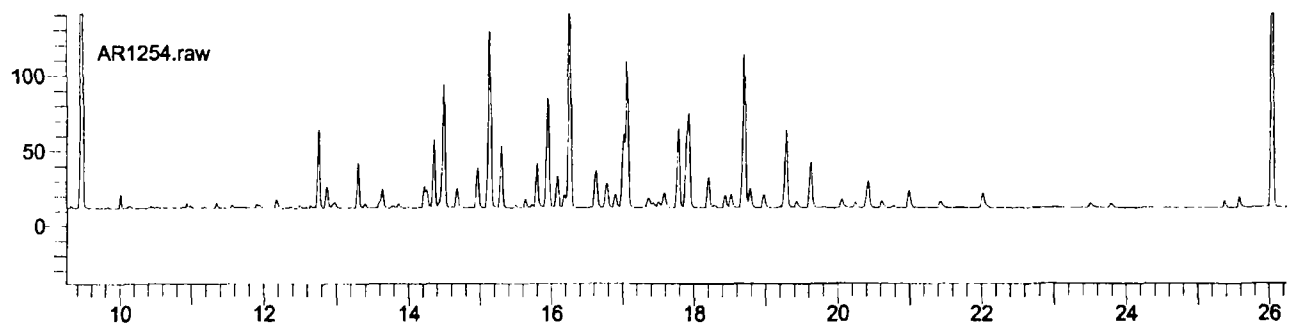
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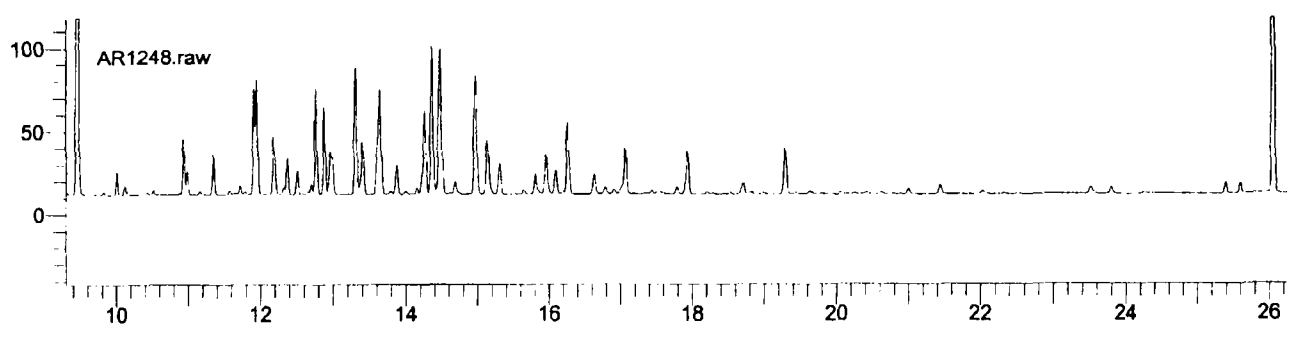
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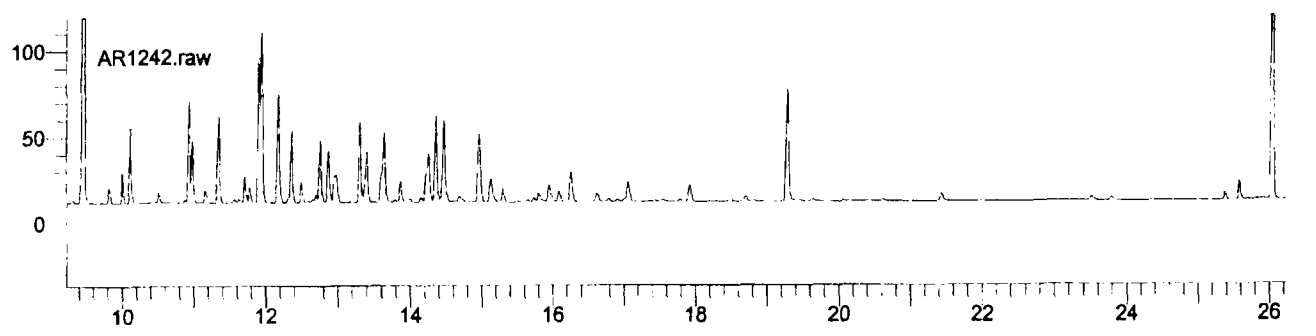
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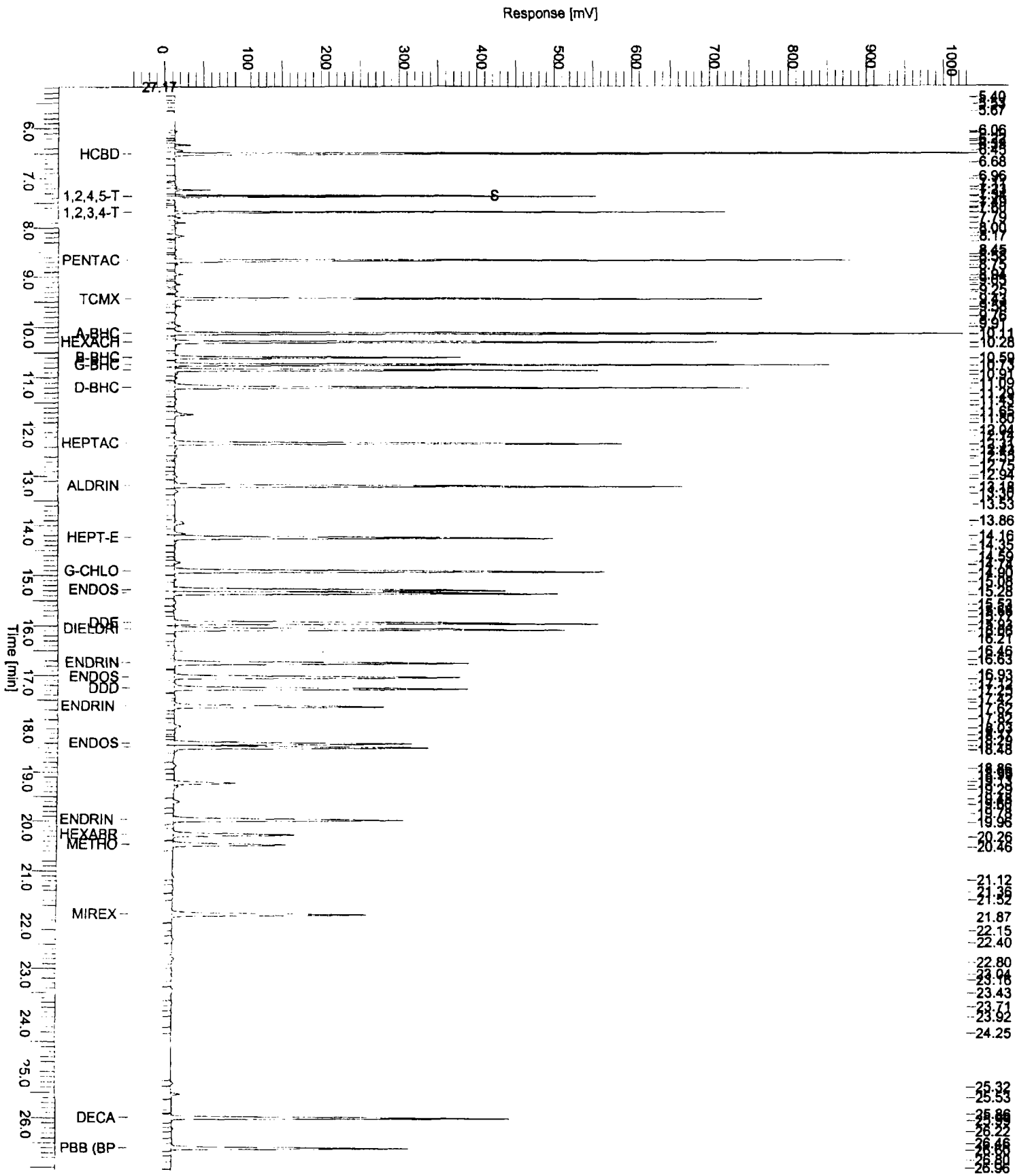
Date : 10/8/02 4:43:52 PM
Method :
Time of Injection: 10/1/02 2:02:33 PM
Start Time : 5.18 min End Time : 27.07 min Low Point : -41.94 mV High Point : 1033.25 mV
Plot Offset: -41.94 mV Plot Scale: 1075.2 mV



Sample Name : PEST SE-744 125PPB Sample #: 03 Page 1 of 1
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Date : 10/8/02 4:44:45 PM
Method : 7-pestb-020925.mth Time of Injection: 10/1/02 2:02:33 PM
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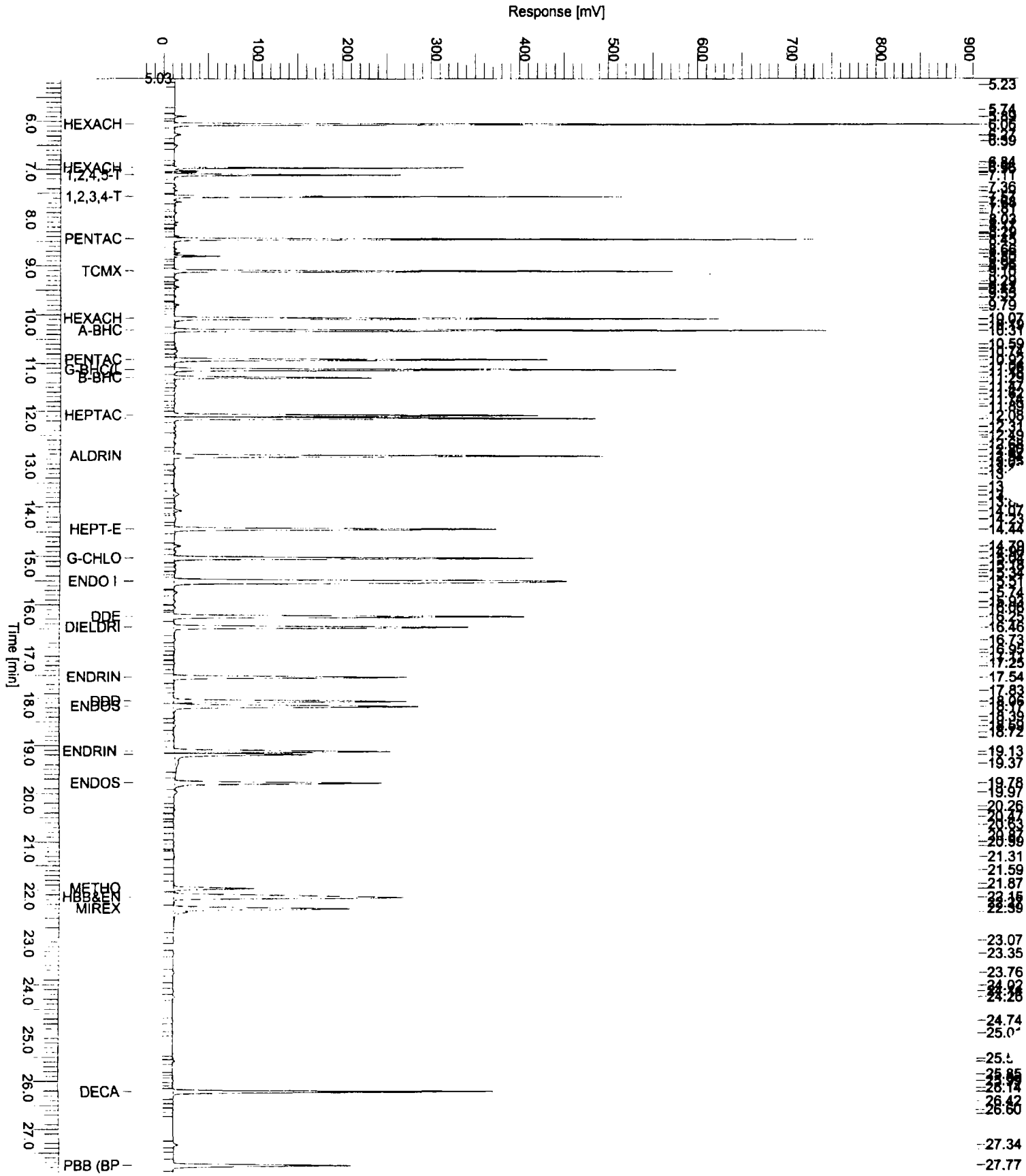

APPENDIX E

ENO RIVER QUALITY ASSURANCE MANUAL AND STANDARD OPERATING PROCEDURES

ENO RIVER LABS

QUALITY ASSURANCE MANUAL

Version 3 (Draft)
Effective October 16, 2006

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Eno River Labs, LLC

Table of Contents

Section	Title	Page	NELAC Reference
1	Quality Policy Statement including Objectives and Commitments by top management	1	5.4.2.3.a
2	Organization and Management Structure of the Laboratory	2	5.4.2.3.b
3	Relationships among management, technical operations, support services, and the quality system	3	5.4.2.3.c
4	Records and Records Management	4	5.4.2.3.d
5	Job Descriptions of key staff and reference to the job descriptions of other staff	8	5.4.2.3.e
6	Identification of the Laboratory's Approved Signatories	9	5.4.2.3.f
7	Laboratory's Procedure for Achieving Traceability in Measurements	10	5.4.2.3.g
8	A List of All Methods Under Which the Laboratory Performs its Accredited Testing, Location of Current Licensure and Licensed Parameters	13	5.4.2.3.h
9	Mechanisms for Ensuring That the Laboratory Reviews All New Work to Ensure It Has the Appropriate Facilities and Resources Before Commencing Such Work	14	5.4.2.3.i
10	Reference to Calibration and/or Verification Test Procedures Used	15	5.4.2.3.j
11	Procedures for Handling Submitted Samples	16	5.4.2.3.k
12	Major Equipment and Reference Measurement Standards Used as well as the Facilities and Services Used by the Laboratory in Conducting Tests	18	5.4.2.3.l
13	Reference to Procedures for Calibration, Verification, and Maintenance of Equipment	19	5.4.2.3.m

14	Reference to verification Practices, Including Inter-Laboratory Comparisons, Proficiency Testing Programs, Use of Reference Materials, and Internal Quality Schemes	21	5.4.2.3.n
15	Procedures to be Followed for Feedback and Corrective Action Whenever Testing Discrepancies are Detected or Departures from Documented Policies and Procedures Occur	22	5.4.2.3.o
16	The Laboratory Management's Arrangements for Exceptionally Permitting Departures from Documented Policies and Procedures or From Standard Specifications	23	5.4.2.3.p
17	Procedures for Dealing With Complaints	24	5.4.2.3.q
18	Procedures for Protecting Confidentiality and Proprietary Rights	25	5.4.2.3.r
19	Procedures for Audits and Data Review	26	5.4.2.3.s
20	Processes/Procedures for Establishing That Personnel are Adequately Experienced in the Duties They are Expected to Carry Out, and/or Receive Any Needed Training	27	5.4.2.3.t
21	Procedures for Reporting Analytical Reports	28	5.4.2.3.u
22	Data Integrity Procedures	29	5.5.2.7
	Appendix 1	30	
	Appendix 2	31	

Eno River Labs, LLC

Quality Policy Statement including Objectives and Commitments by Top Management

This Quality Assurance Manual summarizes the policies and operational procedures associated with Eno River Labs, LLC in Durham North Carolina. It is Eno River Labs, LLC management's policy to maintain sufficient Quality Assurance personnel and activities to ensure the integrity and scientific validity of the data collected and processed. All data generated by Eno River Labs, LLC will be of known precision and accuracy and legally defensible.

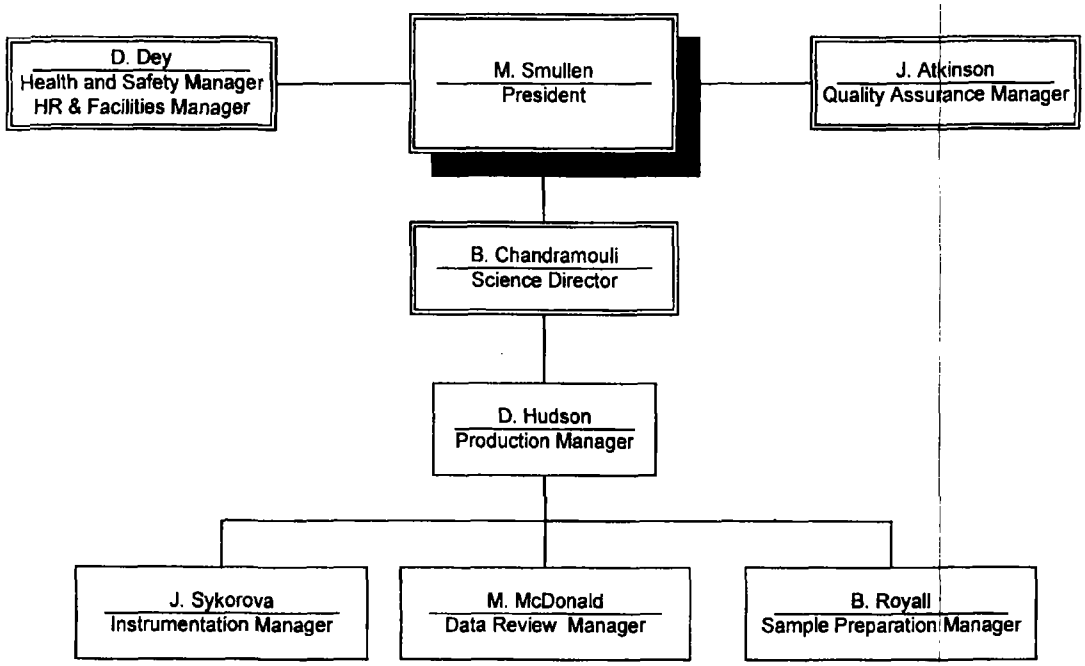
Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item or service against defined standards to verify that they meet the stated requirements established by the chosen analytical method or by the directives of the customer.

All environmental analysis related policies and procedures have been structured in accordance with the National Environmental Laboratory Accreditation Conference (NELAC) standards and applicable EPA Good Laboratory Procedures (GLP) standards, 40 CFR 160, 40 CFR 792.

Our goal is to produce data that are scientifically valid, defensible, and of known and documented quality in accordance with standards developed by NELAC, State, and EPA regulations or requirements.

Eno River Labs, LLC

Organization and Management Structure of the Laboratory



Relationships Among Management, Technical Operations, Support Services, and the Quality System

Management and the quality system
Management is responsible for the design and oversight of the quality system. The Quality Assurance Manager is a top-level manager reporting only to the President.

Technical operations and the quality system
The manager for each department is responsible for the implementation and on-going execution of the quality system elements relevant to the department. The following quality system functions are technical operations functions:

- Method development and implementation
- Materials and equipment specification
- Calibration and error characterization
- Technical staff training
- Technical corrective actions execution
- Facilities and equipment maintenance
- Analytical data review including review and interpretation of ongoing quality audits
- Maintenance of process records

Support services and the quality system
In-house support services include purchasing, billing, sales, and human resources. The managers of each of these functions ensure that these areas operate within the parameters of the quality system and may be subject to internal audits by the quality assurance manager.

Data Collection and Reduction

Quality assurance principles are applied in the acquisition of raw data related to chemical measurements. Raw data is "primary data" which will be used to generate "secondary" data (including the final analytical report). Data can be acquired manually or electronically. Manually acquired data is handwritten on data sheets and in logbooks. Electronically acquired data is acquired from an instrument and instrument/computer interface. Specific definitions and data requirements are detailed in the Raw Data SOP.

Manually Acquired Data

Manually acquired data is recorded on data sheets or in notebooks. The data must be recorded immediately by the analyst in permanent ink. Each entry must be signed and dated immediately after entry. Corrections must not obscure any original entries. Corrections are made by canceling with a single line drawn through the original entry. Each correction is then dated and initialed by the person who made the correction and a reason given for the correction. Data sheets are standardized preprinted forms that are subject to document control. Data sheets may be bound into a book or may be used as loose sheets depending on the application. Notebooks are bound, consecutively numbered, and subject to a controlled distribution and archival system.

Electronic Data

Electronically produced data may consist of chromatograms, spectra, data printouts, and raw quantitation reports. The first accepted hard copy report constitutes the raw data for each sample and calibration. The dated signature of the analyst signifies acceptance. The accepted hard copy report must contain the full sample ID or calibration name, file name, as well as date and time of acquisition. Any changes to the raw data hard copies and computer files must be fully documented and clearly attributable to the person making such alterations (e.g., manual integrations are hard-copied for inclusion in the raw data file, with area changes fully documented on the data printouts). No ambiguity in data system printouts as to what peak on a chromatogram corresponds to an analyte of interest is allowed. Computer-collected data is reduced to hard copy as soon as possible. The signed and dated hard copies of the data files are retained in the project file and are maintained for a minimum of 10 years. The electronic files are safeguarded by a system of disk storage and backup disks to protect loss of data and programs.

Data review and reduction of environmental analyses normally follow the guidelines of relevant EPA reference methods. For HRGC/HRMS analyses, established procedures consist of data acquisition and reduction on a Digital Micro VAX and VAX 3100 and further reduction and data reporting using dBase software on a PC. For HRGC/LRMS analyses, established procedures consist of data acquisition and reduction using PC-based software followed by further data reduction and reporting using dBase software.

All GC/MS data go through several levels of review and inspection, starting with an initial examination in the Instrumentation area, followed by a thorough review before preparation of the final report. After preparation of the report, a chemist other than the one who prepared the report performs an independent review. At each stage of the analytical

process, data are reviewed for completeness, adherence to protocol requirements, and credibility. Results are fully validated, possible compromises of data quality are evaluated, and deviations from protocol requirements are documented. To the greatest extent possible, computer programs are utilized for data reduction. Where manual data procedures are required, data review is performed according to standard operating procedures. This ensures that the results are as independent of the chemist performing the duties as possible. Corrective actions are implemented at the earliest possible opportunity.

Data Validation

The tests performed by Eno River Labs typically involve the performance of complex chemical analyses by a number of chemists. For this reason data validation and coordination are very important. At the conclusion of the analyses, data are checked against the original shipping information and analytical request to be sure that the required analyses have been performed on all samples.

The validity of the data is verified through the analysis of blank samples, duplicate samples and laboratory control or matrix spikes. The blank sample results demonstrate the absence of laboratory contamination of the samples. Duplicate analyses give a measure of analytical precision. The analysis of spike samples permits a measure of accuracy. Data for these QC samples are reviewed as soon as possible after analysis. For example, in the GC/MS area, the instrument operator uses a data quality checklist at the time of analysis, to verify that all calibration verifications are within tolerance, and that other QC indicators such as spike recoveries and blanks, are acceptable for a project.

Data Reporting

The data are reported as components identified and the quantities present. The final report includes example calculations and descriptions of the equipment and procedures utilized. Complete data packages of all raw sample and calibration data are prepared and archived. These are furnished to the client upon request. Sample data flagging procedures for analyses are summarized in the final report.

Data Package Delivery

The Shipping and Archive department, according to their SOP's, prepare data packages, which contain a CD-ROM of the scanned data, for delivery. Unless otherwise requested by the client, a copy of the data package is shipped, while the original is retained in a secured archive facility. Issued Reports are fully paginated. A commercial carrier whose procedures for protecting the data packages are not within the control of Eno River Labs delivers packages. Should the shipped data package be lost or damaged during delivery, a copy can be quickly prepared as a replacement. Clients are made aware that a commercial carrier will deliver their data packages.

Corrections and Additions to Documentation

Additions/corrections of reports already issued are handled according to the SOP. The client requests an addition/correction in writing to the Client Service Representative, who prepares a proposal in response to the request. The area manager then approves the addition/correction proposal. When the addition/correction has been made the revised report is then passed through the normal review procedures. The Data Package Assembly Department mails or faxes the new report, which is then stored with the original data package for a minimum of ten years. In all cases, revised pages are clearly noted as such, as are additional pages added to the report.

Quality Records

Quality records must be maintained to prove that the quality assurance system is being effectively applied. At Eno River Labs, specific procedures for the identification, collection, indexing, filing, storage, maintenance, and disposition of various quality records are described in several SOPs. All quality records must be recorded in permanent (indelible) ink, legible, attributable to those personnel who wrote them, and protected so they may not be adversely affected by an unsuitable environment. They are stored and maintained in a manner that facilitates rapid retrieval for a period of at least ten years after completion. With the exception of internal audit reports, project specific quality records are available for evaluation by the client or his representative during the archive period of ten years. In fact, certain quality records, as specified by SOP or contract, are delivered to the client with the final product.

Project specific quality records are maintained to prove that adequate quality control procedures are being implemented, accountability of the project data is maintained, and traceability of analytical results is facilitated. Accountability refers to reported data that reflect the sample as it was received, that sample mix-up was avoided, and that the sample was properly preserved after receipt. Traceability means that reported data may be reconstructed at a later date. Through proper documentation, a laboratory is able to demonstrate or prove to clients or government agencies that the quality of the data is what the laboratory says it is. Records must contain sufficient information to permit the reconstruction of calibrations, sample preparations, and sample analyses.

Quality records that are maintained at Eno River Labs include, but are not limited to, the following.

-Records for sample receipt, preparation, and handling
-Field sample and quality control sample analysis data
-Project communication tracking forms
-Inspection reports for receiving, in-process, and final product
-Subcontractor records
-Vendor qualification records
-Logbooks, i.e. run logs, maintenance logs, temperature logs, balance logs, etc.
-Method validation records, i.e. MDL studies, initial precision and accuracy demonstrations
-Recovery data for samples, blanks, and spiked samples (maintained in a database)
-System and data audit reports
-Corrective action reports
-QA reports to management

Many of these quality records are discussed at length in other sections of this manual. Laboratory notebooks (or "logbooks") are utilized throughout Eno River Labs for many different purposes. All logbooks are maintained according to written procedures. New logbooks are issued by a system of assigning them via a designated logbook. Information that must be documented, both in the new logbook and the designated logbook, includes the assigned owner, the date issued, and the name and subject of the logbook. Logbooks must be maintained in accordance with the raw data SOP. Logbooks are kept to document all monitoring, maintenance, and calibration of analytical instrumentation, and such laboratory equipment as balances, refrigerators and ovens. Software and hardware

records for computers are also kept in logbooks. Logbooks specific to a piece of equipment are kept near that equipment to ensure that the work is recorded concurrently. When no longer in use, logbooks are archived for a minimum of ten years.

Archive

The Archive Room is locked at all times and only trained, designated staff have access. All other personnel may enter the room only in the presence of a trained Archivist and must sign and date a logbook in the Archive Room. The Archivist must sign out any materials removed from the Archive Room.

All magnetic, optical, and hard copies of data, calibrations, equipment maintenance records, calculations, records of original observations, final test results and any other miscellaneous quality records directly associated with sample analyses are stored in a secured facility for a minimum ten (10) years after completion of a project. They may be stored in the Archive Room or at a secure, off-site storage facility.

Records Retention and Transfer

Should Eno River Labs go out of business or be bought by another company, all clients will be notified immediately. Client records will be handled in one of the following manners:

- If Eno River Labs should go out of business and the client wishes to have control of their data, they will be given the original copies.
- If another company buys Eno River Labs and the client wishes to have control of their data, they will receive the original copies and an exact copy (with proper documentation) will be retained by the purchaser. The purchaser will be responsible for retaining the data for the remainder of the applicable time.

In each case, clients will be notified before disposal of their records, and all records will be disposed of in a secure manner.

Job Descriptions of Key Staff and Reference to the Job Descriptions of Other Staff

While not all-inclusive of assigned duties, the following are brief descriptions of the chief technical personnel at Eno River Labs.

President: Responsible for the overall operation of the company. The President determines strategic directions, establishes company goals, and directly supervises the management staff.

Quality Assurance Manager: Coordinates and manages the Quality Assurance Department. Coordinates internal and external audits, performance samples, and laboratory certification data. Maintains quality assurance documents, i.e. the Standard Operating Procedures, the Quality Assurance Manual, and the Quality Assurance Plan. Responsible for overseeing all quality aspects of the laboratory. The QA Manager reports directly to the President. Minimum qualifications are: Education - B.S. in Chemistry or equivalent, and Experience - 5 years in a scientific field. In the absence of the QA Manager, the President will appoint an acting QA Manager.

Environmental Science Director: Provides consultation and guidance on specific technical and scientific questions and issues. Performs audits of the technical aspects of business operations. The Technical Director reports directly to the VP Operations. Minimum qualifications are: Education - Ph.D. in Chemistry, and Experience - 5 years of analytical chemistry. Eno River Labs has two Co-Technical Directors. In the absence of both the President will appoint an Acting Technical Director.

Area Manager: Responsible for the management of a defined production area such as sample preparation, instrumentation, or data review and reporting. Minimum qualifications are: Education - B.S. in a Physical Science or equivalent experience, and Experience – 2 years analytical chemistry experience.

Chemist: Participates in development projects as they relate to routine processing by applying knowledge of chemistry in resolving routine problems. Resolves routine issues such as deciding when a sample needs additional preparatory efforts. Minimum qualifications are: Education - B.S. in Chemistry from an ACS accredited program.

Technician: Applies knowledge of chemistry to the application of routine procedures Minimum qualifications are: Education - an associates degree or relevant experience.

Identification of the Laboratory's Approved Signatories

The final inspector has signatory authorization for the client reports.

The Environmental Science Director has signatory authorization for approval of non-conformances and standards deviations.

In the event the Environmental Science Director is not available the Bioanalytical Science Director has signatory authorization to act on behalf of the Environmental Science Director.

The President or President's designee has signatory authorization to sign on behalf of the Quality Assurance Manager.

Purchasing, Receiving, Inspection, Inventory and Storage of Laboratory Materials

Practices utilized for the purchase, receipt, inspection, inventory, and storage of laboratory materials are described in several SOPs. A completed purchase requisition form provides a clear description of the product ordered. This includes, where applicable, a precise identification and reference to any specifications that must be met. Purchases are pre-approved by department heads. The purchasing department orders the material, from an approved supplier whenever possible. Upon receipt of the goods, receiving personnel examine them for damage before signing the bill of lading. Within two days, items and quantities in all shipments are compared with what was ordered and this information is communicated to purchasing and accounts payable. All stocked items are stored in the warehouse and a monthly inventory is performed. Non-stocked inventory is forwarded to the requisitioning person. Reagent materials are assigned expiration dates and placed on shelves so that the older materials will be used first.

During the analytical process, it is possible to obtain a variety of measurements. These include such measurements as volume, weight, concentration, pH, and temperature to name just a few. The laboratory must implement practices that facilitate the traceability of these measurements to recognized standards of measurement.

Chemical Standards

The procurement, preparation, handling, and storage of chemical standards is critical to the analytical process. It is through these chemical standards that reported analyte measurements in samples are traceable to reference values. Only the highest quality chemicals are used as reference materials at Eno River Labs. Whenever possible, standard solutions will be traceable to national standards such as NIST or EPA certified reference materials. Numerous written procedures describe the management of these analytical standards. These procedures are written to ensure consistency with the requirements of analytical methods and current certifications and accreditations.

Sources of Standards, Traceability and Verification

Eno River Laboratories purchases standards from approved suppliers of chemical standards. Occasionally, clients supply standards specifically for use in the preparation and analysis of their samples. Prior to using these standards, an agreement must be reached with the client about the handling and disposition of their standards. Information about these standards and any client requirements are recorded in the pertinent standards logbook. The chemist receiving a chemical standard shipment verifies that the information on the standard label is consistent with that on the supplier paperwork. Information about the standard is recorded in a standards logbook. Traceability of standard solutions is facilitated by the use of codes that unambiguously identify the supplier, materials and all derived preparations. Non-certified standard materials are verified against certified reference standards, when the latter are available.

Types of Standards

Analytical methodologies define a variety of standard solutions that are used by the laboratory. Included among them are: surrogate spikes, matrix spikes, internal standards, QC check standards, recovery standards, and calibration solutions. The composition and concentration of these solutions must conform to method specifications.

Standards are categorized at Eno River Labs according to the following definitions:

Primary Standard	A neat standard received from a supplier.
Stock Standard	A solution of a primary standard at a high concentration, used to prepare secondary standards. These may be prepared in-house or received from a supplier.
Secondary Standard	A solution of one or more stock standards, with each analyte prepared at a selected concentration, to be used as a beginning mixture for preparation of calibration or spike solutions. These may be prepared in-house or received from a supplier.
Working Standard	A solution that will be used without dilution for instrument calibration or sample fortification. These may be prepared in-house from secondary standards, or purchased from a supplier,

Preparation of Standards

The preparation of any standard solution is performed by an experienced chemist, and is documented in the appropriate standards logbook. New standard solutions are prepared as needed. The manner of preparation for a standard solution depends upon the required amount and concentration and its intended application. Several SOPs are utilized to assure the correct preparation and documentation of standard solutions.

All standards are assigned an expiration date. The supplier's assigned expiration date, if provided, is used for neat or primary standards. Otherwise, the expiration date is assigned based upon the supplier's date of preparation and the known stability of the analyte. (Some analytes are known to be highly volatile or to easily degrade or react.) When applicable, assigned expiration dates meet the requirements of analytical methods. A standard mixture is assigned an expiration date no later than that of the earliest expiring component. The expiration date is only a guideline. Standards are removed from production prior to the assigned expiration date if deterioration is observed visually or analytically or if the integrity of the material can no longer be assured.

Analyte or standard components common to calibration solutions and associated sample fortification solutions may be of the same primary source or an independent source. Some methodologies require that primary standards of the same supplier batch or lot number be used for both. Certain spiked QC samples must be prepared from reference material that is independent of the associated calibration standards. New standards are prepared as necessary to meet these requirements.

Calibration Procedures and Frequencies

Equipment used for inspection, measuring and testing must meet all specific requirements for proper measurement capability as identified in the pertinent analytical method and applicable certification agency. This includes small equipment and instruments as well as large analytical instruments such as gas chromatographs and mass spectrometers. Calibration procedures and frequencies specific to types of equipment are briefly described below.

The instrumental performance requirements of the published methods will be followed unless otherwise specified for a project. Other performance tests may also be executed to further demonstrate proper functioning of instrumentation.

Small equipment

Thermometers	Laboratory thermometers are routinely checked for accuracy against certified, NIST-traceable thermometers. These calibrations are performed annually for mercury or alcohol in glass thermometers, and quarterly for metal thermometers. Infrared thermometer calibrations are verified daily. Correction factors derived from the annual and quarterly calibrations are applied to temperature readings where applicable. NIST-traceable thermometers are professionally calibrated and re-certified annually.
Balances	Calibration checks are performed for each day of use for each balance. The calibration consists of a minimum of two weights that encompass the weight the balance will be used to measure. Calibration weight measurements must meet the acceptance criteria listed in the associated balance calibration logbook. Each balance is serviced and calibrated by a certified professional, semiannually. The accuracy of the calibration weights is verified annually.
Volumetric Glassware	All volumetric glassware used at Eno River Laboratories, Inc. must be type "class A". Volumetric glassware is never heated or placed in an oven.
Automatic Pipettes	Delivery volumes for the automatic pipettes are checked gravimetrically monthly. Each pipette is checked throughout the volume range of use. Acceptance criteria for continued use is 2% RSD and 97.5 - 102.5% accuracy. Pipettes that fail to meet these criteria are tagged and removed from service until repaired.

A List of All Methods Under Which the Laboratory Performs its Accredited Testing

DIOXIN/FURAN COMPOUNDS

Methods 8280, 8280A, 8290, 23, 0023A, 1613B, TO-9

Specific Isomers	Total Isomers
2,3,7,8-TCDD	Total TCDD (22 isomers)
1,2,3,7,8-PeCDD	Total PeCDD (14 isomers)
1,2,3,4,7,8-HxCDD	Total HxCDD (10 isomers)
1,2,3,6,7,8-HxCDD	
1,2,3,7,8,9-HxCDD	
1,2,3,4,6,7,8-HpCDD	Total HpCDD (2 isomers)
OCDD	
2,3,7,8-TCDF	Total TCDF (38 isomers)
1,2,3,7,8-PeCDF	Total PeCDF (28 isomers)
2,3,4,7,8-PeCDF	
1,2,3,4,7,8-HxCDF	Total HxCDF (16 isomers)
1,2,3,6,7,8-HxCDF	
2,3,4,6,7,8-HxCDF	
1,2,3,7,8,9-HxCDF	
1,2,3,4,6,7,8-HpCDF	Total HpCDF (4 isomers)
1,2,3,4,7,8,9-HpCDF	
OCDF	

TCDD	tetrachlorodibenzo-p-dioxin
PeCDD	pentachlorodibenzo-p-dioxin
HxCDD	hexachlorodibenzo-p-dioxin
HpCDD	heptachlorodibenzo-p-dioxin
OCDD	octachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
PeCDF	pentachlorodibenzofuran
HxCDF	hexachlorodibenzofuran
HpCDF	heptachlorodibenzofuran
OCDF	octachlorodibenzofuran

Current licensure and the licensed parameters for the laboratory are publicly displayed in the front office space of the facility. This information is also maintained and controlled by the company Environmental Contract Officer.

Mechanisms for Ensuring That the Laboratory Reviews All New Work to Ensure It Has the Appropriate Facilities and Resources Before Commencing Such Work

The Contracts Officer verifies with the Environmental Science Director any scheduling of in-coming work.

During the quoting stage all parameters are decided, including, but not limited to, detection limits, available sample, and method to perform. Upon sample receipt, all parameters are checked to ensure that the analysis can be carried out using current SOP's. If it is determined that special instructions will be needed, the production manager will coordinate the creation and follow-up those instructions with the science director.

Reference to Calibration and/or Verification test Procedures Used

Calibration and verification test procedures for each method can be found in the company's SOPs.

Sample Receipt and Chain-of-Custody

A Sample Custodian or a designated assistant receives deliveries of all samples. The Sample Custodian assigns a unique project number to each shipment of samples received from a client and initiates the first in-house records for the new project. The internal chain-of-custody must be included in the initial set of in-house records. When samples are hand delivered by a customer, the individual's name is recorded on the internal chain-of-custody. The Sample Custodian examines the shipping containers, their contents, and accompanying client documentation. Information about the presence and condition of custody seals and the state of preservation of the samples is noted on the internal chain-of-custody. Any discrepancies in documentation or problems with sample condition are also noted and brought to the attention of the client, who may provide clarification or further instructions. The Sample Custodian assigns an internal sample ID to each sample, which is labeled on the sample container. The following information pertinent to each sample is recorded on the internal chain-of-custody: internal sample ID, client sample ID, sample matrix and storage location. The original internal chain-of-custody is placed in storage with the samples. The sample receipt and handling SOPs describe procedures for sample receipt and log-in, chain-of custody, along with those for handling sample shipment containers provided by clients.

Sample Preservation and Security

Samples are stored in a manner that ensures their integrity and security. Samples are stored at temperatures that meet specifications of the methodology and client. Depending on the nature of the sample and the requirements of the method, samples may be stored in a freezer at -70° ± 20° C or at -20° ± 10° C, in a refrigerator or cooler at 4° ± 2° C, or in a cabinet at room temperature. Required preservation techniques may be found in *Appendix 2* for most methods employed at Eno River Labs. Protocols often give specific preservation requirements that must be observed. Addition of chemical preservative to sample containers normally takes place at the time of sample collection. Sample storage facilities at Eno River Labs are located within laboratory areas. The entire laboratory area is secured and external personnel must be accompanied at all times. Internal chain-of-custody procedures and documentation pertaining to sample possession, removal from storage and transfer are outlined in written procedures. Care is taken to ensure that cross-contamination does not occur during sample storage. Temperatures of cold storage areas are monitored and recorded, any corrective action is taken as necessary. Further details about sample storage and preservation may be found in the sample receipt and handling SOPs.

Sample Preparation Procedures

Samples are prepared in a way that is method and matrix specific. Most environmental samples must be prepared within a method-specified time after sampling. Non-compliance of holding times requires client approval. The client is contacted if samples are received near or beyond the expiration of these holding times. For most methods employed at Eno River Labs, holding times may be found in *Appendix 2*. Protocols must be consulted for project-specific holding time requirements. Many primary extracts require clean-up procedures before they may be injected into a GC or GC/MS analytical system. Appropriate SOP's covers all sample preparation procedures employed at Eno River Labs.

Sample and Sample Extract Storage and Disposal

The sample management team is responsible for the storage and disposal of samples. Following preparation, samples are retained in cold storage for 30 days after shipment of the final data package. Samples to be stored are placed in boxes, labeled with the project numbers, and retained in a secured area for the specified length of time prior to disposal. Written procedures describe routine storage and disposal practices. Clients are informed about these procedures and are given an opportunity to request exceptions to these routine practices. Analysts are responsible for the storage and disposal of sample extracts. Sample extracts are stored in the dark at room temperature for 90 days after initial analysis.

Sample Return to the Client

When a client has requested the return of samples, a sample custodian prepares and ships the samples according to written procedures. Protection of the samples during delivery is ensured by the implementation of special packaging procedures. Packages are delivered by a commercial carrier, whose procedures for protecting the samples are not within the control of Eno River Labs. Clients are informed that a commercial carrier will deliver their samples.

Sample Loss, Damage, or Unsuitability

It is possible for samples or sample containers to be lost, damaged, or determined to be unsuitable, for whatever reason, after initial receipt at Eno River Labs. When this occurs, the event is recorded in the sample handling documentation by the observer. The problem is brought to the attention of a Client Service Representative who reports it to the client. Plans for disposition of the affected sample(s) or containers are agreed upon with the client, carried out, and recorded in the project records.

Major Equipment and Reference Measurement Standards Used as well as the Facilities and Services Used by the Laboratory in Conducting Tests.

Summary of Scientific Instrumentation			
Instrument Type	***Model/Name***		***Applicable Methods***
High Resolution GC/MS	VG Analytical 70-S	U	1613B, 8290,M23
High Resolution GC/MS	VG Analytical 70-S	S	1613B, 8290,M23, 1668A
High Resolution GC/MS	VG Analytical 70-S	T	1613B, 8290,M23,1668A
High Resolution GC/MS	VG Analytical 70-SE	W	1613B, 8290,M23,1668A
High Resolution GC/MS	VG Analytical 70-SE	P	TCDF Confirmation
High Resolution GC/MS	VG Analytical 70-VS	M	1613B, 8290,M23,1668A
High Resolution GC/MS	HP MSD 5971A	Z	8280, 680
High Resolution GC/MS	HP MSD 5971A	Y	8280
High Resolution GC/MS	HP MSD 5971A	V	8270, 680
High Resolution GC/MS	HP MSD 5971A	C	8280

Our reference standards are EPA-approved methods.

Facilities

Eno River Labs, LLC currently occupies approximately 26,000 square feet. The facility is divided according to work function, including separate areas for sample receipt; sample, standard, and glassware preparation; sample and data storage; instrumentation; report generation, quality assurance; shipping; maintenance; and business/management offices.

Environmental and Security Systems

Eno River Labs provides a secure environment for our employees, guests, clients, samples, and analytical data.

Access All entry points into the building are locked. Each employee is issued a coded electronic key for the door locks. The receiving area is secured via a locked gate so deliveries may be received without disruption of workflow and without breaching the security of the building. A conference room has been equipped for use by visitors. This room allows visitors to enter the room from outside the building, but the door to the rest of the laboratory is locked to restrict access. Visitors are required to sign the Visitor Log and must be accompanied by an employee of Eno River Labs when beyond the confines of the reception area, audit conference room, or secured receiving area.

Reference to Procedures for Calibration, Verification, and Maintenance of Equipment

Gas Chromatography/Mass Spectrometry (GC/MS) and Liquid Chromatography/Mass Spectrometry (LC/MS/MS)

Tuning and Mass Calibration

For high resolution, selected ion monitoring analyses, the high-resolution mass spectrometer is tuned to give the required resolution, which is checked on the instrument screen or using a resolution plot. This measurement is confirmed by the use of a data system. The instrument is then mass calibrated using perfluorokerosene (PFK) or perfluorotributylamine (PFTBA). Mass calibration is adjusted automatically by the data system, to within ± 5 parts-per-million (ppm), approximately once per second during the course of all quantitative analyses.

The mass calibration of a quadrupole mass spectrometer is checked daily through the use of the perfluorotributylamine reference compound (PFTBA). The instrument is adjusted to give specified peak ratios for this compound, consistent with the type of analysis to be performed. The GC/MS is tuned prior to performing the initial and continuing calibrations. Results must meet the peak ratio specifications of the analytical methods. For semivolatiles analyses, 50 ng of decafluorotriphenylphosphine (DFTPP) is used.

The mass calibration of a triple-quadrupole mass spectrophotometer is checked during validation using a sodium/cesium iodide solution. Further mass calibration checks are performed as necessary for these instruments.

Initial Calibration

For environmental samples, the mass spectrometer response is typically calibrated by analyzing a set of five or more initial calibration solutions, as appropriate for each GC/MS method. Typically, each solution is analyzed once unless the method requires multiple analyses. The relative response factor for each analyte (target compound or surrogate / internal / alternate standard) is calculated using the expression in Appendix 1A. The mean relative response factor for each analyte is then obtained using the expression in Appendix 1B. Integrated ion currents are utilized for these expressions. An acceptable calibration must meet the method specified criteria for percent relative standard deviations (% RSD) of the mean relative response factors, calculated for each analyte. Failure to meet the criteria will result in corrective action (e.g., locating the source of the problem and adjusting the instrument tuning parameters) before repeating the rejected analyses. Eno River Labs does not analyze any samples unless the performance criteria for calibrations are satisfied.

Continuing Calibration

For environmental analyses, the initial calibration is verified through the analysis of a continuing calibration standard every 12 hours. The concentration of continuing calibration standard is dependent on the requirements of the specific method. The relative response factors for all analytes of interest are calculated and verified against the initial calibration mean relative response factors. The percent difference (%D) for each analyte is calculated using the expression in Appendix 1C. An acceptable continuing calibration run must have measured percent differences for the analytes within method specified ranges. Should any criteria for an acceptable calibration not be met, either instrument maintenance is performed such that a new continuing calibration analysis meets all criteria or a new initial calibration will be established before any samples can be analyzed. No samples may be analyzed unless acceptance criteria have been met.

Preventative Maintenance

Eno River Labs, LLC has a procedure for the performance of preventative maintenance, and for the scheduling all instrumentation used by the laboratory. This document can be found in all SOP manuals throughout the facility.

Reference to verification Practices, Including Inter-Laboratory Comparisons, Proficiency Testing Programs, Use of Reference Materials, and Internal Quality Schemes

Eno River Labs, LLC participates in the EPA WS Proficiency Testing program, which occurs bi-annually.

Analyses are processed in daily batches for each test. Each blank includes a method blank and a laboratory control standard (LCS). The LCS is prepared from stock solutions separate from the calibration standards. The LCS is spiked into a blank and carried through all sample preparation and analysis steps.

Quality control schemes vary for each method; the practices are detailed in each method SOP.

Procedures to be Followed for Feedback and Corrective Action Whenever Testing Discrepancies are Detected or Departures from Documented Policies and Procedures Occur

Nonconformity

Each field sample that is incorporated into the analytical process is unique. Laboratory procedures are designed to introduce as much standardization as possible. Whenever conformance to standards is uncertain, the product is reviewed to determine the nature and cause of the nonconformance. If the nonconformance is due to the unique nature of a sample we will inform the client and discuss the options that are available.

Each case of failure to comply with written acceptance criteria must be recorded in a non-conformance report (NCR). The person who detected or observed it must record the failure. All investigative efforts are recorded in the NCR with an evaluation of the impact the non-conformance had on the associated samples. Impact on the analytical process is also noted. If needed, recommendations for corrective action are made. A copy of the NCR is kept with the project data. Rework and reanalysis is subject to the same inspection procedures as the initial work.

Corrective and Preventive Action

Appropriate actions must be taken to prevent or correct nonconformities in products and problems in analytical systems. When actions result in permanent procedural changes, pertinent documentation (e.g., SOPs) must also be modified to reflect these changes. Preventive measures are applied whenever possible.

Corrective Action

Specific corrective actions are of two types: routine corrective actions applied to solve minor or non-routine problems and formal corrective actions taken to eliminate major or commonplace problems.

The chemists, technicians, or instrument operators who detect minor problems or product nonconformance usually make routine corrective actions. These actions are taken in response to observed non-conformance issues and are recorded on the associated NCRs.

There are three procedures for conducting formal corrective actions. The first is corrective action in response to a system audit report from the Quality Assurance Unit. This procedure is more thoroughly described in Section 13. The second procedure is the formal Corrective Action Report, which may be initiated by anyone who detects a significant quality problem. The Quality Assurance Unit also administers this procedure. Further information about it can be found in Section 13. The third practice is described in the SOP covering the handling of client complaints.

Preventive Action

Preventive actions are implemented as part of standard operating procedures, process improvement efforts, and corrective actions. When circumstances inherent to a procedure are known to have a high potential for error, the SOP must define measures to prevent the error from occurring. Preventive actions are an integral part of corrective actions because resultant changes in procedures often prevent the recurrence of problems.

The Laboratory Management's Arrangements for Permitting Exceptional Departures from Documented Policies and Procedures or From Standard Specifications

Eno River Labs, LLC has a Standard Operating Procedure that describes the authorization requirements for exceptional departures from the documented procedure. This document may be found in all SOP Manuals in the facility.

Eno River Labs, LLC

Reference to Procedures for Dealing With Complaints

Eno River Labs, LLC has a Standard Operating Procedure that describes the process on handling customer complaints. It can be found in the facility's SOP manuals.

Procedures for Protecting Confidentiality and Proprietary Rights

All employees are required to sign a confidentiality agreement prior to their first day of employment. This is the first step in initiating their employment; if they refuse to sign the employment process is terminated.

The confidentiality and proprietary rights are reminded during the required annual ethics training for employees.

All visitors are required to sign a confidentiality agreement prior to beginning their visit into the facility.

After sample analysis is completed and the data is processed, the analyst reviews the resultant data. If established acceptance criteria are not met, corrective action is taken to resolve problems. Once all the samples in a project have been analyzed and the data have met the criteria, the project documentation (instructions, raw data, reports, etc.) is sent to the next stage for preparation of the final report.

In the event of a discovery of the existence of defective measurement or test equipment, which had been used to report data, it must be reported immediately to the area supervisor. If it is a recurring problem, which indicates a repetitive failure of the analytical system, it must be reported to the Production Manager, Technical Director, and Quality Assurance Manager. A corrective action report is initiated. (See section 13 of this manual for more details on corrective action reports.)

Processes/Procedures for Establishing That Personnel are Adequately Experienced in the Duties They are Expected to Carry Out, and/or Receive Any Needed Training

Training is provided for new employees and as continuing education for veteran employees, both at the Eno River Labs facility and off-site.

On-Site Training: Training takes place at different levels throughout the facilities. Numerous manuals, texts, videos, SOPs, journals, analytical protocols, and in-house instructors are available to trainees. On-the-job training related directly to the position is given by area managers or other qualified staff. Typically, a trainee goes through a stepwise method to learn procedures pertaining to areas such as analytical methodology, report generation, or quality assurance activities. The trainee is first given an SOP to read and is required to observe the trainer performing the procedure. The trainee then assists the trainer in performing the procedure several times before he or she is allowed to perform the procedure independently. Frequent inspection of the trainee's work is performed during this independent performance. Finally, upon successful completion and documentation of the training process, the trainee may perform the procedure without supervision. Trainees may need to pass a proficiency validation prior to being approved for particular tasks.The Quality Assurance Manual is available to all employees. Cross training, supervisory training, and other related training takes place on a scheduled basis and is documented in training files.

Off-Site Training: This type of training takes place on an as-needed basis. Recommendations and suggestions about promising educational programs come from all levels of staff. Completed studies are documented and updated regularly in the training files. Courses may be taken at local colleges and universities. Instrument manufacturers, software companies, and national associations specializing in analytical chemistry or laboratory quality assurance often make workshops and seminars available.

The Human Resources Department maintains Résumés, education and experience records, and job descriptions. The résumés are updated on an annual basis or as needed. Additional education and experience is updated with the résumés. There is a job description for each position existing within the company. Active training records are kept on file in the work areas. Employees are responsible for maintaining their own training records and files. These training files contain records for any pertinent on- or off-site educational experiences, orientation records, SOP competence records, or self-help courses.

Procedures for Reporting Analytical Reports

Eno River Labs, LLC has a procedure for describing the requirements for the data package assembly. This document can be found in all SOP manuals throughout the facility.

Data Integrity Procedures

Eno River Labs, LLC has procedures for ensuring that all employees receive data integrity training. Data integrity training is provided as a formal part of new employee orientation, and is also provided on an annual basis for all current employees. Topics covered are documented in writing and provided to all trainees. Key topics covered during training include Eno River Labs, LLC organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues, and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation. Employees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution. The initial data integrity training and the annual refresher training have a signed individual training form that is filed in the employees individual training record. Senior managers acknowledge their support of these procedures by 1) upholding the spirit and intent of the organization's data integrity procedures and 2) effectively implementing the specific requirements of the procedures. Specific examples of breaches of ethical behavior are discussed during employee data integrity training. All employees receive training and assurance with regards to total confidential reporting of data integrity procedures within the laboratory. Eno River Labs, LLC is committed to ensuring a receptive environment in which all employees may privately discuss ethical issues or report items of ethical concern to management. The topics presented during data integrity training are documented in written form and are available to all employees in the company library. Employees may also access the data integrity training for review in electronic form on the company computer file server.

Appendix 1

Formula 1A

$$RRF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

where:

RRF = the relative response factor for the analyte
A_{is} = integrated area or ion current of the internal standard
A_s = integrated area or ion current of the analyte
C_{is} = amount of the internal standard
C_s = amount of the analyte

Formula 1B

$$\overline{RRF} = \frac{1}{n}\sum_{i}^{n}\frac{A_s C_{is}}{A_{is} C_s}$$

where:

$\overline{RRF}$ = the mean value of the relative response factors for the analyte
n = the total number of data points derived from the initial calibration
A_{is}, A_s, C_{is} and C_s have the same meaning as in formula 10-1.

Formula 1C

$$\%D = \frac{RRF_{cc} - \overline{RRF}}{\overline{RRF}} \times 100$$

where:

$\overline{RRF}$ = mean relative response factor for the analyte in the initial calibration
RRF_{cc} = relative response factor for the analyte from the continuing calibration

Appendix 2

CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Parameter	Matrix	Holding time	Recommended Volume	Preservative[a]
Extractable organics	Water	7 days from collection 40 days from extraction	Two 1.0 L amber glass bottles	Cool, 4°C; $Na_2S_2O_3$ if residual chlorine (80 mg/L)
	Soil	14 days from collection 40 days from extraction	100 g in amber glass jar	Cool, 4°C
Dioxin	Water	method specific, see	Two 1.0 L amber glass bottles	Cool, 4°C; 1613 - $Na_2S_2O_3$ if residual chlorine (80 mg/L)
	Soil	method specific, see	100 g in amber glass jar	Cool, 4°C

[a] For SW-846: Preserve PAHs with 0.008% $Na_2S_2O_3$. PAHs should be stored in the dark.

Preservation temperatures are approximate with an acceptable range of ±2.0° C.

ENO RIVER LABS, LLC.
* CONFIDENTIAL and PROPRIETARY INFORMATION

ORIGINAL

PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

Author: Bharat Chandramouli Effective Date: 4/17/2006

Authorization: _____ Date Authorized: 4/10/2006
Management

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I. **PURPOSE AND IDENTIFICATION:** To provide detailed procedures concerning the analysis of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-p-furans according to method 8290A.

II. **SCOPE AND APPLICATION:** This method provides procedures for the analysis of polychlorinated dibenzo-p-dioxins (tetra- through octachlorinated homologues; PCDDs), and polychlorinated dibenzofurans (tetra- through octachlorinated homologues; PCDFs) from extracts of samples prepared according to EPA Method 8290A – EPA January 1998. The list of analytes that can be detected and quantitated using this method is shown in Table 1.

A. Applicable Matrices: This method can be used for the analysis of solid matrices including soils, aqueous matrices, tissue, and oils. A matrix not specifically addressed in an SOP can be processed using a combination of existing SOPs and special instructions from the technical director/designee.

B. Detection and Quantitation Limits: The default reporting limits, also known as the Target Detection Limit (TDL), Practical Quantitation Limit, or the Minimum Level (ML) are shown for the various matrices in Table 1. Sample Specific Detection limits (SSDL) are calculated for each analyte in each sample based on the height of the noise and can therefore not be tabulated. The reporting limits are based on the concentration of the first point of the calibration solution set.

C. Method Summary: The sample is first spiked with a known amount of a mixture of isotopically labeled dioxins and furans. The sample is then extracted using techniques that are specific to the matrix. For example, solid samples are extracted using Soxhlet extraction. After extraction, the extract is spiked with a known amount of $^{37}Cl_4$-TCDD, the cleanup standard. The extract is then concentrated on a rotary evaporator; the extraction solvent is evaporated and replaced with heptane. A cleanup procedure involving both bulk steps and column chromatographic steps is performed on the extract to remove bulk interferences and specific interferences. The purified extract is then evaporated to dryness on a vacuum centrifuge and reconstituted in a known amount of an isotopically labeled recovery standard. The reconstituted extract is analyzed

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using Gas Chromatography-High Resolution Mass Spectrometry (GC-HRMS) on an instrument that has previously been calibrated at six analyte concentration levels. Peak identifications are based on the retention time of the analyte and a characteristic ratio between the areas of the two ions that are monitored for each analyte. Analyte concentrations are calculated based on the area ratios between the areas of the analyte and its corresponding internal standard. Internal standard recoveries are calculated using a similar technique involving the internal standard areas and the recovery standard areas. A blank sample consisting of laboratory quality controlled standard matrix and a spiked sample, known as an laboratory Control Spike (LCS) sample consisting of laboratory quality controlled matrix spiked with a known amount of an analyte spike mixture are extracted and analyzed with each batch to monitor analysis performance. In addition, duplicate aliquots of one sample out of every batch (The Matrix Spike sample – MS and Matrix Spike Duplicate sample – MSD) are spiked with an analyte mixture, analyzed and the results monitored for analyte accountability in sample matrix Results are reported to the reporting limits, or to the Sample Specific Detection Limits at client's request.

D. Interferences: Dioxins and furans are measured at very low levels among other organic compounds that can be present at many orders of magnitude higher concentrations. Due to the sensitivity and selectivity of the analysis, every organic compound in the same volatility range as the target analytes is considered an interference and has to be removed prior to analysis. Common bulk interferences include, but are not limited to long chain alkanes, polymeric materials, petroleum byproducts and phthalates. Common specific interferences include Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), and polychlorinated Diphenyl Ethers (PCDPEs). The bulk interferences and specific interferences are removed using a multi-step extract cleanup process specified in Section IX.G. Because PCDPEs otherwise meet all criteria for positive identification as a PCDF, they are specifically monitored during the analysis and positive PCDPE identifications are treated using procedures detailed in Section IX.K.1.e)(3)(f).

E. Before the method can be applied routinely on client samples, the Initial Precision and Recovery procedure, as detailed in SOP DHR 192 – Initial Precision and Recovery must carried out.

III. **RESPONSIBILITY:** It is the responsibility of the analytical staff who have been trained to perform the procedure as described in this SOP.

IV. **SAFETY:** The 2,3,7,8-TCDD isomer has been found to be acnegenic, carcinogenic, and teratogenic in laboratory animal studies. Other PCDDs and PCDFs containing chlorine atoms in the 2,3,7,8 positions are known to have toxicities comparable to that of 2,3,7,8-TCDD. Extreme care must be exercised in all

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handling of extracts and standards in the application of this SOP. For additional safety information, see the Safety and Health Manual and the appropriate MSDS.

A. Pollution Prevention: The greatest source of preventable pollution in the analysis is in the use of solvents, and the laboratory takes various steps to minimize the use of hazardous solvents. Hexane has been substituted throughout the analysis by heptane, a safer alternative. Where possible, solid samples are extracted using accelerated solvent extraction (ASE) to reduce solvent usage from 500 ml to approximately 100 ml.

B. Waste Management: Waste management for this method is detailed in laboratory SOPs EHS 018 – Handling and Disposal of Hazardous and Biohazardous Waste, and EHS 016 Hazardous Waste Disposal.

V. **DEFINITIONS**: For a full list of definitions, see SOP 5.08 - Definitions of Terms Used in Environmental Sample Analysis.

VI. **EQUIPMENT:** The equipment listed in this SOP primarily deals with the instrumental analysis of the sample extracts. Equipment used in earlier parts of the process are detailed in the particular SOPs for the process

A. Gas Chromatographs: Hewlett Packard 5890 or 5890 Series II (equipped for temperature programming and capillary columns). The GC must be equipped for splitless injection with an inert liner and the injection port must be able to handle temperatures of 300 °C.

B. GC Columns

1. A 60 m x 0.25mm DB-5 or equivalent fused silica capillary column with 0.25 µm film thickness is used for isomer-specific determination of all the target analytes except 2,3,7,8-TCDF.

2. 30 m x 0.25mm DB-225 or equivalent fused silica capillary column for confirmation analysis of 2,3,7,8-TCDF.

C. Mass Spectrometer – A VG 70 Series magnetic sector high-resolution mass spectrometer is used. See SOP 6.2.01 – VG 70S High Resolution mass spectrometer operation for details on instrument setup. The static resolving power of the instrument must be maintained at a minimum of 10,000 (10 percent valley).

D. Data System - VG Analytical PDP11 with 11-250 software or VAX Alpha with Opus 3.2 software, MILES – Eno River Labs, LLC Laboratory Information Management System (LIMS), LARS – Eno River Labs, LLC. Reporting System

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VII. **REAGENTS**: reagents used in each step of the process are specified in the particular SOP for the process.

VIII. **STANDARDS:** The purchase, login and expiration dates of standards is governed by SOP ODS 128 - Receiving and Tracking of Standards. All standards are prepared by a designated standards chemist. The standard composition calculations are verified prior to preparation by the Technical director or designee. The standards are tested for accuracy against a known source per SOP STD 002 – Standard Solutions - Acceptance and the standards are subsequently certified for use by the Technical Director.

A. Internal Standard spiking solution: A known amount of this solution is added to samples immediately prior to extraction. This amount is typically 20 µl. Refer to SOP ESP 008 – Adding Spike Standards to Samples/Extracts for details on the amount added. The composition of this solution is shown in Table 2.

B. Cleanup Standard spiking solution: A known amount of this solution is added to samples immediately prior to the initial concentration of the sample extract. This amount is typically 20 µl. Refer to SOP ESP 008 for details on the amount added. The composition of this solution is shown in Table 2.

C. Recovery Standard Solution: This nonane solution contains two recovery standards, $^{13}C_{12}$-1,2,3,4-TCDD and $^{13}C_{12}$-1,2,3,7,8,9-HxCDD, at a nominal concentration of 100 ng/mL per compound (Table 2). 20 µl of this solution is spiked into each sample extract before the HRGC/HRMS analysis.

D. Matrix Spiking Solution: This solution is used in to monitor the LCS and MS/MSD and also to establish initial precision and recovery (IPR). The composition of this solution is shown in Table 3.

E. Calibration Solutions: The composition of the calibrations solutions is shown in Table 4. All six concentrations are used to calibrate the instrument and the concentration point CS3 is used as the continuing calibration verification at the start of an analytical batch.

F. GC Column Performance/Retention Window Check Solution (RTCHK)- This solution contains the first and last eluting isomers for each homologous series from tetra- through heptachlorinated congeners. The solution also contains a series of other closely eluting TCDD and TCDF isomers for the purpose of documenting the chromatographic resolution. The composition of this solution is shown in Table 5.

IX. **PROCEDURE**

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A. Sample Collection, Preservation, shipment and storage – See SOP MGS 001 – Sample Receipt, Identification, Handling, Storage and Disposal. Eno River Labs does not collect samples, but receives samples collected by the client.

B. Sample Login – See SOP MGS 002 – Environmental Sample Login.

C. Quality Control Samples and Extraction Batch: An extraction batch consists of 20 or fewer client samples of similar matrix, along with a laboratory blank sample and a laboratory spiked LCS sample and an MS/MSD pair (if sufficient sample is available – if not, an LCS/LCSD pair is used). The QC matrix used for the matrices is as follows:

1. Soil/Solid/Sediment/Sludge – Playground sand
2. Aqueous – HPLC grade laboratory water
3. Tissue – a mixture of corn oil and sodium sulfate
4. Other matrices – See production team leader/technical director for guidance
5. For details, see ESP 012 – QC samples.

D. Sample Preparation prior to extraction:

1. Solid samples – See SOP ESP 284 – Prep of Solid Samples.
2. Water samples – See SOP ESP 020 – Water Extraction.
3. Tissue samples - See SOP ESP 130 – Fish- Preparation and Extraction
4. All other matrices – Contact the production team leader to check if an SOP is available for the matrix in question. If an SOP is not available, contact the technical director/designee for special instructions.

E. Spiking of samples prior to extraction – See SOP ESP 008 – Adding Spike Standards to Samples/Extracts for instruction on the spiking protocol. All samples are fortified with the internal standard solution containing the 13C-labeled dioxin/furan compounds specified in Table 2. The amount added is typically 20 µl. The LCS/LCSD and MS/MSD samples are additionally fortified with a standard solution containing the 2,3,7,8- substituted dioxins/furans shown in Table 3.

F. Extraction of samples

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1. Soil/Solid samples

   a) Soxhlet extraction – See SOP ESP 105 – Soxhlet Extraction.

   b) Accelerated solvent extraction (ASE) – See SOP ESP 261 – ASE Extraction.

2. Aqueous samples (Non Drinking water) – See SOP ESP 020 – Water Extraction.

3. Fish/Tissue samples – See SOP ESP 130 - Fish- Preparation and Extraction.

4. All other matrices – Contact the production team leader to check if an SOP is available for the matrix in question. If an SOP is not available, contact the technical director/designee for special instructions.

G. Concentration, solvent exchange and sample cleanup. – See work area guideline (WAG) ESP 124A – Processing Extracts in Concentration/Cleanup. After extraction, all samples are in solvent extracts of toluene, heptane, methylene chloride or another solvent. The further processing of these samples now depends not on the matrix of sample origin, but on the extraction solvent and the nature of the interferences that need to be removed from the extract prior to analysis.

H. Final Concentration/Transfer of sample extracts – See SOP ESP 272 – Transfer of Sample Extracts.

I. Instrument Setup, Calibration and Standardization Procedures:

1. Setup the high resolution mass spectrometer to monitor the ions listed in Table 6.

2. Setup the Gas Chromatograph's temperature program and flow rates. A typical temperature program is shown in Table 7.

3. Tune the mass spectrometer with Perfluorokerosene (PFK) to achieve a static resolving power of at least 10,000 (10% valley).

4. Document the mass spectrometer resolving power by recording the peak profile of the high-mass reference signal (typically m/z 330.9792) obtained during a peak examination experiment using the low-mass PFK ion at m/z 292.9825 (or lower in mass) as a reference.

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a) The format of the peak profile representation allows manual determination of the peak resolution. The peak width (at 5% peak height) of the high-mass reference ion must not exceed 100 ppm (resolving power: 10,000). Peak width is determined by triangulation with no more than 10% allowance for sampling error. Check, adjust and document instrumental ion transmission and resolution in case the resolution is below the minimum required 10,000 resolving power.

5. Once the GC and Mass Spectrometric conditions are setup, run the GC column performance/retention window check solution (RTCHK). The following criteria for the GC column performance/retention window check solution must be achieved before performing an Initial Calibration.

   a) For tetra-octa chlorinated analysis, verify that the acquisition time windows are set to allow observation of the first and last eluting isomer of each congener by visually identifying and marking the first and last eluting congener at each chlorination level in the chromatograms. If the first/last eluting congeners are not identified, adjust the mass spectrometer acquisition windows and repeat the analysis.

   b) Demonstrate a valley of < 25% between TCDD and the closest eluting isomers (DB5 column), and between TCDF and the closest eluting isomers (DB225 column). An example chromatogram for the DB5 column is shown in Figure 1. Note that 25% is the method required valley. Method performance on the DB-5 column degrades once the valley exceeds 20%. If the valley is greater than 20% on the DB-5 column, check the GC flow rates and check the GC column for possible replacement.

6. Initial Calibration (ICAL): Initial calibration of the instrument is required before any samples are analyzed for PCDDs and PCDFs. Initial calibration is also required if a continuing calibration does not meet the required criteria listed in section IX.K.1.c)(3). Separate calibrations are required for the tetra-octa analysis using the DB5 column and the 2,3,7,8-TCDF confirmation analysis using the DB225 column.

   a) All six calibration solutions listed in Table 4 must be used for the initial calibration.

   b) Using the same GC and MS conditions that produced acceptable results for the column performance check solution, analyze a 2 µL portion of each of the six calibration solutions.

   c) Referring to Table 8 for the quantitation relationships and Table 6 for the specific ions, calculate the relative response factors (RRF) for

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unlabeled target analytes relative to their appropriate internal standards and the RRF for the labeled $^{13}C_{12}$ internal standards relative to the two recovery standards according to the following formula:

(1) $$RRF(n) = \frac{A_x Q_{is}}{Q_x A_{is}} \qquad RRF(m) = \frac{A_{is} Q_{rs}}{Q_{is} A_{rs}}$$

(a) RRF(n) = Analyte RRF, and RRF(m) = Standard RRF

(b) A_x = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDD/PCDFs, A_{is} = sum of the integrated ion abundances of the quantitation ions for the labeled internal standards, and A_{rs} = sum of the integrated ion abundances of the quantitation ions for the labeled recovery standards

(c) Q_{is} = quantity of the internal standard injected (pg), Q_{rs} = quantity of the recovery standard injected (pg), and Q_x = quantity of the unlabeled PCDD/PCDF analyte injected (pg).

d) The relative response factors to be used for the determination of the concentration of total isomers in a homologous series are calculated as follows:

(1) For congeners that belong to a homologous series containing only one 2,3,7,8-substituted isomer (TCDD, PeCDD, HpCDD, OCDD, TCDF, and OCDF), the RRF used is equal to the mean RRF calculated for the 2,3,7,8- substituted congener.

(2) For congeners that belong to a homologous series containing more than one 2,3,7,8-substituted isomer, the RRF used for those homologous series will be the average of the mean RRFs calculated for all individual 2,3,7,8-substituted congeners.

(3) HRGC/HRMS responses of all isomers in a homologous series that do not have the 2,3,7,8-substitution pattern are assumed to be the same as the responses of one or more of the 2,3,7,8-substituted isomer(s) in that homologous series.

e) Acceptance Criteria for Initial Calibration: The criteria listed below for acceptable calibration must be met before the analysis is performed.

(1) The signal-to-noise ratio (S/N) must be greater than or equal to 10:1 for each 2,3,7,8-substituted analyte and all standards. Signal-

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to-noise ratio for the non 2,3,7,8- substituted tetras must be greater than or equal to 3:1.

(2) The percent relative standard deviations for the mean response factors from the unlabeled compounds must not exceed 20%. The percent relative standard deviations for the mean response factors from the labeled compounds must not exceed 30%

(3) The first run of a set of Initial Calibration standards must be verified against a second source, independently prepared calibration solution with the composition of the CS3 standard. To perform this verification, run the second source CS3 solution under valid instrument conditions after the Initial Calibration is complete. This solution should pass all the criteria for a continuing calibration verification as outlined in section IX.K.1.c). The purpose of this step is to ensure that the response factors obtained from the ICAL can be independently verified against an independently prepared solution. This is therefore a test of the ICAL standard solutions and only needs to be carried out once for every new preparation of the ICAL standard solutions.

f) If the criteria for acceptable calibration are met, the analyte specific RRF can then be considered independent of the analyte quantity for the calibration concentration range. The mean RRF will be used for all calculations until the continuing calibration criteria are no longer met. At such time, new mean RRF will be calculated from a new set of injections of the calibration solutions.

J. Calculations for the samples in the extraction batch (Blank, samples, LCS/LCSD and MS/MSD)

1. Concentration: $C_x = \frac{A_x Q_{is}}{A_{is} W \overline{RRF(n)}}$

a) C_x = concentration of unlabeled PCDD/PCDF congeners (or group of coeluting isomers within an homologous series) in pg/g or pg/L

b) A_x = sum of the integrated ion abundances of the quantitation ions for unlabeled PCDDs/PCDFs

c) A_{is} = sum of the integrated ion abundances of the quantitation ions for the labeled internal standards

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d) Q_{is} = quantity, in pg, of the internal standard added to the sample before extraction

e) W = weight, in grams or liters of the sample (solid or liquid)

f) $\overline{RRF(n)}$ = calculated mean relative response factor for the analyte

g) The concentration of labeled internal standards can be calculated in similar fashion using the areas of the internal standard for A_x, using the areas of the recovery standard for A_{is}, using the quantity of recovery standard added for Q_{is} and using the relative response factor for the internal standard for $\overline{RRF(n)}$.

2. Estimated Maximum Possible Concentration (EMPC) –

   a) Of the two peaks that do not meet the theoretical ratio specified in Table 9, multiply the area of the smaller peak by the theoretical ratio. The product is now the considered the area of the larger peak.

   b) Calculate of concentration in Section IX.J.1 using the calculated summed area

3. Internal standard percent recovery = $\dfrac{A_{is}Q_{rs}100}{Q_{is}A_{rs}\overline{RRF(m)}}$

   a) A_{is} = sum of the integrated ion abundances of the quantitation ions for the labeled internal standard

   b) A_{rs} = sum of the integrated ion abundances of the quantitation ions for the labeled recovery standard

   c) Q_{is} = quantity, in pg, of the internal standard added to the sample before extraction

   d) Q_{rs} = quantity, in pg, of the recovery standard added to the cleaned-up sample residue before HRGC/HRMS analysis

   e) $\overline{RRF(m)}$ = calculated mean relative response factor for the labeled internal standard relative to the appropriate recovery standard

4. Sample Specific Estimated Detection Limit - The sample specific estimated detection limit (SSDL) is the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background

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signal level. An SSDL is calculated for each 2,3,7,8-substituted congener that is not identified.

a) Congeners showing a response for at least one quantitation ion that is less than 2.5 times the noise level. For procedure on estimating noise level, please refer to SOP EHR 107 – Enlarging chromatograms for noise calculation

(1) $$SSDL = \frac{2.5 \times H_N \times Q_{is}}{H_{is} \times \overline{RRF(n)} \times W}$$

(a) SSDL = sample specific, estimated detection limit for a target analyte

(b) 2.5 = minimum signal/noise required for a GC signal to be accepted

(c) H_N = height of the noise

(d) Q_{is} = amount of internal standard added to the sample before extraction

(e) $\overline{RRF(n)}$ = mean analyte relative response factor from the initial calibration

(f) W = sample weight or volume

(g) H_{is} = sum of peak heights of the characteristic ions of the corresponding internal standard.

K. Instrumental Analysis

1. A typical analytical batch consists of the following samples that need to be run in a 12 hour time period known as a "clock".

a) Demonstration of mass resolution using procedures in Section IX.I.4. This is required both at the beginning and at the ending of the analytical batch.

b) A valid RTCHK run using procedures in Section IX.I.5

c) Continuing Calibration Check (CONCAL) - Continuing calibrations must be performed at the beginning of a 12 hour period after

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successful mass resolution and GC resolution performance checks. A continuing calibration is also required at the end of a 12-hour shift.

(1) Inject 2 µl of the CONCAL solution, the CS3 standard using the MS conditions used to acquire the initial calibration data.

(2) Calculate the relative response factors of the analytes using the procedure outlined in IX.I.6.c).

(3) Acceptance Criteria for CONCAL - The following criteria must be met before further analysis is performed.

(a) The measured RRFs for the unlabeled standards (including the additional tetras) obtained during the continuing calibration runs must be within ± 20 percent of the mean values established during the initial calibration.

(b) The measured RRFs for the labeled standards obtained during the routine calibration must be within ± 30 percent of the mean values established during the initial.

(c) The ion-abundance ratios (Table 9) must be within the allowed control limits.

(d) If the continuing calibration at the end of a 12-hour period fails by no more than 25% RPD for the unlabeled compounds and 35% RPD for the labeled reference compounds, use the mean RRFs from the two daily calibration runs to compute analyte concentrations, instead of the RRFs obtained from the initial calibration

(4) If any of the acceptance criteria listed for the calibration verification are not satisfied, repeat after performing any necessary instrument maintenance.

(5) If an acceptable CONCAL still cannot be achieved, the system must be evaluated. If the instrument is determined fit to run, an acceptable initial calibration must be obtained before any sample may be analyzed.

d) A valid extraction batch blank/instrument blank must be run with each analysis batch. For blank acceptance criteria, see X.D

e) Samples:

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(1) Inject a 2 µL aliquot of the extract into the GC, operated under the GC conditions that have produced acceptable CONCAL and RTCHK results.

(2) Acquire data using the same GC/MS conditions used to determine the relative response factors.

(3) Identification Criteria - For a gas chromatographic peak to be identified as a PCDD or PCDF, it must meet all of the following criteria:

(a) Retention Time: For 2,3,7,8-substituted congeners, which have an exactly matching isotopically labeled internal or recovery standard present in the sample extract (this represents a total of 15 congeners including OCDD), the retention time at maximum peak height of the sample components (i.e., the two ions used for quantitation purposes, must be within -1 to +3 seconds of the isotopically labeled standard.

(b) Totals by chlorination level: For non-2,3,7,8-substituted compounds, the retention time for each identified peak must be within the corresponding homologous retention time windows established by analyzing the RTCHK solution.

(c) The ion current responses for both ions used in quantitation (e.g., for TCDDs: m/z 319.8965 and 321.8936) must reach maximum simultaneously (± 2 seconds).

(d) The integrated ion current for the two ions used for quantitation purposes must have a ratio between the lower and upper limits established for the homologous series to which the peak is assigned (Table 9).

(e) Signal-to-Noise Ratio: All ion current intensities must be > 2.5 times noise level for positive identification of a PCDD/PCDF compound or a group of coeluting isomers.

(f) Polychlorinated Diphenyl Ether Interferences: In addition to the above criteria, the identification of a GC peak as a PCDF can only be made if no signal having a S/N > 2.5 is detected at the same retention time (±2 seconds) in the corresponding polychlorinated diphenyl ether (PCDPE) channel or if the PCDPE signal is less than 10% of the PCDF signal. If a PCDPE signal is detected, the particular analyte/totals

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channel will be appropriately flagged as detailed in the project's case narrative.

(4) For gas chromatographic peaks that have met specified criteria calculate the concentration of the PCDD or PCDF compounds as outlined in Section IX.J.1.

(5) For gas chromatographic peaks that met all positive identification criteria except the ratio requirement (IX.K.1.e)(3)(d)), calculate the estimated maximum possible concentration (EMPC) as described in IX.J.2. Note that this calculated concentration is an estimate and will be flagged as such.

(6) For all analytes that did not meet positive identification criteria, calculate the sample specific detection limits as outlined in Section IX.J.4.

(7) Calculate the recoveries for the labeled standards as outlined in Section IX.J.2.

(8) Calculate the total concentration for each homologous series of PCDD and PCDF by summing up the concentrations of all positively identified isomers of each homologous series. Therefore, the total also includes the 2,3,7,8-substituted congeners. The total number of GC signals included in the homologous total concentration value must be specified in the report.

(9) If 2,3,7,8-TCDF is detected in the sample at a concentration above the reporting limit, the sample extract must be re-analyzed on a GC/HRMS instrument equipped with a DB-225 column. This instrument must have been calibrated to analyze the tetrachlorinated dioxins/furans as outlined in Section IX.I. The concentration measured on this instrument is reported as the 2,3,7,8-TCDF concentration.

X. QUALITY CONTROL REQUIREMENTS

A. All requirements for a valid analytical batch, as defined in Section IX.K must have been met.

B. Percent recoveries of labeled standards within 25 - 135% with a signal to noise ratio > 10:1

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1. If there are specific matrix related reasons for recoveries lower from the specified range, and the low recovery is isolated to the client sample and not present in the control samples, the data needs to be evaluated for acceptability by considering the sample specific detection limit for the analyte that is associated with the non-conforming standard. If the affected analyte is not detected and SSDL for the analyte affected is lower than the reporting limits specified, it is likely that the low recovery did not have a significant impact on data quality.

2. Higher recoveries than the range are indicative of either instrument drift, spiking errors or interference on the standard peaks and the data cannot be released without instrumental re-analysis resulting in acceptable recoveries or re-extraction and re-analysis in case the instrument re-analysis did not result in any changes.

3. If there are matrix specific interferences resulting in interference on one of the two components of the recovery standard, the internal standard recovery will appear to be higher/lower than it actually is. This does not affect the quantitation of the analytes if the internal standard peaks are not affected, but it will affect the reporting of the internal standard recovery data.

C. The sample specific detection limits for all analytes in all samples must be less than the quantitation limits/minimum levels specified in Table 1 (appropriately scaled if a non-standard sample size is used).

D. The blank should not contain any analytes specified in Table 1. The following exceptions apply:

1. Specific analyte concentrations in the method blank do not exceed 5% of the level found in the field samples associated with the blank.

2. The sample does not contain the analyte detected in the blank at a concentration above the quantitation limits specified in Table 1.

3. Note that if 2,3,7,8-TCDF is detected in the blank, and if any sample in the blank shows 2,3,7,8-TCDF concentrations above the reporting limit resulting in confirmation analysis, the blank must be confirmed on the DB-225 column as well to ensure compatibility in the numbers being compared.

E. Spiked Sample Performance

1. LCS/ LCSD Acceptance Criteria

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a) The percent recoveries of analytes must be within 70 - 130% for at least 15 of the 17 specific analytes. For up to two analytes, the spiked sample variance is allowed to be within 60-145%.

b) Relative percent difference (RPD) between LCS and LCSD must be < 20% for at least 15 of the 17 specific analytes. For up to two analytes, the RPD is allowed to exceed 20% as long as it is less than 35%

c) Any analyte not meeting the 70-130% criterion, but within the 60-145% criterion must have an RPD of <20%.

d) Any analyte not meeting the 20% RPD criterion, but within the 35% RPD criterion must have a percent recovery between 70-130%.

2. MS/MSD – Acceptance Criteria are the same as LCS/LCSD criteria

a) Uncertainty: The MS and MSD recoveries have been used to estimate the measurement uncertainty for the 8290 analysis and to establish the acceptance criteria for the matrix spike samples and laboratory spike samples. If the variability in the MS/MSD pair exceeds acceptance criteria, and the LCS meets acceptance criteria, the increased uncertainty for the associated field samples will be noted in the case narrative(s).

F. If the concentration in the final extract of any of the seventeen 2,3,7,8-substituted PCDD/PCDF compound exceeds the calibration range, additional internal standard solution may be added to a separate, archived portion (or diluted portion) of the sample extract to decrease the analyte to internal standard ratio and bring this ratio within the calibration's dynamic range. See the SOP DHR 205 – Calculation Methods for Analysis of Dilutions for specific instructions.

XI. **CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA AND CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA**: Refer to SOP 2.04 – Non-Conformance on further guidance for corrective actions if any of these requirements are not met.

XII. **REFERENCES**

A. EPA SW-846 Method 8290 - 1998

B. Eno River Labs SOPs DHR 192, EHS 018, EHS 016, 6.2.01, ODS 128, STD 002, ESP 008, MGS 001, MGS 002, ESP 012, ESP 284, ESP 020, ESP 130, ESP 105, ESP 261, ESP 020, ESP 130, ESP 124A, ESP 272, EHR 107, DHR 205, 2.04

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Table 1: List of analytes quantitated, and reporting limits (target detection limits) for the various matrices of interest – These limits assume standard sample sizes of 10g for solids, 1L for aqueous samples and 20g for tissues.

Analyte	Soil/Solid (pg/g)	Aqueous (pg/L)	Tissue (pg/g)	Extract[1] (pg/µl)
2,3,7,8-TCDD	1	10	0.5	0.5
2,3,7,8-TCDF	1	10	0.5	0.5
1,2,3,7,8-PeCDD	5	50	2.5	2.5
1,2,3,7,8-PeCDF	5	50	2.5	2.5
2,3,4,7,8-PeCDF	5	50	2.5	2.5
1,2,3,4,7,8-HxCDD	5	50	2.5	2.5
1,2,3,6,7,8-HxCDD	5	50	2.5	2.5
1,2,3,7,8,9-HxCDD	5	50	2.5	2.5
1,2,3,4,7,8-HxCDF	5	50	2.5	2.5
1,2,3,6,7,8-HxCDF	5	50	2.5	2.5
1,2,3,7,8,9-HxCDF	5	50	2.5	2.5
2,3,4,6,7,8-HxCDF	5	50	2.5	2.5
1,2,3,4,6,7,8-HpCDD	5	50	2.5	2.5
1,2,3,4,6,7,8-HpCDF	5	50	2.5	2.5
1,2,3,4,7,8,9-HpCDF	5	50	2.5	2.5
OCDD	10	100	5	5
OCDF	10	100	5	5

[1] For non-standard sample sizes/other matrices, the reporting limits can be calculated by multiplying the reporting limits for the sample extract by default extract volume (20 µl) and dividing by the extracted sample size.

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Table 2: Composition of Internal standard, cleanup standard and recovery standard spiking solutions

Constituent	Concentration (ng/ml)
Internal standard spiking solution	
$^{13}C_{12}$-2,3,7,8-TCDD	100
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100
$^{13}C_{12}$-OCDD	200
$^{13}C_{12}$-2,3,7,8-TCDF	100
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100
Surrogate/Alternate Standards (for troubleshooting)	
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100
Cleanup Standard spiking solution	
$^{37}Cl_4$-2,3,7,8-TCDD	10
Recovery standard spiking solution	
$^{13}C_{12}$-1,2,3,4-TCDD	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100

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Table 3: Composition of Matrix Spiking solution

Component	Concentration (ng/ml)
2,3,7,8-TCDD	10
1,2,3,7,8-PeCDD	50
1,2,3,4,7,8-HxCDD	50
1,2,3,6,7,8-HxCDD	50
1,2,3,7,8,9-HxCDD	50
1,2,3,4,6,7,8-HpCDD	50
1,2,3,4,6,7,8,9-OCDD	100
2,3,7,8-TCDF	10
1,2,3,7,8-PeCDF	50
2,3,4,7,8-PeCDF	50
1,2,3,4,7,8-HxCDF	50
1,2,3,6,7,8-HxCDF	50
2,3,4,6,7,8-HxCDF	50
1,2,3,7,8,9-HxCDF	50
1,2,3,4,6,7,8-HpCDF	50
1,2,3,4,7,8,9-HpCDF	50
1,2,3,4,6,7,8,9-OCDF	100

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PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

Table 4: Concentration of PCDDs/PCDFs in calibration and calibration verification solutions

CDD/CDF	CS1 (ng/mL)	CS2 (ng/mL)	CONCAL CS3 (ng/mL)	CS4 (ng/mL)	CS5 (ng/mL)	CS6 (ng/mL)
2,3,7,8-TCDD	0.5	1	10	50	100	200
2,3,7,8-TCDF	0.5	1	10	50	100	200
1,2,3,7,8-PeCDD	2.5	5	50	250	500	1000
1,2,3,7,8-PeCDF	2.5	5	50	250	500	1000
2,3,4,7,8-PeCDF	2.5	5	50	250	500	1000
1,2,3,4,7,8-HxCDD	2.5	5	50	250	500	1000
1,2,3,6,7,8-HxCDD	2.5	5	50	250	500	1000
1,2,3,7,8,9-HxCDD	2.5	5	50	250	500	1000
1,2,3,4,7,8-HxCDF	2.5	5	50	250	500	1000
1,2,3,6,7,8-HxCDF	2.5	5	50	250	500	1000
1,2,3,7,8,9-HxCDF	2.5	5	50	250	500	1000
2,3,4,6,7,8-HxCDF	2.5	5	50	250	500	1000
1,2,3,4,6,7,8-HpCDD	2.5	5	50	250	500	1000
1,2,3,4,6,7,8-HpCDF	2.5	5	50	250	500	1000
1,2,3,4,7,8,9-HpCDF	2.5	5	50	250	500	1000
OCDD	5.0	10	100	500	1000	2000
OCDF	5.0	10	100	500	1000	2000
$^{13}C_{12}$-2,3,7,8-TCDD	100	100	100	100	100	100
$^{13}C_{12}$-2,3,7,8-TCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	100	100	100	100	100
$^{13}C_{12}$-PeCDF	100	100	100	100	100	100
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	100	100	100	100	100
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	100	100	100	100	100
$^{13}C_{12}$-OCDD	200	200	200	200	200	200
$^{37}Cl_4$-2,3,7,8-TCDD	0.5	1	10	50	100	200
$^{13}C_{12}$-1,2,3,4-TCDD	100	100	100	100	100	100
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100	100	100	100	100	100

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Table 5: GC retention time window defining solution and isomer specificity test standard

CDD/CDF	FIRST ELUTED	LAST ELUTED
TCDF	1,3,6,8	1,2,8,9
TCDD	1,3,6,8	1,2,8,9
PeCDF	1,3,4,6,8	1,2,3,8,9
PeCDD	1,2,4,7,9	1,2,3,8,9
HxCDF	1,2,3,4,6,8	1,2,3,4,8,9
HpCDF	1,2,3,4,6,7,8	1,2,3,4,7,8,9
HpCDD	1,2,3,4,6,7,9	1,2,3,4,6,7,8
DB-5 COLUMN TCDD SPECIFICITY TEST STANDARD		
1,2,3,7 + 1,2,3,8-TCDD		
2,3,7,8-TCDD		
1,2,3,9-TCDD		
DB-225 COLUMN TCDF ISOMER SPECIFICITY TEST STANDARD		
2,3,4,7-TCDF		
2,3,7,8-TCDF		
1,2,3,9-TCDF		

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PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

Table 6: Elemental compositions and exact masses of the ions monitored by HRGC/HRMS for PCDDs and PCDFs

Descriptor Number[2]	Accurate Mass[3]	Ion Type	Elemental Composition	Analyte
2	292.9825	LOCK	C_7F_{11}	PFK
	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF
	315.9419	M	$^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF (S)
	317.9389	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF (S)
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8847	M	$C_{12}H_4{}^{37}Cl_4O_2$	TCDD (S)
	330.9792	QC	C_7F_{13}	PFK
	331.9368	M	$13C_{12}H_4{}^{35}Cl_4O_2$	TCDD (S)
	333.9339	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD (S)
	375.8364	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}ClO$	HxCDPE
	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF
	341.8567	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO$	PeCDF (S)
	353.8970	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF (S)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD
	357.8516	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	367.8949	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD (S)
	369.8919	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD (S)
	409.7974	M+2	$C_{12}H_3{}^{35}Cl_6{}^{37}ClO$	HpCDPE
3	373.8208	M+2	$C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF
	375.8178	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O$	HxCDF
	383.8639	M	$^{13}C_{12}H_2{}^{35}Cl_6O$	HxCDF (S)
	385.8610	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO$	HxCDF (S)
	389.8157	M+2	$C_{12}H_2{}^{35}Cl_6{}^{37}ClO_2$	HxCDD
	391.8127	M+4	$C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD
	392.9760	LOCK	C_6F_{15}	PFK

[2] Descriptor 1 contains mono-, di- and trichlorinated dibenzodioxins and dibenzofurans that are not quantitated by Method 1613

[3] The following nuclidic masses were used: H = 1.007825, O = 15.994915, C = 12.000000, ^{35}Cl = 34.968853, ^{13}C = 13.003355, ^{37}Cl = 36.965903, F = 18.9984

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PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

Descriptor Number[2]	Accurate Mass[3]	Ion Type	Elemental Composition	Analyte
	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_6{}^{37}ClO_2$	HxCDD (S)
	403.8529	M+4	$13C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD (S)
	445.7555	M+4	$C_{12}H_2{}^{35}Cl_6{}^{37}Cl_2O$	OCDPE
	430.9729	QC	C_9F_{13}	PFK
4	407.7818	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF
	409.7789	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O$	HpCDF
	417.8253	M	$^{13}C_{12}H^{35}Cl_7O$	HpCDF (S)
	419.8220	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO$	HpCDF (S)
	423.7766	M+2	$C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD
	425.7737	M+4	$C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD
	435.8169	M+2	$^{13}C_{12}H^{35}Cl_6{}^{37}ClO_2$	HpCDD (S)
	437.8140	M+4	$^{13}C_{12}H^{35}Cl_5{}^{37}Cl_2O_2$	HpCDD (S)
	479.7165	M+4	$C_{12}H^{35}Cl_7{}^{37}Cl_2O$	NCDPE
	430.9729	LOCK	C_9F_{17}	PFK
	441.7428	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO$	OCDF
	443.7399	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7779	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}ClO_2$	OCDD (S)
	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD (S)
	513.6775	M+4	$C_{12}{}^{35}Cl_8{}^{37}Cl_2O$	DCDPE
	442.9728	QC	$C_{10}F_{17}$	PFK

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Table 7: Typical Gas Chromatographic setup (DB5)

Parameter	Value
Initial Temperature	150 °C
Initial Time	2.75 minutes
Temperature Ramp	50 °C/min to 215 °C. 2 min hold, 1.5 °C/min to 225 °C, hold for 8 min, 7 °C/min to 315 °C. Hold for 12 minutes
Column Head Pressure	30 psi
Injector Temperature	250 °C
Purge A	Start at 1 min
Purge B	Stop at 7 min

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Table 8: Retention time references and quantitation references for unlabeled and labeled PCDDs and PCDFs

Analyte	**Standard Used During Quantitation**
2,3,7,8-TCDD	$^{13}C_{12}$-2,3,7,8-TCDD
Other TCDDs	$^{13}C_{12}$-2,3,7,8-TCDD
1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,7,8-PeCDD
Other PeCDDs	$^{13}C_{12}$-1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
Other HxCDDs	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD
1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD
Other HpCDD	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD
OCDD	$^{13}C_{12}$-OCDD
2,3,7,8-TCDF	$^{13}C_{12}$-2,3,7,8-TCDF
Other TCDFs	$^{13}C_{12}$-2,3,7,8-TCDF
1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,7,8-PeCDF
Other PeCDFs	$^{13}C_{12}$-1,2,3,7,8-PeCDF
1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
Other HxCDFs	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF
Other HpCDFs	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF
OCDF	$^{13}C_{12}$-OCDD
$^{13}C_{12}$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDD	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD

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PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

Analyte	Standard Used During Quantitation
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-OCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-2,3,7,8-TCDF	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDF	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{37}Cl_4$-2,3,7,8-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-2,3,4,7,8-PeCDF	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	$13C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD

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Table 9: Ion-abundance ratio: Acceptable ranges for PCDDs and PCDFs

Number of Chlorine Atoms	Ion Type	Theoretical Ratio	Control Limits	
			Lower	Upper
4	M/M+2	0.77	0.65	0.89
5	M+2/M+4	1.55	1.32	1.78
6	M+2/M+4	1.24	1.05	1.43
6[a]	M/M+2	0.51	0.43	0.59
7[b]	M/M+2	0.44	0.37	0.51
7	M+2/M+4	1.04	0.88	1.20
8	M+2/M+4	0.89	0.76	1.02

[a] Used only for ^{13}C-HxCDF
[b] Used only for ^{13}C-HpCDF

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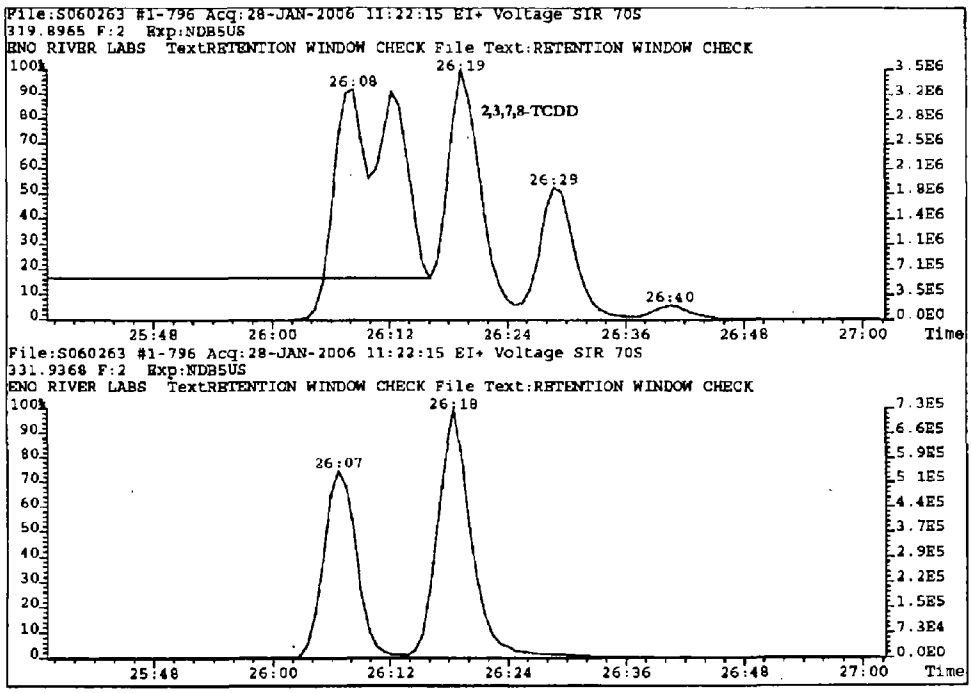

Figure 1: A demonstration of a successful column performance check for 2,3,7,8-TCDD on the DB5 column.

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PCDDs AND PCDFs BY HRGC/HRMS-METHOD 8290A	
SOP No.: DHR182 Version: 15	Date Revised: February 1, 2006

APPENDIX 1: Deviations from and improvements to US EPA Method 8290 POLYCHLORINATED DIBENZODIOXINS (PCDDs) AND POLYCHLORINATED DIBENZOFURANS (PCDFs) BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/ HIGH-RESOLUTION MASS SPECTROMETRY (HRGC/ HRMS) as performed at Eno River Labs

Note: All references are to the cited method.

7.7.1.1. and Table 5

Eno River Labs uses 6 calibration points ranging from 0.5 pg/µL to 200 pg/µL for tetrachlorinated dioxin and furan. Concentrations of penta- through heptachlorinated analytes are 5 times higher than tetra congeners and octachlorinated analytes are 10 times higher (Compare with Table 5., Method 8290).

5.8 and Table 2

1. Seven additional labeled PCDDs/ PCDFs are used as surrogate and alternate standards to provide additional quality control information.

2. The 1,2,3,6,7,8 - hexachlorodibenzofuran (HxCDF) is used as an internal standard instead of 1,2,3,4,7,8 - HxCDF. Eno River Labs uses 1,2,3,4,7,8 - HxCDF as a surrogate standard.

5.9

A. Each $^{13}C_{12}$ -labeled standard in the initial calibration solution has a concentration of 100 pg/µL except $^{13}C_{12}$ - OCDD, which is at 200 pg/µL. Concentrations of $^{13}C_{12}$ - labeled standards in sample fortification solutions are the same as in the initial calibration solution.

8.2

The method blank does not need to be analyzed on each analysis clock that samples are analyzed. Once a valid analysis is provided for the method blank it may be replaced with an instrument blank prepared using the recovery standard solution (Table 2 of this SOP).

8.2.2.3.

Documentation of the mass spectrometer resolving power is accomplished by recording the peak profile of m/z 416.9760 and 330.9792.

8.4

The Internal Standard recoveries in all QC samples and field samples are considered valid as long as the signal to noise ratio is greater than 10:1, the recovery is $\geq$ 25% and target detection limits for the analytes are met

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RAPID SCREEN FOR TEQ

SOP DHR200 Version: 2	Date Revised: January 4, 2005

Author: Donald Harvan

Authorization: _____ Management

Effective Date: 1/27/2005

Date Authorized: 1/13/2005

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I. **PURPOSE:** This SOP is intended to describe the GCMS procedures to implement the Eno River Labs, LLC, RAPID SCREEN FOR TEQ METHOD.

II. **SCOPE:** This method provides procedures for the screening for a selected set of PCBs, chlorinated dioxins and furans in extracts of samples prepared according to Eno River Labs, LLC. RAPID SCREEN FOR TEQ METHOD. The method is analyzed on a GC column that is **not necessarily isomer specific**. It is intended as a rapid screen assay that will screen for Toxicity Equivalence values that are greater than some target value.

III. **SAFETY CONSIDERATIONS:** The 2,3,7,8-TCDD isomer has been found to be acnegenic, carcinogenic, and teratogenic in laboratory animal studies. Other PCDDs and PCDFs containing chlorine atoms in the 2,3,7,8 positions are known to have toxicities comparable to that of 2,3,7,8-TCDD. Extreme care must be exercised in all handling of extracts and standards in the application of this SOP. For additional safety information, see the Eno River Labs, LLC Safety and Health Manual and the appropriate Material Safety Data Sheets.

IV. **PROCEDURE:**

A. *Sample preparation*

1. A measured portion of the sample to be analyzed is fortified with a solution that contains compounds that are the ^{13}C- labeled equivalents of the subset of analytes to be measured.
2. The sample is extracted, using conventional organic solvents, in order to remove the compounds of interest from the bulk of the sample matrix.
3. The extract is purified by means of proprietary chromatography, such that the final extract can be analyzed by Gas Chromatography – High Resolution Mass Spectrometry (GC-HRMS).

B. Sample Analysis

1. The analysis uses a GC-HRMS with the following specifications:
   a) Gas Chromatographs: Hewlett Packard 5890 or 5890 Series II (equipped for temperature programming and capillary columns) with either HP 7673 Autosampler or CTC200SE Autosampler.

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b) High Resolution Mass Spectrometers: VG 70 Series, VG 70-SE Series, VG Autospec.

c) Data Systems: VG Analytical PDP11 with 11-250 software or VAX Alpha with Opus 3.2 software.

d) GC Injection Port - The GC injection port is designed for capillary columns. Typically, 1 or 2 μL injection volumes are used unless otherwise noted.

e) Gas Chromatograph/Mass Spectrometer(GC/MS) Interface - The GC/MS interface components can withstand 350°C. The GC column is fitted directly into the mass spectrometer ion source without being exposed to the ionizing electron beam.

f) Mass Spectrometer - The static resolving power of the instrument should be maintained at approximately 5000 (10 percent valley).

g) A fused silica capillary column is used. The column is not necessarily isomer specific for the monitored analytes.

C. Data processing

1. Data is acquired by monitoring appropriate ions from the molecular ion cluster of the analytes of interest.

2. A calibration standard is used to establish the target detection point for the analysis. This standard is used to establish the correct retention time window for the analytes of interest. The ratio of the response from the target compound to its corresponding ^{13}C- labeled standard is used to calculate a response factor for each analyte.

3. Identification Criteria - For a gas chromatographic peak to be identified it must meet all of the following criteria:

   a) The retention time of the two ions used for quantitation purposes must be within -1 to +3 seconds of the isotopically labeled standard.

   b) The ion current responses for both ions must reach maximum intensity simultaneously (± 2 seconds).

   c) The ion current responses for both ions used for the labeled standards must reach maximum simultaneously (± 2 seconds).

4. Signal-to-Noise (S/N) Ratio

   a) All ion current intensities must be ≥ 2.5 times noise level for positive identification of a target compound.

5. For each sample, the ratio of the summed ion responses from the target compound to its corresponding ^{13}C- labeled standard is calculated. The

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calculated response factor from the calibration is used to estimate the levels of each target analyte.

$$C_x = \frac{A_x \times Q_{is}}{A_{is} \times W \times RRF_{(n)}}$$

Where:

C_x = concentration of unlabeled analyte

A_x = sum of the integrated ion abundances of the quantitation ions for unlabeled analyte,

A_{is} = sum of the integrated ion abundances of the quantitation ions for the labeled internal standard,

Q_{is} = quantity (expressed in appropriate units , ng or pg) of the internal standard added to the sample before extraction,

W = weight or volume, in grams or liters, of the sample (solid or liquid; = 1 for an air sample) and

$RRF_{(n)}$ = calculated relative response factor for the analyte.

6. Toxicity Equivalence Factors (TEF) are then used to estimate the Toxicity Equivalence (TEQ) for the sample by summation of the TEQ value for each compound that is monitored. The TEF factors from the EPA 1989a are used as default values for soil samples. World Health Organization, 1997 TEFs may also be used, at client request. The current default is to use the calculated detection limit for each compound in the TEQ equation (i.e., the upperbound concentration).

7. If the TEQ is equal to or above the specified target point, the sample is reported as positive. If it is below the specified target point, the sample is reported as negative. A rounding function is utilized to provide a safety factor.

8. A positive control (a laboratory sample fortified with the target analytes and ^{13}C- labeled standards) and negative control (a laboratory sample fortified with the ^{13}C- labeled standards only) are analyzed with each sample batch for quality control purposes.

D. QUALITY CONTROL REQUIREMENTS

1. A calibration standard must be analyzed at the beginning of the analytical sequence.

2. Negative control ("method blank")

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a) The results should be determined to be negative at the required TEQ.

3. Positive control ("laboratory control spike")

   a) The results should be determined to be positive at the required TEQ.

4. Sample Criteria

   a) The internal standard must be of sufficient intensity to achieve the required target reporting limit.

   b) Samples associated with a batch that has a failing positive or negative controls must be reextracted and reanalyzed. Exceptions may be made for sample matrices which require extreme additional cleanup procedures, or which contain extremely high levels of analytes.

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RAPIDSCREEN EXTRACTION – SOIL, SEDIMENT		
SOP No.	DHR200A Version: 4	Date Revised: June 14, 2006

Author: Kenny Mims Effective Date: 09/28/2006

Authorization: _____ Management Date Authorized: 6/20/2006

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I. **PURPOSE:** The purpose of this standard operating procedure (SOP) is to describe the procedures and techniques used to extract soil or sediment samples for the RapidScreen analysis.

II. **SCOPE:** This procedure applies to all RapidScreen soil, sediment samples processed within the Sample Preparation Laboratory.

III. **RESPONSIBILITY**: The Sample Preparation Laboratory Technician is responsible for following the procedures outlined in this standard operating procedure and for proper documentation of the extraction process.

IV. **SAFETY**: Samples may contain harmful substances. Wear a lab coat, appropriate eyewear, and gloves. These solvents are flammable; avoid flames and sparks. Do not breathe the vapors, and avoid contact with skin and eyes. They may cause irritation, nausea, dizziness, and, in extreme cases, death. For additional information, see the Safety and Health Manual and appropriate MSDS, or contact the Safety Officer and management.

V. **GLASSWARE AND EQUIPMENT**:

A. 6 oz amber glass jars- 1 per sample
B. Aluminum foil
C. 2 spatulas or scoops for each sample
D. Sand bath- Containing at least 1.5" sand
E. Hot plate
F. Orbital shaker
G. 50 mL glass tubes – 1 per sample
H. Glass funnel – 1 per sample
I. Pre-extracted G8 Filter paper– 1 per sample
J. Pasteur Pipets
K. Short glass thermometer

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RAPIDSCREEN EXTRACTION – SOIL, SEDIMENT	
SOP No. DHR200A Version: 4	Date Revised: June 14, 2006

VI. **REAGENTS:**

A. 10% acetone in heptane- Add 50 mL acetone to 450 mL heptane. Mix well and cap until ready to use. Prepare fresh each day. Volume can be increased or decreased proportionally as needed for the number of samples being prepared each day. Document this solution prep in the extraction solution prep log.

B. Anhydrous sodium sulfate.

C. Pre-extracted sand as matrix for control samples.

D. Pre-extracted glass wool.

VII. **PROCEDURE:**

From the project information, determine the target value for the batch. This value is required to determine the sample size to extract. The percent moisture should be determined for the samples and used in the final reporting. If the % moisture is less than 50%, the following sample sizes will meet method objectives.

A. Use 20 to 30 grams of sample for a 1 ppt target value of TEQ.

B. Use 4 to 6 grams of sample for a 4 ppt target value of TEQ.

C. Use 0.7 to 1.0 grams of sample for a 30 ppt target value of TEQ.

D. Using a calibrated 3-place balance, weigh the appropriate sample amount into a labeled 6 oz glass jar. Record the exact sample weight on the laboratory tracking form.

E. Prepare the positive and negative Control samples last. Match the sample size of the controls to the largest sample size in the batch.

F. Working with one sample at a time, add sodium sulfate to the sample with mixing until the sample is free flowing.

G. After all samples have been mixed with sodium sulfate until free flowing, check each jar to make sure the sample is still free flowing. Add additional sulfate as needed.

H. Add RapidScreen internal standard to all samples following the WAG on spiking samples. Be sure the standard is added to the sample and not placed on the glass jar.

I. Add RapidScreen matrix spike solution to the positive control only following the WAG on spiking samples. Be sure the standard is added to the sample and not placed on the glass jar.

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RAPIDSCREEN EXTRACTION – SOIL, SEDIMENT		
SOP No.	DHR200A Version: 4	Date Revised: June 14, 2006

J. Add 15 mL 10% acetone in heptane (extraction solvent) to each sample. If the extraction solvent does not cover the entire sample, add additional extraction solvent as needed. The solvent level should be approximately ¼" or more above the solid layer.

K. Cover each jar with aluminum foil.

L. Place the sand bath on the hot plate.

M. Inset a short glass thermometer in the sand bath. Just cover the bulb. Make sure the thermometer does not touch the bottom of the bath.

N. Heat the sand bath to 50° C. While the bath is heating, place the sample containing jars in the bath. Each jar is inserted into the top 1" of the sand. Do not allow the jars to touch the bottom or sides of the bath.

O. When the bath reaches 50° C, immediately place the entire bath in the shaker. Adjust the shaker speed to move gently. Make sure the solvent does not "slosh". A gentle movement of the solvent over the sample is the objective.

P. Gently shake the bath containing jars for 1 hour. Do not leave the bath and shaker unattended for more than a few minutes at a time.

Q. After gently shaking for 1 hour, remove the sand bath from the shaker.

R. Immediately remove the sample jars from the warm sand.

S. Line a small glass funnel with a pre-extracted G-8 filter paper. Add sodium sulfate to the filter.

T. Transfer the extraction solvent from the jar into a labeled 50 mL glass tube for each sample through the sodium sulfate in the pre-extracted G-8 filter paper.

1. Make certain that the filter paper covers the ENTIRE surface area of the glass funnel.
2. It is IMPERATIVE that the sample stays within the filter paper and does NOT flow between the filter paper and the glass funnel.
3. Use a Pasteur pipet to transfer the solvent from the jar to the sodium sulfate.

U. Rinse each sample with 1-2 mL clean extraction solvent. Filter the rinse as described above. Repeat this step for a total of two (2) rinses.

V. Rinse the sodium sulfate with 1-2 mL clean extraction solvent. Repeat rinse for a total of two (2) rinses.

W. Remove the glass funnels and discard the sodium sulfate.

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RAPIDSCREEN EXTRACTION – SOIL, SEDIMENT		
SOP No.	DHR200A Version: 4	Date Revised: June 14, 2006

X. Cap each tube with aluminum foil.

Y. Samples are now ready for the cleanup process.

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RAPID SCREEN FOR TEQ –ANALYSIS AND DATA PROCESSING	
WAG DHR200B Version: 4	Date Revised: January 4, 2005

Author: Donald Harvan

Effective Date: 1/27/2005

Authorization: _____ Management

Date Authorized: 1/13/2005

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I. **PURPOSE:** This WAG is intended to describe the detailed procedures to process and review data for the implementation of the Eno River Labs, LLC, RAPID SCREEN FOR TEQ METHOD. **More detailed information related to Opusquan use can be obtained in the VG Analytical Opusquan Manual.**

II. **SCOPE:** This method provides procedures for the screening for a selected set of PCBs, chlorinated dioxins and furans in extracts of samples prepared according to Eno River Labs, LLC RAPID SCREEN FOR TEQ METHOD. The method is analyzed on a GC column that is **not necessarily isomer specific**. It is intended as a rapid screen assay that will screen for Toxicity Equivalence values that are greater than the specified target value. It is used in conjunction with the SOP for the Eno River Labs, LLC, RAPID SCREEN FOR TEQ METHOD.

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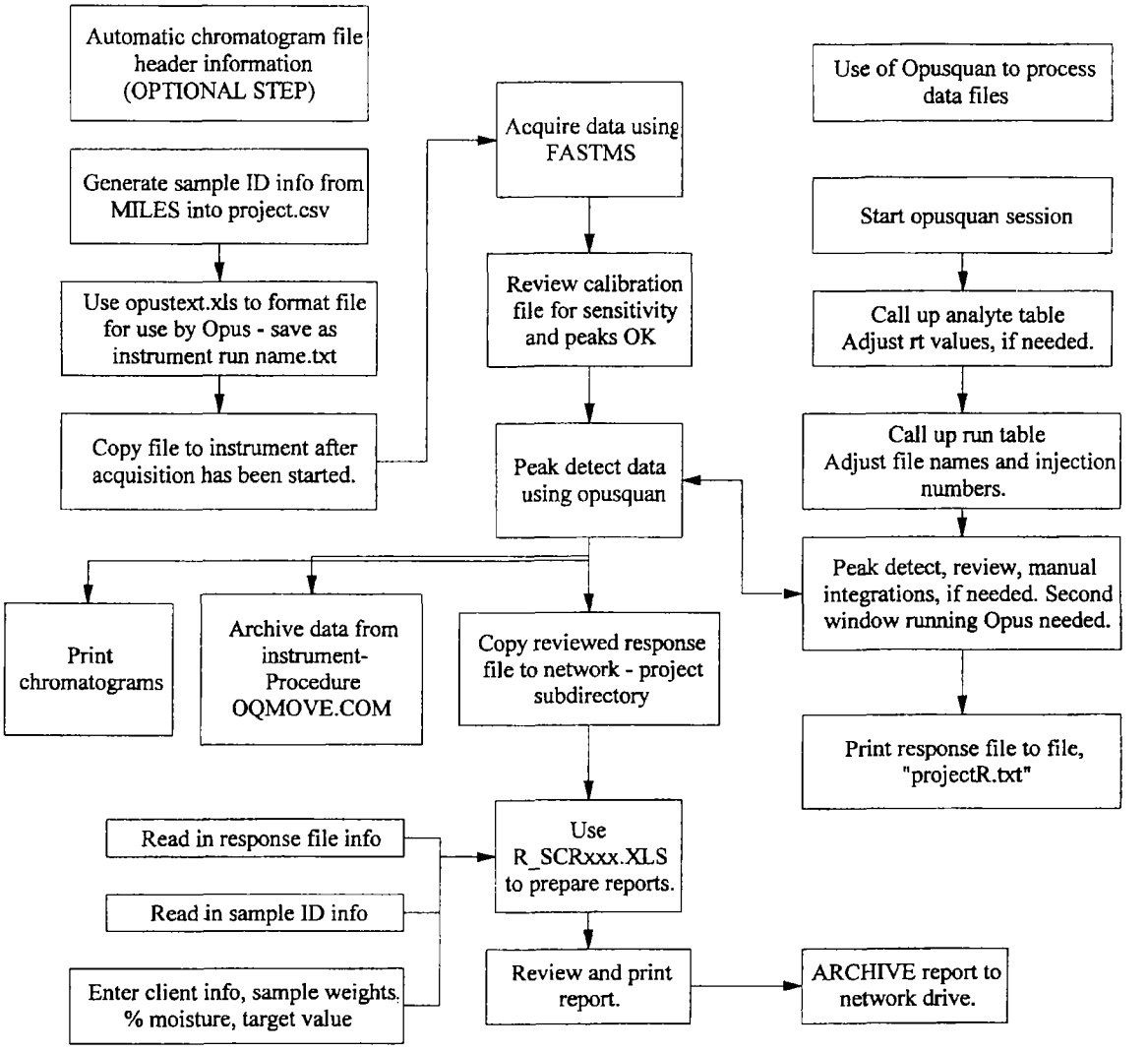
RAPID SCREEN FOR TEQ —ANALYSIS AND DATA PROCESSING	
WAG DHR200B Version: 4	Date Revised: January 4, 2005

PROCESS OVERVIEW



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III. **INSTRUMENTAL ANALYSIS**

A. Set up the GCMS, using the DB5-MS 30m – 0.25mm – 0.5 µ film column. Head pressure is 27 psi, 70 ml/min split flow, 0.8 ml/min septum purge flow. Use MS descriptors FASTMS and GC descriptor FASTMS. Mass resolution is adjusted to a minimum of 5000. An electron energy of approximately 38 eV provides optimal sensitivity. A small plug of glass wool in the injection port liner is recommended to protect the column and prevent solvent ion gauge trips.

B. A valid analysis of calibration and method or instrument blank must have been obtained prior to the analysis of any sample sequence.

C. Remove the sample extract from storage. Add recovery standard, dissolve sample and transfer the extract (*20 µL typical volume* - **NOTE**: *for 700 ppt* method, 50 µL) to a labeled autosampler vial.

D. Inject a 1µL aliquot of the extract into the GC, operated under the GC conditions that have produced acceptable calibration results.

E. Acquire SIM data using the same acquisition and mass spectrometer operating conditions previously used to determine the relative response factors.

F. **OPTIONAL** Procedure to Transfer sample IDs from Miles into the chromatographic data file headers.

1. From the Miles Main Menu, select P – Pharmaceutical data Reports
2. From the Pharmaceutical Menu, select E - Data Extraction
3. From the Data Extraction menu, select B - Build project Run List CSV file
4. Enter the project number, and change the output to write the file to C:\temp\"project number.csv"
5. This will create a csv (comma separated values) file that can be imported into an Excel spreadsheet and then formatted so that the Opus software will read this information into chromatogram text headers. This information can also be used for generating final report sample header information.
6. Use the excel file **opustext.xls** to format the csv data, create the text file that contains sample header information and then copy it to the instrument. The instructions for this procedure are contained in the header of **opustext.xls.**

IV. **PROCEDURE using Opusquan:** The High-Resolution Gas Chromatograph/High-Resolution Mass Spectrometer/Data System (GC/MS/DS) equipment utilized for this analysis includes the following software:

A. VG Micromass Opusquan operated within the Opus software system.

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B. High Resolution Mass Spectrometers: VG 70 Series, VG 70-SE Series, VG Autospec.

C. Data Systems: VAX Alpha with Opus 3.2 software.

D. Starting opusquan (this assumes that the mass spectrometer acquisition software is loaded in terminal session 1)

1. Start a second Decterm terminal session and from the $ prompt, type the command **setquan**.

   a) This command enters into the directory, VG_QUAN, sets up the print command and resizes the window.

2. From the $ prompt, type quan

   a) This will call up the opusquan processing software.

3. Start another terminal session and start Opus. Then return back to the window that is running Opusquan. Minimize the other windows to reduce screen clutter.

   a) Following the procedure **in the above order** will allow the Opusquan software to have access to the VG graphics windows, and allow peak inspection and manual integrations, if needed.

E. Data processing - For all directions below, items in brackets < > should be entered by the user. Items that are in square brackets [ ] should be typed by holding the CTRL key simultaneously with the other specified key. The commands in bold can usually be executed by typing the letter that is listed in upper case in the menu (for example, V for View).

1. The Opusquan screen is divided into 4 sections:

   a) The major upper part is for display of parameters and results (usually via forms).

   b) The black area contains status information – the current table, form and runs and any current status information.

   c) The next line contains the command menu, with a lower line that contains simple help messages for each option on the menu. The **DO key** allows toggling between the command menu and the form editing mode.

   d) The bottom line contains any error messages.

2. Call up the analyte table for processing rapid screen data by:

   a) From the opusquan window, type **Read Analytes <FAST>**

   b) This reads the previously created analyte table **FAST** into memory. This analyte table will specify the analytes by name, mass, and retention time.

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c) Type **View Form <Sum>**, This will present a view of the analyte table for the method. This table can be edited by the user, if needed. The expected retention times may need to be changed to reflect current GC conditions. Get this retention time information from the current calibration file. After updating the retention time information, save the changes by the commands **W**rite **A**nalyte **FAST** <overwrite?> **Y**. Make these corrections to the analyte table before processing any sample data.

3. To process data, it is necessary to set up a Run table.

   a) Type **View Form <Run>**. This will present a listing that the user can edit to enter the file name, injection number, and analyte table for data processing.

   b) **A**dd **A**ppend **R**un **C**opy, and copy a run for each file to be processed. For autosampler runs, the first entry in the run can be copied and edited.

   c) Enter the sample numbers for each run to process.

   d) Make sure the Hardcopy (HC) option is set to Y.

4. To process data, it is necessary to execute processing on the files listed in the Run table.

   a) Type **Execute Next**. (if doing all samples from a run at once, use Execute All).

   b) The software will perform peak detection on all of the files listed in the run table. This is very rapid, because no graphic calls are used. The progress can be monitored by watching the status information line.

5. To view the results of the peak detection, type **View Form <Resp>**.

   a) This calls up a table containing the analytes and listing the retention times, peak areas and calculated ratio of the detected peaks.

   b) This form can be used to quickly view and edit the peak integrations. **Be sure that a second Decterm window that is running Opus has been started before proceeding.**

   c) With the cursor, cover the name of the analyte to be reviewed and type **[CTRL G].**

   d) Opus will generate and peak detect the chromatogram corresponding to the two ions related to that analyte. If corrections are needed, do a manual integration **on one of the ions** as normal. Then, using the mouse, return back to the

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opusquan window, highlight the ion that was integrated and type **[CTRL R].** The area of the most recently manually integrated peak will be transferred back into Opusquan.

e) Manual integrations should be used sparingly. If the analyte peaks and internal standards have been properly identified, minor corrections should not be necessary. Because this is a screening assay, if the sample has been determined to be positive, there is no added value to more accurately determining peak baselines. If the computer generated integration may lead to a false negatives due to failure to detect an analyte or an interference, manual integrations may be required.

f) Repeat steps c) and d) for each ion to be manually integrated. **Be careful when switching from Opusquan to Opus that you DO NOT CLICK THE MOUSE IN THE OPUS WINDOW UNTIL AFTER Opusquan HAS COMPLETED ITS CALL. OTHERWISE, THE Opus WINDOW WILL CRASH.**

g) Hit the **[DO]** key. This command will update all results using the newest value.

6. Select another run in the lists of files to be processed by using the pageup / pagedown keys (\P=pageup). Continue processing in this manner until all data has been reviewed, and peaks are properly integrated and the data transferred into the opusquan response table. After the data is fully processed, the user creates an ASCII file containing the results by typing **Print Form File All <full file name>** will print the response form into a file. The full file name should be identified as the "FilenameR.txt" (for example, M1002R.txt). Remember that this file must conform to DOS 8.3 naming conventions. This ASCII file will then be copied to a PC for data reporting in Microsoft Excel.

7. To print the chromatograms, return to the run table –

a) Type **Execute Opus Print Run <run number>,** will print the chromatograms for each specified run. Repeat this for each run to be printed.

b) OPTIONALLY, the chromatograms can be captured in a postscript file. This file can then be transferred to a local PC and converted into a PDF document that can be reviewed on-screen, or printed. To create the postscript file:

c) In a separate Decterm window, type - set proc/priv =all

d) Stop/reset/queue qms_prn020 (this will hold the print queue)

e) Type **Execute Opus Print Run <run number>,** will print the chromatograms for each specified run to the disk.

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f) Go to the Decterm window and type @proc_rs

g) The system will query you for a filename.

h) Respond with the filename-sample number (for example, M100201 - the first sample from file M1002).

i) Go back to step e, and print the next chomatogram. When done, type "Start /queue qms_prn020" to restart the print queue.

j) The created files (M100201.ps ... M1002xx.ps) can be transferred to a local PC and opened in Acrobat Distiller. They will automatically be converted into PDF documents.

8. After review at the instrument is completed, save the processed data by typing **Write Results<file name>,** where file name is the name of the data file (for example, M1002).

F. Data Review Identification Criteria - For a gas chromatographic peak to be identified it must meet all of the following criteria:

1. Retention Times

a) The retention time of the sample components (i.e., the two ions used for quantitation purposes listed in Table 1.), must be within -1 to +3 seconds of the isotopically labeled standard.

b) The ion current responses for both ions used in quantitation (e.g., for TCDD: m/z 319.8965 and 321.8936) must reach maximum intensity simultaneously (± 2 seconds).

2. The ion current responses for both ions used for the labeled standards (e.g., for $^{13}C_{12}$-TCDD: m/z 331.9368 and m/z 333.9339) must reach maximum simultaneously (± 2 seconds).

3. Manual integrations should be used sparingly. Detection limits for samples giving a response for at least one quantitation ion that is less than 2.5 times the background level are estimated in the Excel spreadsheet using a peak area that is 0.1% of that of the corresponding internal standard. This means that small peaks can usually be ignored, because the default peak area that is used for the TEQ calculation will be larger than those that result from manual integrations of insignificant peaks. Because this is a screening assay, if the sample has been determined to be positive, there is no added value to more accurately determining peak baselines. If the computer generated integration may lead to a false negatives due to failure to detect an analyte or an interference, manual integrations may be required. The general guideline is to be certain that false negatives are not reported because of failure to detect a targeted peak.

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4. Sample Specific Estimated Detection Limit - The sample specific estimated detection limit (EDL) is the concentration of a given analyte required to produce a signal with a peak height of at least 2.5 times the background signal level.

   a) Detection limits for samples giving a response for at least one quantitation ion that is less than 2.5 times the background level are calculated using an area that is 0.1% of that of the corresponding internal standard. This occurs automatically in the Excel reporting spreadsheet.

V. **Exporting and data reporting in Excel.**

1. It is more efficient to operate on the local PC drive and then copy the results to the network drive for data archival. Typically, C:\TEMP\ can be used for initial data processing.

2. To archive the processed data, the project subdirectory will need to be created on the network drive "\\srvr1\HI_RES_REP" (usually assigned to Q:)

   a) To create a subdirectory on the "Q" drive, go to that service and then, use the DOS command "md":

      md projectnumber , where projectnumber is the Miles project number.

3. For data processing, the reduced data (M1002R.txt file) can be copied from the data acquisition Vax station to a local PC by typing, from the local PC:

   a) **NFTN COPY 11.xx"VG ANALYSIS"::[VG.QUAN]filenameR.TXT C:\TEMP** , (where filename is, for example, M1002R.TXT).

   b) **NFTN COPY 11.xx"VG ANALYSIS"::[VG.QUAN]filename.qre C:\TEMP** is used to keep all the processed results from the project for archival purposes.

   c) The sample IDS can be retrieved by copying the appropriate .txt files from [VG.DATA].

      NFTN COPY 11.xx"VG ANALYSIS"::[VG.DATA]filename.TXT C:\TEMP\ , (where filename is the instrument run name, e.g. M1002.txt).

   d) 11.9 is the network device ID for the AlphaM

   e) 11.18 is the network device ID for the AlphaW

   f) 11.15 is the network device ID for the AlphaU

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4. The Excel 5.0 file R_SCRXXX.XLS [R_SCR_01(for 1ppt), R_SCR_04 (for 4ppt) and R_SCR_30 (for 30ppt) and R_SCR_7B (for 700 ppt)] is used to generate reports. They are located on the network at srvr1\\limp\R_screen\ (= P:\R_screen\).

   a) Open the read-only R_SCR_XXX spreadsheet file and save in C:\TEMP\ as C:\TEMP\"project.xls"

   b) Then, open the response text file from step V-2-a. This is opened from Excel as a text file, using delimited - space options from the Import Wizard.

   c) In step 3 of the Wizard, select all fields and specify Text for the column data format. The resulting file is copied and pasted into cell A1 of the **INPUT TAB** of the R_SCR_XX spreadsheet.

   d) Go to the tab labeled **Process**.

   e) Enter the Client ID in cell C26, as specified.

   f) Enter the Eno River Labs, LLC project number in C27.

   g) Enter the received date in H23.

   h) The sample ID information is read by opening each instrument filename.TXT file into Excel, using the delimited – space options. The resulting parsed file (skip row 0) is then copied and pasted into the **Process** tab, starting at cell K3. The corresponding file name is entered into cells in column J. The sample IDs will then be parsed and read into the appropriate cells on the **Processed** tab. This procedure will need to be modified for filenames that are longer than 5 characters.

   i) The information will be automatically read into the **Processed** tab.

   j) The **Processed** tab contains default %moisture values, default RF values for non-detects (currently set at 0.1% of the internal standard value) and the target values for reporting. The %moisture and target values may need to be adjusted, as required.

   k) The sample weights are currently manually entered into column G of the **Processed** tab. The % moisture values can be entered into column I, if needed. The positive and negative control should utilize a default % moisture value, typically 30%.

   l) Print the top results page (hide columns that are not needed) and the appropriate sections of the Processed page for use by data reviewers.

B. Archival of processed data

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a) Copy the final excel spreadsheet, and the corresponding text files (M1002.txt and M1002R.txt) and the results file (M1002.qre) to the network "Q" drive ("\\srvr1\HI_RES_REP").

C. Archival of raw data

1. When all the processing has been completed, open up a Decterm window. At the VG$ prompt, enter **@OQMOVE.COM**. The computer will prompt you for the filename. Enter the filename to be archived and hit return. The computer will automatically archive all data to the proper archive drectory. The computer will ask you if you have any more files that need to be archived. If there are more, continue to enter filenames until all files that you wish to archive are done. Once that occurs, type in "**N**" when prompted. This will exit the OQMOVE routine.

D. Structure of the spreadsheet R_SCRXXX.XLS

1. REPORT TAB- Final report to client is summarized on this page. Hidden cells contain sample weights and percent moisture to facilitate data review.
2. PROCESS TAB – Information is entered by analyst to show client specific information and the sample ID information. Version histories are also on this page.
3. INT STD RECS TAB - A summary of the internal standard recoveries is on this page. These data can be used for QC purposes.
4. PROCESSED TAB – The calculations are performed on this page. All data is read in from the INPUT TAB, with the exception of certain default information (%moisture, what TEF value to use, Target level), that can be modified as needed.
5. INPUT TAB – The response data from the instrument analysis are copied and pasted into this page.
6. The first file from the Input Tab **MUST** be the calibration file. This is read into the top of the Processed page, and all samples are calculated from the Response factors that are calculated from this file.

VI. QUALITY CONTROL REQUIREMENTS

A. Routine calibrations must be performed during the analytical sequence.

B. The target detection limits (TDL) will be the following:

1. TDLs for food oils (sample size – 1g):

   ≤ 10pg / g TEQ

2. TDLs for solids (sample size – 4 to 6 g):

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≤ 4 pg / g TEQ

3. TDLs for solids (sample size – 20 to 30 g):

   ≤ 1 pg / g TEQ

4. TDLs for solids (sample size – 0.8 to 1 g):

   ≤ 30 pg / g TEQ

5. TDLs for solids (sample size – 4 to 6 g; alternate IS spike):

   ≤ 700 pg / g TEQ

6. TDLs for solids (sample size - unity):

   ≤ 10 pg TEQ

C. Negative Control

   1. The results should be determined to be negative at the required TEQ.

D. Positive Control

   1. The results should be determined to be positive at the required TEQ.

E. Sample Criteria

   1. The internal standard must be of sufficient intensity to achieve the required target reporting limit.

   2. Samples associated with a batch that has a failing positive or negative controls may need to be reextracted and reanalyzed. Exceptions may be made for sample matrices which require extreme additional cleanup procedures, or which contain extremely high levels of analytes.

F. **NOTE:** If only dioxin/ furan TEQ has been requested by the client, then hide column C on the Report page prior to printing.

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RAPID SCREEN FOR TEQ –ANALYSIS AND DATA PROCESSING

WAG DHR200B Version: 4 | Date Revised: January 4, 2005

TABLE 1: ELEMENTAL COMPOSITIONS AND EXACT MASSES OF THE IONS MONITORED BY HRGC/HRMS FOR PCBs, PCDDs AND PCDFs

FASTMS

Descriptor Number	Accurate Mass[a]	Ion Type	Elemental Composition	Analyte
1	289.9224	M	$C_{12}H_6{}^{35}Cl_4$	Tetra PCB
	291.9194	M+2	$C_{12}H_6{}^{35}Cl_3{}^{37}Cl$	Tetra PCB
	301.9626	M	$^{13}C_{12}H_6{}^{35}Cl_4$	Tetra PCB (IS)
	303.9597	M+2	$^{13}C_{12}H_6{}^{35}Cl_3{}^{37}Cl$	Tetra PCB (IS)
	304.9824	REFERENCE	C_8F_{11}	PFK (LOCK)
	304.9824	REFERENCE	C_8F_{11}	PFK (QC)
2	303.9016	M	$C_{12}H_4{}^{35}Cl_4O$	TCDF
	305.8987	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF
	319.8965	M	$C_{12}H_4{}^{35}Cl_4O_2$	TCDD
	321.8936	M+2	$C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD
	327.8775	M+4	$C_{12}H_5{}^{35}Cl_5$	Penta PCB
	329.8745	M+6	$C_{12}H_5{}^{35}Cl_4{}^{37}Cl$	Penta PCB
	330.9792	REFERENCE	C_7F_{13}	PFK (LOCK)
	330.9792	REFERENCE	C_7F_{13}	PFK (QC)
	315.9419	M	$^{13}C_{12}H_4{}^{35}Cl_4O$	TCDF (IS)
	317.9389	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO$	TCDF (IS)
	331.9368	M	$^{13}C_{12}H_4{}^{35}Cl_4O_2$	TCDD (IS)
	333.9339	M+2	$^{13}C_{12}H_4{}^{35}Cl_3{}^{37}ClO_2$	TCDD (IS)
	339.9177	M+4	$^{13}C_{12}H_5{}^{35}Cl_5$	Penta PCB (IS)
	341.9148	M+6	$^{13}C_{12}H_5{}^{35}Cl_4{}^{37}Cl$	Penta PCB (IS)
3	339.8597	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}Cl\,O$	PeCDF
	341.8568	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF
	351.9000	M+2	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}Cl\,O$	PeCDF (IS)
	353.8970	M+4	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O$	PeCDF (IS)
	355.8546	M+2	$C_{12}H_3{}^{35}Cl_4{}^{37}Cl\,O_2$	PeCDD

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RAPID SCREEN FOR TEQ –ANALYSIS AND DATA PROCESSING

WAG DHR200B Version: 4 | Date Revised: January 4, 2005

TABLE 1: ELEMENTAL COMPOSITIONS AND EXACT MASSES OF THE IONS MONITORED BY HRGC/HRMS FOR PCBs, PCDDs AND PCDFs				
	357.8517	M+4	$C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD
	359.8415	M+2	$C_{12}H_4{}^{35}Cl_5{}^{37}Cl$	Hexa PCB
	361.8385	M+4	$C_{12}H_4{}^{35}Cl_4{}^{37}Cl_2$	Hexa PCB
	365.8978	M	$^{13}C_{12}H_3{}^{35}Cl_4{}^{37}ClO_2$	PeCDD (IS)
	367.8949	M+2	$^{13}C_{12}H_3{}^{35}Cl_3{}^{37}Cl_2O_2$	PeCDD (IS)
	371.8817	M+2	$^{13}C_{12}H_4{}^{35}Cl_5{}^{37}Cl$	Hexa PCB (IS)
	373.8788	M+4	$^{13}C_{12}H_4{}^{35}Cl_4{}^{37}Cl_2$	Hexa PCB (IS)
	380.9760	REFERENCE	C_8F_{15}	PFK (LOCK)
	380.9760	REFERENCE	C_8F_{15}	PFK (QC)
4	401.8559	M+2	$^{13}C_{12}H_2{}^{35}Cl_5{}^{37}ClO_2$	HxCDD (RS)
	403.8530	M+4	$^{13}C_{12}H_2{}^{35}Cl_4{}^{37}Cl_2O_2$	HxCDD (RS)
	404.9760	REFERENCE	$C_{10}F_{15}$	PFK (LOCK)
	404.9760	REFERENCE	$C_{10}F_{15}$	PFK (QC)
5	441.7428	M+2	$C_{12}{}^{35}Cl_7{}^{37}Cl\,O$	OCDF
	443.7398	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O$	OCDF
	457.7377	M+2	$C_{12}{}^{35}Cl_7{}^{37}Cl\,O_2$	OCDD
	459.7348	M+4	$C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD
	469.7780	M+2	$^{13}C_{12}{}^{35}Cl_7{}^{37}Cl\,O_2$	OCDD (IS)
	471.7750	M+4	$^{13}C_{12}{}^{35}Cl_6{}^{37}Cl_2O_2$	OCDD (IS)
	480.9696	REFERENCE	$C_{10}F_{19}$	PFK (LOCK)
	480.9696	REFERENCE	$C_{10}F_{19}$	PFK (QC)

a) The following nuclidic masses were used:

H = 1.00782537 O = 15.99491464
C = 12.000000 ^{35}Cl = 34.968852729
^{13}C = 13.0033548 ^{37}Cl = 36.965902624
F = 18.9984

RS = Recovery standard
IS = Labeled Internal Standard
QC = PFK Reference Ion Selected for Monitoring Instrument Stability During the GC/MS Analysis

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TABLE 2: COMPOSITION OF THE INITIAL CALIBRATION SOLUTIONS

Compound	Concentrations (µg/mL)
Unlabeled Analytes	
3,3',4,4'-TCB	0.0025
3,3',4,4',5-PeCB	0.0025
3,3',4,4',5,5'-HxCB	0.0025
2,3,7,8-TCDF	0.0005
2,3,7,8-TCDD	0.0005
1,2,3,7,8-PeCDF	0.0005
2,3,4,7,8-PeCDF	0.0005
1,2,3,7,8-PeCDD	0.0005
OCDF (vs. $^{13}C_{12}$-OCDD)	0.005
OCDD	0.005
Internal Standards	
$^{13}C_{12}$-3,3',4,4'-TCB	0.1
$^{13}C_{12}$-3,3',4,4',5-PeCB	0.1
$^{13}C_{12}$-3,3',4,4',5,5'-HxCB	0.1
$^{13}C_{12}$-2,3,7,8-TCDF	0.1
$^{13}C_{12}$-2,3,7,8-TCDD	0.1
$^{13}C_{12}$-1,2,3,7,8-PeCDF	0.1
$^{13}C_{12}$-2,3,4,7,8-PeCDF	0.1
$^{13}C_{12}$-1,2,3,7,8-PeCDD	0.1
$^{13}C_{12}$-OCDD	0.2
Recovery Standard	
$^{13}C_{12}$-1,2,3,4-TCDD	0.1

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TABLE 3: GAS CHROMATOGRAPHY CONDITIONS

Column type	DB-5MS
Length (m)	30
i.d. (mm)	0.25
Film Thickness (um)	0.5
Carrier Gas	Helium
Carrier Gas Flow (mL/min)	1-2
Injection Mode	splitless
Purge Valve Time (s)	60
Initial Temperature (°C)	175
Injection Port Temperature (°C)	250
Program Temperature	See Note

Note: The GC temperature program is subject to change. Refer to work area guidelines for exact definitions of the current run conditions and descriptor name. Initial temperature 175 °C for 1 min, ramp at 40 °C/min to 270 °C and hold for 1 min, ramp at 5 °C/min to 295 °C, and ramp at 10 °C/min to 350 °C.

TABLE 4. ION-ABUNDANCE RATIO ACCEPTABLE RANGE FOR TARGET ANALYTES

Number of Chlorine Atoms	Ion Type	Theoretical Ratio	Control Limits	
			Lower	Upper
4	M/M+2	0.77	0.65	0.89
5 (PeCDF/D)	M+2/M+4	1.55	1.32	1.78
5 (PCB)	M+4/M+6	3.20	2.72	3.68
8	M+2/M+4	0.89	0.76	1.02

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TABLE 5: TOXICITY EQUIVALENCE FACTORS

Compound	TEF - WHO (1997)	TEF - EPA 1989a)
Unlabeled Analytes		
3,3',4,4'-TCB	0.0005	0.0005
3,3',4,4',5-PeCB	0.1	0.1
3,3',4,4',5,5'-HxCB	0.01	0.01
2,3,7,8-TCDF	0.1	0.1
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDF	0.05	0.05
2,3,4,7,8-PeCDF	0.5	0.5
1,2,3,7,8-PeCDD	1	0.5
OCDF (vs. $^{13}C_{12}$-OCDD)	0.0001	0.001
OCDD	0.0001	0.001

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INITIAL AND FINAL REVIEW OF HRGC/HRMS DATA PACKAGES	
SOP No. EDR100 Version: 2	Date Revised: September 19, 2005

Author: Kenneth Varley

Effective Date: 11/12/05

Authorization: _____ Management

Date Authorized: 11/24/05

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I. **PURPOSE:** The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for the Initial and Final Review of HRGC/HRMS data packages.

II. **SCOPE:** This procedure applies to all personnel performing Initial and Final review of HRGC/HRMS data packages.

III. **PROCEDURE:**

A. Preliminary Review of Sample Reports

1. Review data package for completeness (all paperwork, DB-5 analyses, DB-35 analyses, DB-225 analyses, and dilutions are present when required).

2. Verify that clerical and spike file information are correct and make corrections as needed.

3. Verify noise calculation(s) and make corrections as needed.

4. Check that all acceptance criteria are met using all relevant sources to obtain acceptance criteria (Method SOP, QAPPs, special client requirements, etc.)

5. Initiate a Non-Conformance Report (NCR) for any criteria that have not been met and submit to designated personnel.

B. Review of Chromatograms and Generation of Final Quantitation Reports

1. Review chromatograms and B-files for accurate match, accurate peak integration, missing analyte and standard peaks, qualifiers, analyte and standard peak identification, and analytical quality.

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2. Integrate any peaks with inaccurate integrations and integrate any missing peaks using the OPUS software.

3. Use the LARS software to edit the report files (enter manual integrations, delete and add peaks, reassign analyte and standard names, and add qualifiers). Print final quantitation and summary reports.

4. Use MILES software to generate TEF reports and QC sample reports.

5. Use MILES and Access Software to create and verify electronic diskette deliverables and the results summary report.

6. Recheck that all acceptance criteria have been met and all necessary NCR reports have been initiated. Recheck for completeness.

C. Case Narrative Generation - Using Microsoft Word software create a case narrative that includes but not limited to the method of analysis, field and QC samples analyzed, receiving information, data quality issues, non-conformance issues, and qualifiers.

D. Assemble the Data Package

E. Final Review of the Data Package - An additional review by second chemist.

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INITIAL AND FINAL REVIEW OF HRGC/HRMS DATA PACKAGES	
SOP No. EDR100 Version: 2	Date Revised: September 19, 2005

Author: Kenneth Varley Effective Date: 11/17/05

Authorization: _____ Date Authorized: 11/21/05
Management

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I. **PURPOSE:** The purpose of this Standard Operating Procedure (SOP) is to describe the procedure for the Initial and Final Review of HRGC/HRMS data packages.

II. **SCOPE:** This procedure applies to all personnel performing Initial and Final review of HRGC/HRMS data packages.

III. **PROCEDURE:**

A. Preliminary Review of Sample Reports

1. Review data package for completeness (all paperwork, DB-5 analyses, DB-35 analyses, DB-225 analyses, and dilutions are present when required).

2. Verify that clerical and spike file information are correct and make corrections as needed.

3. Verify noise calculation(s) and make corrections as needed.

4. Check that all acceptance criteria are met using all relevant sources to obtain acceptance criteria (Method SOP, QAPPs, special client requirements, etc.)

5. Initiate a Non-Conformance Report (NCR) for any criteria that have not been met and submit to designated personnel.

B. Review of Chromatograms and Generation of Final Quantitation Reports

1. Review chromatograms and B-files for accurate match, accurate peak integration, missing analyte and standard peaks, qualifiers, analyte and standard peak identification, and analytical quality.

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2. Integrate any peaks with inaccurate integrations and integrate any missing peaks using the OPUS software.

3. Use the LARS software to edit the report files (enter manual integrations, delete and add peaks, reassign analyte and standard names, and add qualifiers). Print final quantitation and summary reports.

4. Use MILES software to generate TEF reports and QC sample reports.

5. Use MILES and Access Software to create and verify electronic diskette deliverables and the results summary report.

6. Recheck that all acceptance criteria have been met and all necessary NCR reports have been initiated. Recheck for completeness.

C. Case Narrative Generation - Using Microsoft Word software create a case narrative that includes but not limited to the method of analysis, field and QC samples analyzed, receiving information, data quality issues, non-conformance issues, and qualifiers.

D. Assemble the Data Package

E. Final Review of the Data Package - An additional review by second chemist.

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WATER EXTRACTION			
SOP No. ESP020	Version: 3	Date Revised: June 8, 2006	

Author: Charles Read

Effective Date: ~~June 20, 2006~~ 09/28/2006 09/26/2006 CRR 9/26/20

Authorization: _____ Management

Date Authorized: 6/20/2006

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I. **PURPOSE:** The purpose of this SOP is to describe the preparation of water samples for extraction of PCDD/PCDFs, PCBs, and PAHs.

II. **SCOPE:** This SOP applies to the extraction of aqueous samples by methods 1613, 8290, 8280, HRPCB, LRPCB and 8270.

III. **RESPONSIBILITY:** Authorized Sample Preparation Laboratory Extraction Personnel are responsible for executing these procedures.

IV. **SAFETY CONSIDERATIONS:** The samples may contain harmful materials. Wear lab coat, gloves, and appropriate eyewear. Do not breathe the solvent vapors, and avoid contact with the skin and eyes. The solvents may cause irritation, dizziness, nausea, and in extreme cases, death. The solvents are flammable. Avoid flames and sparks. For additional safety information, see the Eno River Labs, LLC Safety and Health Manual and appropriate MSDS.

V. **PROCEDURE:**

Note: All samples in a batch must be set up and spiked in the same session. All extractions for a batch must be initiated on a single shift by a single extraction team. Samples must have warmed to room temperature before any processing is done.

A. **PRELIMINARY DETERMINATIONS:**

1. Check sample ID on sample containers against sample ID on the Sample Preparation Tracking and Management Form. If there are any discrepancies contact the lab manager for further instructions.
2. Weigh the bottle with its contents, to the nearest 1 g. Record the weight on the sample prep extraction/spiking sheet as the "before" weight.
3. Take diagnostic measurements:
   a) Measure and record the pH. Lay the pH strip on aluminum foil. Using a disposable glass pipet, remove a few drops of

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sample from the bottle and drip onto the pH strip. Match the resulting color with the color strip on the pH paper container. Record the pH value the color indicates.

(1) **The pH of some samples may need to be adjusted.**

(a) For HRPCB, LRPCB, and 8270 samples,

(i) If the pH is between 5 and 9 proceed with extraction.

(ii) If the pH is lower than 5 or above 9, attempt to adjust the pH to between 5 and 9 using 10N NaOH or 1:1 Sulfuric Acid.

(iii) If the pH will not change, make note of this in the observations and proceed with extraction.

(b) For "difficult water samples," described in ESP020C, adjust the pH of each sample to an acidity between 2 and 3 using a 1:1 sulfuric acid / water solution.

b) Measure and record the free chlorine content. No adjustment is required.

B. **BLANKS, LCS/LCSDs, OPRs**

1. Use 1000 mL HPLC water for blanks, LCS/LCSDs, and OPRs.

C. **IS FILTRATION REQUIRED?**

1. Shake the bottle to suspend any sediment, then examine to see if visible particulates are present. Record observation on sample prep observations form.

2. Regardless of what may be written on the chain of custody form, by EPA definition a "sludge" is a solid or semisolid matrix and there is no separatory funnel extraction of sludge. If the sample can be shaken up and poured out, it does not meet the definition of a sludge. A two-phase mixture of solid and water, more than 1% solid, should be processed as a sediment.

3. Determine whether or not filtration will be necessary as follows:

a) For method 1613 the sample is filtered if and only if there are visible particulates. Cloudy samples that are no opaque do

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not require filtration. However, if the sample is so opaque you can't see whether there are particulates or not, filter it.

b) All 1613 "difficult water" samples are filtered.

c) Again for method 1613, Percent Particulates would only be measured if there are in fact visible particulates (that is, if the sample needs to be filtered).

d) For method 8290, let any suspended particulates settle for 30 minutes. If the layer of sediment on the bottom of the bottle is greater than 1% of the height of the water layer. then filter. If the sediment layer is less than 1% of the height of the water layer, don't filter. (Percentage by volume.)

e) **For method 8280, all client samples and quality control samples must be filtered regardless of appearance.**

f) For HRPCB, LRPCB, and 8270, no filtration is required.

g) If filtration is not necessary as determined above, or if filtration is necessary but the method is 8290 **or 8280**, proceed with spiking (Section B).

4. If filtration is necessary, see SOP ESP020D.

5. At this point you have determined whether the sample is to be considered "water" or "sediment" by the procedures applicable to method 1613. If the samples were submitted as "water" under method 8290 **and 8280**, they will be processed as water regardless of the particulate content, as long as they are pourable and single phase.

D. **SPIKING**

1. The nominal sample size is 1000 mL. Before spiking, estimate whether or not the sample bottle contains less than 900 mL of water. If it does, generate an non-conformance report and await instructions from the sample manager.

2. Spike samples according to the WAG on adding spike standards to samples.

3. After the spiked sample has been transferred to the appropriate extraction apparatus as described in the appropriate SOP below, save the sample bottle. Weigh the empty bottle to the nearest 1 g and enter the weight on the sample prep extraction/spiking sheet as

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the "after" weight. Subtract the "after" from the "before" weight and enter this as the sample size in mL.

E. **EXTRACTION:**

1. The prepared water samples may now be extracted by continuous liquid-liquid or separatory funnel extraction.

2. See the appropriate SOP:

a)	continuous liquid-liquid	ESP020A
b)	separatory funnel	ESP020B
c)	"difficult" water samples	ESP020C
d)	filtering waters	ESP020D
e)	percent particulates determination	ESP020E

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SOXHLET EXTRACTION	
SOP No. ESP105 Version: 21	Date Revised: June 8, 2006

Author: F. Kenny Mims

Effective Date: ~~09/28/2006~~ 09/28/2006 09/26/06 CTO KH 6/20

Authorization: _____ Management

Date Authorized: 6/20/2006

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I. **PURPOSE:** This method provides procedures for the extraction of polychlorinated dibenzo-p-dioxin (tetra- through octachlorinated homologues; PCDDs), polychlorinated dibenzofuran (tetra- through octachlorinated homologues; PCDFs), polychlorinated biphenyls, and polyaromatic hydrocarbons from solid samples.

II. **SCOPE:** It may be applied to the extraction of non-tissue solids, including, but not limited to soil, sediment, pulp, sludge, paper and/or cardboard, according to SW-846 Method 8290, 1613, 8280, HRPCB, LRPCB, and 8270.

III. **RESPONSIBILITY:** Trained Sample Preparation Laboratory Technicians are responsible for executing these procedures.

IV. **SAFETY CONSIDERATIONS:** Samples may contain harmful substances. Wear labcoat, appropriate eyewear and gloves. Toluene and reagent alcohol are flammable; avoid flames and sparks. Do not breathe the vapors, and avoid contact with skin or eyes, as these solvents may cause irritation, nausea, and dizziness. For additional safety information, see the Safety and Health Manual and the appropriate MSDS.

V. **REAGENTS:**

A. n-Heptane- pesticide grade (< 1 ppm residue)

B. Toluene- pesticide grade (< 1 ppm residue)

C. Methylene Chloride-pesticide grade (< 1 ppm residue)

D. Reagent Alcohol

E. Reagent Alcohol/Toluene (68/32 v/v) - Take 68 parts (by volume) of Reagent Alcohol and mix well with 32 parts (by volume) of Toluene.

VI. **GLASSWARE PREPARATION**

A. All glassware used in this procedure must have been prepared according to glassware washing SOP.

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SOXHLET EXTRACTION					
SOP No.	ESP105	Version:	21	Date Revised:	June 8, 2006

B. The following glassware is needed for each sample:

1. beaker
2. 500 mL flat bottom flask
3. forceps
4. spatula
5. Thimble Holder
6. thimble - pre-Soxhlet extracted in extraction solvent

C. If sample is wet (i.e. > 5 g of water), a Soxhlet Dean Stark (SDS) extractor must be used in addition to the Soxhlet extractor.

D. The flask, thimble holder and SDS extractor must have the same size fittings.

E. If SDS is required, assemble the SDS extractor with stopcock.

F. Rinse all glassware with the extraction solvent.

G. Label each beaker and flask by placing a color coded sample label on top of a strip of colored lab tape. The colored lab tape is necessary because the adhesive on the color coded labels is difficult to remove from the glass and will cause contamination problems.

H. All flasks require two labels - one on the side of the flask and one on the neck.

VII. EXTRACTION PROCEDURE:

A. Observe and document the physical appearance, color and odor of each sample on the Sample Prep paperwork for later entry into the wet lab observation log in MILES. Mix the sample well before taking an aliquot for extraction. Make sure homogeneity is maintained--exclude anything that does not constitute the sample's natural matrix.

B. Tare the balance. Weigh sample and its container.

C. Record the gross weight "before" on the sample preparation paperwork.

D. Tare the beaker containing the extraction thimble.

E. Using the Sample Size, Solvent Chart, weigh into the thimble the amount of sample needed.

1. For 'wet weight' measurements, weigh the amount of sample required without percent moisture consideration.

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2. For 'dry weight' measurements, use the target weight calculated by MILES based on the percent moisture, to determine how much of the sample to extract.

F. For HRPCB samples:

1. For all solid samples (including MS/MSD) except paper products, weigh 10g dry weight of sample into a pre-extracted thimble. Add 20 grams of anhydrous sodium sulfate and mix well.
2. For dry ash samples (including MS/MSD), weigh 10g dry weight of sample into a pre-extracted thimble. Do not add sodium sulfate.
3. For paper products, (including MS/MSD) weigh 10g dry weight into a pre-extracted thimble. Do not add sodium sulfate.

G. For LRPCB and 8270 samples:

1. For dry ash samples (including MS/MSD), weigh approximately 30.0 g of sample into a pre-extracted thimble. Do not add sodium sulfate.
2. For paper products, (including MS/MSD) weigh approximately 15.0 g into each of 2 pre-extracted thimbles for a combined total of 30.0 g. Do not add sodium sulfate.
3. For 8270 XAD samples, use the entire contents of the trap. Do not add sodium sulfate.
4. For all other solid samples (including MS/MSD) weigh approximately 30.0 g of sample into a pre-extracted thimble. Add 60 grams of anhydrous Sodium Sulfate and mix well.

H. For batches with sand as the QC Matrix, mix an equal amount of the sand with the sample to ensure that solvent will be able to flow through.

For batches with sodium sulfate as the QC Matrix, mix an equal amount of the sodium sulfate with the sample.

I. Record the sample weight on the Sample Preparation Spiking Sheet. Indicate if there is sample left as described below:

(Y)= There is enough sample left to perform re-extraction
(N)= There is NOT enough sample left to perform re-extraction

J. Zero balance. Weigh leftover sample and its container.

K. Record the gross weight "after" on the Sample Preparation Spiking Sheet.

L. Clean the balance by swiping with a Reagent Alcohol soaked wipe.

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SOXHLET EXTRACTION					
SOP No.	ESP105	Version:	21	Date Revised:	June 8, 2006

M. **Note:** Method 1613 considers liquid samples which contain >1% solids to be solid samples. Therefore a "solid" sample may be pourable with solids >1% or not pourable.

For pourable Method 1613 samples, weigh the sample portion into a beaker. Filter the sample portion. If the filtrate is <100 mL, archive it. If the filtrate is ≥ 100 mL, extract liquid according to the method appropriate SOP for this type of extraction. Place the filtered solids into a thimble which has been pre-Soxhlet extracted with toluene.

For non-pourable Method 1613 samples, weigh the sample portion into a thimble which has been pre-Soxhlet extracted with toluene.

N. Prepare the blank and lab control samples (OPR or LCS/LCSD) by weighing the same amount of the appropriate QC matrix as sample.

O. Prepare the Soxhlet apparatus as follows:

1. Use a 500 mL setup, place ~400 mL of the appropriate solvent (See Sample Size , Solvent Chart) in the flat bottom flask.
2. Add Teflon boiling chips in each flask.
3. Place the color coded label on top of the colored lab tape and then on the boiling flask. Write the solvent used on the flask.
4. Place the thimble holder on top of the flask.

P. Using the forceps place the thimble with the sample into the thimble holder. Be sure to seat the thimble at the bottom of the holder and ensure that the top of the thimble is below the "dump" tube.

NOTE: While the Soxhlet apparatus is sitting on the counter, keep the top capped with aluminum foil to avoid contamination.

Q. Spike the samples according to the document on adding spike standards to samples.

R. After spiking, use forceps to place a glass wool plug on top of the sample in each thimble. Use pre-extracted glasswool.

S. If Soxhlet Dean Stark (SDS) is being used, be sure the stopcock is closed, and fill the reservoir with appropriate solvent.

T. Place the Soxhlet apparatus on the heating mantle and connect the Soxhlet apparatus to the condenser at the ground glass joint. Cap the top of the condenser with aluminum foil.

U. Turn on the heat to a level at which each unit should be cycling at a rate of five times per hour.

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SOXHLET EXTRACTION					
SOP No.	ESP105	Version:	21	Date Revised:	June 8, 2006

V. Complete the Soxhlet extraction runlog.

W. Check the units after cycling has occurred, generally one-half hour (1/2 hour). Each unit should be cycling, have no leaks and have sufficient solvent. Make adjustments as necessary.

X. If adjustments were made, check the units again in one-half hour (1/2) hour to ensure that cycling has occurred. Periodic checks should be made throughout the required time to ensure proper cycling.

Y. Extract for 16 hours.

SAMPLE SIZE SOLVENT CHART

Method	Matrix	Solvent	Sample Size	QC Matrix
8290/1613	Solid, Non GP Sludge, and Non GP Pulp	Toluene	10g dry weight	Sand
8280	Solid	Toluene	2g wet weight	Sand
1613	Biosolid	Toluene	2g dry weight	Sand
8290	GP Pulp	Reagent Alcohol (RA)	10g dry weight	Ground G8 Filters
8290	GP Pulp Sludge	68:32 RA:Toluene	10g dry weight	Ground G8 Filters
HRPCB	Solid	Methlyene Chloride	10g dry weight	Sodium Sulfate
HRPCB	Biosolid	Methylene Chloride	2g dry weight	Sand
LRPCB, 8270	Solid (notXAD)	Methlyene Chloride	30g wet weight	Sodium Sulfate
LRPCB, 8270	Ash	Methlyene Chloride	30g wet weight	Sodium Sulfate
LRPCB, 8270	Paper product	Methlyene Chloride	30g wet weight	Ground G8 Filters
8270	XAD	Methlyene Chloride	entire trap contents	pre-cleaned XAD

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PROCESSING EXTRACTS IN CONCENTRATION/CLEANUP	
SOP No. ESP124 A Version: 6	Date Revised: June 7, 2006

Author: Belinda Royall Effective Date: 06/23/2006

Authorization: _____ Management Date Authorized: 6/22/2006

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I. **PURPOSE:** The purpose of this standard operating procedure (SOP) is to describe the proper order of steps for processing samples through concentration and cleanup.

II. **SCOPE:** These procedures apply to all industrial and environmental samples concentrated by sample preparation laboratory staff.

III. **RESPONSIBILITY:** Authorized sample preparation laboratory staff performing concentration techniques are responsible for following the procedures in this SOP.

IV. **PROCEDURE:**

A. Identify the method and matrix of samples entering the concentration area.

B. Locate the method and matrix in Table 1 or 2 and follow the order of procedures listed.

C. Numbers in brackets are sample dependent. For example, 8290 waters will need the [5, 4A] steps performed only if the sample was filtered and a combine exists. Combines may also be added prior to initial concentration on the rotary evaporator if there is sufficient room in the flask.

D. 1613 Biosolids typically require bulk acid cleanup.

NOTE: Special instructions supersede these procedural guidelines.

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PROCESSING EXTRACTS IN CONCENTRATION/CLEANUP	
SOP No. ESP124 A Version: 6	Date Revised: June 7, 2006

Table 1 – Method 8290 & 1613 Matrix/Procedure Combinations

Matrix	Procedure
Water	2, 3, 4A, [5,4A], 7, [8A, 3, 4A], 8B
Solids (sludges, soils, sediments, etc)	2, 3, 4A, 7, [8A, 3, 4A], 8B
Solids-Extracted with Reagent Alcohol	2, 4C, 3, 7*, [8A, 3, 4A], 8B
Oil	2, 3, 4A, 7, 8A, 3, 4A, 8B
(Food) Oil	8C, 2, 3, 4A, 7, 8A, 3, 4A, 8B
(Fish) Oil	2, 8A (100g), 3, 4A, 8B
Any Matrix- w/ %lipid	4B, 7, (dilute to 25mL), 2, 6 (20mL/5mL), 8A, 3, 4A, 8B
Serum/Fish/Milk/Tissue- w/o % lipids	2, 3, 4A, 7, 8A, 3, 4A, 8B
Chemical	2, 3, 4A, 7, [8A, 3, 4A], 8B
Air- PUFs, Wipes, Filters, etc	2, 3, 4A, 7, 6 (50:50), 8B
Rinses - for air samples	Concentrate to approximately 5 mL.

Key to the procedural steps noted for each method and matrix.

2- Spike after extraction – (ESP008)
3- Add 0.5 mL tridecane – (ESP124)
4A- Concentrate to 0.5mL (tridecane) – (ESP124)
4B- Concentrate to 3mL – (ESP124)
4C- Concentrate to 10mL – (ESP124)
5- Combine – (ESP124)
6- Divide (50:50; 20mL/5mL [process 20mL, 5mL for lipids]) – (ESP010)
7- Solvent exchange – (ESP124)
7*- Solvent exchange with 40mL heptane once-only if sample extracted in Reagent Alcohol – (ESP124)
8A- Bulk acid cleanup - (ESP280)
8B- Default dioxin/furan chromatographic cleanup – (ESP260)
8C- Carbon Column – (ESP298)
8D- Default PCB chromatographic cleanup – (ESP209)
8E- Copper treatment (if at transfer samples contain sulfur) – (ESP277)
8F- Silver Nitrate cleanup (if residue at transfer fluoresces and is ≥ 2mg) – (ESP260B)

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PROCESSING EXTRACTS IN CONCENTRATION/CLEANUP	
SOP No. ESP124 A Version: 6	Date Revised: June 7, 2006

Table 2 –All Other Method/Matrix/Procedure Combinations

Method/Matrix	Procedure
8280 - Water	2, 3, 4A, 5, 4A, 7, [8A, 3, 4A], 8B
8280 - Soil/Solid	2, 3, 4A, 7, [8A, 3, 4A], 8B
M23 - XAD	2, 3, 4A, 7, 6 (50:50), 8B
8270 – MM5	4C (by K/D evaporator), [5, 4C], send to Transfer (If samples will sit for an extended period of time, they must be stored in a cooler.)
LRPCB - Most	2, 4B, 7, 8A, 4B, send to Transfer
LRPCB - Air	2, 4B, 7, 6 (50:50), 8A, 4B, send to Transfer
HRPCB - Most	2, 4B, 7, 8A, 4B, 8D
HRPCB - Air	2, 4B, 7, 6 (50:50), 8A, 4B, 8D
(Fish) Oil	2, 8A (50g), 4B, 8C (HRPCB carbon column)
RapidScreen - All	8-Rapid screen cleanup

Key to the procedural steps noted for each method and matrix.

2- Spike after extraction – (ESP008)
3- Add 0.5 mL tridecane – (ESP124)
4A- Concentrate to 0.5mL (tridecane) – (ESP124)
4B- Concentrate to 3mL – (ESP124)
4C- Concentrate to 10mL – (ESP124)
5- Combine – (ESP124)
6- Divide (50:50; 20mL/5mL [process 20mL, 5mL for lipids]) – (ESP010)
7- Solvent exchange – (ESP124)
7*- Solvent exchange with 40mL heptane once-only if sample extracted in Reagent Alcohol – (ESP124)
8A- Bulk Acid Cleanup – (ESP280)
8B- Default dioxin/furan chromatographic cleanup – (ESP260)
8C- Carbon Column – (ESP298)
8D- Default PCB chromatographic cleanup – (ESP209)
8E- Copper treatment (if at transfer samples contain sulfur) – (ESP277)
8F- Silver Nitrate cleanup (if residue at transfer fluoresces and is ≥ 2mg) – (ESP260B)

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ENVIRONMENTAL SAMPLE LOG-IN				
WAG No.	MGS002	Version: 4	Effective Date:	4/28/2005
Author:	Charles Reed		Date Revised:	March 14, 2005
Authorization:	Management		Date Authorized:	4/12/2005

I. **SCOPE AND APPLICATION:** The purpose of this SOP is to describe the procedure to be followed when conducting sample log-in.

II. **RESPONSIBILITY:** It is the responsibility of the Sample Management Group or designated assistant to conduct sample log-in.

III. **PROCEDURE:**

A. The Sample Log-in process is the process by which received samples are entered into the MILES system. This is the initial step of the production process.

B. To begin the process, choose "**A**" Project Maintenance from the Miles Menu.

C. Select "**A**", ***"Add a Project"*** and enter in password.

D. Supply information in all fields applicable. For any additional information for which there is insufficient field space or no field at all, enter into the receiving remarks field. Save information by using CTRL + W keys simultaneously.

1. **Client Code** – each client is assigned a code that is contained in the MILES database. The first three letters of the client's name may be entered to find the assigned client code in the database.

2. **Cust. PO # --** The client's COC will sometimes contain a purchase order # and should be logged into this field. If no PO# is given, enter "NONE".

3. **Who --** the initials of the sample custodian that is performing the log-in process.

4. **Carrier/Number--** This field is for the carrier by which the samples arrive and the tracking # that is associated with the container delivered. (Ex. Fed Ex 1111 2222 3333)

5. **Date Received** – the date on which the samples actually arrived. *NOTE:* ***Saturday deliveries are normally logged in the following Monday. If so, please log Saturday's date into the Date Received field and notate on the***

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ENVIRONMENTAL SAMPLE LOG-IN	
WAG No. MGS002 Version: 4	Date Revised: March 14, 2005

client's COC that the samples were received on Saturday and logged in on Monday. Include all dates applicable)

6. **Imported** -- Change to "Y" if samples arrived from anywhere outside of the U.S.

7. **Logbook/Page No.** -- Miles will automatically assign an electronic file # for laboratory tracking purposes. No data should be entered in this field.

8. **Samp. Rcvd** -- This is the actual # of samples received minus any duplicates (or back-up) samples. Please match count with the client's COC and actual samples received ***[ex. Sample 1 may have an "A" and "B" bottle, which means lab received 1 sample but it has 2 containers.]***

9. **Temp.** -- The temperature at which the sample management group received the client's sample(s). Temperature is recorded by using the infrared thermometer.

10. **Sample Origin.** -- If sampling site is indicated on COC, enter data in this field.

11. **Name** -- If the client has listed a Project Name/Number for their samples, log this information in this field. **(ex. The Eno River Labs Foundation Project)**

12. **Cooler Seal** -- Some coolers will arrive with a small adhesive strip located along the lid of the cooler which will denote if the cooler itself has been tampered with during shipping. Note "N" or "Y' in this field.

13. **SmpSeals** -- Similar to cooler seals only they are positioned on the actual samples. "N" or "Y"

14. **Intact** -- "N" or "Y" to indicate if either the cooler or sample seals were intact upon delivery.

15. **COC** -- Did the client include a chain of custody with received samples. "N" or "Y".

16. **SamTags** -- Some samples will come in with actual tags normally positioned around the neck of the samples. "N" or "Y"

17. **Num** -- Check "Y" if sample tag #s are listed on the client's COC for samples that arrive with sample tags.

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ENVIRONMENTAL SAMPLE LOG-IN	
WAG No. MGS002 Version: 4	Date Revised: March 14, 2005

18. **Dry Ice** -- If the samples arrived on dry ice, no temp should be entered into the temp field and this should also be noted in the receiving remarks section. Also, delete "C" for Celsius so temp will not display on COC.

19. **Ice** – Were samples preserved on ice. "N" or "Y"

20. **Box** -- A type of container by which the samples were shipped. "N" or "Y"

21. **Ice Chest** – An actual "cooler" is defined by this term. "N" or "Y"

22. **Cooler** – This implies a styrofoam style cooler. "N" or "Y"

23. **SMO** – This field is normally used only for EPA samples.

24. **Ice Pack** – Were samples preserved by ice packs. "N" or "Y"

25. **Container Condition (I) or (D)** – Were the containers intact on delivery or was the container demaged. "N" or "Y"

26. **Field for Receiving Remarks** -- This field is used to notate any additional comments or observations concerning the samples received. Such comments as broken or damaged samples, discrepancy with ID #s listed on COC and samples, high temp, conversations with client, and any other pertinent information. Press *"CTRL + W"* to save data and ESC to Project Maintenance Menu Screen.

E. Now, choose **"C"** for ***Chain of Custody*** and enter password.

F. Select "A" for adding samples to the laboratory chain of custody. Be sure to match ID #s from the client's COC and the samples received before entering data.

NOTE: Subscript letters for the ERL COCs need to be assigned to the ERL virtual logbook when entering sample data for sample ID #s that have "backup" or duplicate containers per sample ID. Also, if MS/MSD are supplied with shipment and indicated on client COC as MS/MSD, MS & MSD subscript letters apply.

1. Enter the client's sample ID # into the first field as it appears on the sample.

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ENVIRONMENTAL SAMPLE LOG-IN	
WAG No. MGS002 Version: 4	Date Revised: March 14, 2005

2. Enter the sample ID # as it appears on the client COC as indicated in the prior field. NOTE: If ID #s match, you can simply enter "=" in this field.

3. Enter the matrix of the sample received. Refer to client's COC when applicable. If a water sample has a 40mL vial, indicate here by typing "40mL."

4. Enter the storage location where the samples will be housed. (Ex. C02 = Cooler 2).

5. The remaining 2 fields are not applicable.

6. Select "E" for edit to make sure all information has been entered correctly. If not, changes are made on this screen.

7. Once editing is complete, select "P" for Print, Page Down, and select applicable printer.

8. Lastly, select "L" for Labels, "1" for Output Device, make sure all applicable ID #s are checked, and press "F10" to print labels. These labels are matched to samples with corresponding ID #s and placed in a storage box. Place project # label on outside of box and place inside designated storage location.

G. The sample custodian's signature must be included on each page of the ERL COC and the client's COC must include signature and time & date of sample receipt.

H. Make (1) copy of the client COC and (2) copies of the laboratory COC.

I. Place copies of the client's and laboratory's COCs in the project folder, place an ERL copy and the client original COC copy in the file cabinet, and the original laboratory COC, will travel with the samples. Also, be aware that some clients may want their original COC returned w/ their data packages. In this case, you will place the original in the project folder instead of a copy.

Original stamped in blue:

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DATA PACKAGE ASSEMBLY AND SHIPPING	
SOP No. MRG001 Version: 3	Date Revised: August 17, 2006

Author: Norman Hoffa Effective Date: 09/28/2006

Authorization: _____ Date Authorized: 9/25/06
Management

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I. **PURPOSE:** This SOP provides for the consistent assembly, processing and shipping of analytical Data Deliverables that meet all regulatory requirements and the unique requirements and expectations of our clients.

II. **SCOPE:** This SOP applies to all environmental data deliverable packages prepared and shipped to clients of Eno River Labs, LLC.

III. **RESPONSIBILITY:** All personnel, regular or temporary, assigned to the Shipping Department are responsible to follow the procedures of this SOP to ensure that quality data deliverables are created and shipped.

IV. **PROCEDURE:**

A. Obtain a Project from the "Ready to Ship" shelf.

B. Check the Case Narrative for the proper signature by the Data Review Chemist.

IF NOT SIGNED, RETURN TO DATA REVIEW

C. Verify the Data Deliverable requirements for each Project to be shipped.

1. Review Quote, Project, Shipping or Special Instructions attached to front of Project Folder for any Unusual or Client Specified Report requirements.

2. Print out the "Shipping Information" for this Project.

a) At the Main Menu in MILES, select F (Shipping and Archiving)

b) Select Sample Shipment Update/Inquiry

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c) Enter Project information:

Project #:
Output Device: 2
Ship Date: (check current date)
Shipped this date: M (to select 'Marked for Shipment')
Transfer to Archive: Y
Password: (see Shipping Representative)
Print 2nd page: N
Tag all samples and check to see if they are currently "in Shipping" by looking for SH in the AR column. IF PM is shown instead, call the Project Manager assigned to this Project to confirm that all samples are ready to ship.
<F10>
Enter your UserName, reason: SHIPPED, and your User Password to print out the "Shipping Information"

d) Review the "Shipping Information" report:

e) Confirm correct Project # and Client Name

f) Confirm "Due Date"

- If PAST DUE or Due TODAY, fax or e-mail the Report Summary and any Special Reports (Biosolids Report or Drinking Water form) to the Client

3. Review the "Sample Tracking And Project Management Form" in the Document Control section of the Data Package. [Appendix 2]

a) Check for "Special Instructions"

b) Confirm Reporting Format and Requirements

(1) Report Option 0 = Results only

(a) Sample Summary Report

(b) Special Forms (State Drinking Water forms for example)

(c) Case Narrative

(d) Chain of Custody forms

(2) Report Option I = Summary Data Report

(a) Sample Summary Report

(b) Special Forms (State Drinking Water forms for example)

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(c) Case Narrative

(d) Document Control

(e) Sample Data Result Summary

(f) Sample Results Top Sheets

(g) ICAL/ConCal Files

(h) NO Raw Data and NO Chromatograms

(3) Report Option II = Full Data Package

(a) All of the above PLUS Raw Data and Chromatograms

(4) Report Option III = Full CLP-Like Data Package

(a) Includes COMPLETE, including Ending Calibrations, Calibration files

c) Special Requirements and/or Special Instructions specified by the client:

(1) Paper Hard Copy deliverable required

(2) Multiple copies of the Data Deliverable required

(3) Special/Alternate Shipping Addresses

4. Check BOTH the "Shipping Information" and "Sample Tracking and Project Management Form" for an EDD (Electronic Data Deliverable) requirement

a) If an EDD is required, is it attached to the Data Package?

(1) If YES, continue processing.

(2) IF NO, RETURN DATA PACKAGE TO DATA REVIEW FOR THE EDD

D. Assemble the final Data Deliverable package in the following order, as applicable. Insert Section Cover Sheets, as required.

1. Sample Summary Report [Copy onto Eno River Labs letterhead paper.]
2. Special Reports (i.e. Biosolids Report or Drinking Water Forms)
3. Case Narrative
4. Data Flags
5. List of Certifications and Accreditations
6. QC Results Summary

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7. Toxic Equivalency (TEQ) Reports
8. OPR
9. Blank
10. Sample # 1, #2, #3, etc.
11. MS
12. MSD
13. LCS
14. LCSD
15. Document Control
16. Attach the "Project Data" page from MILES which shows the client's name and address. This page is in MILES under the "List Project(s) and Samples menu item.

NOTE: Calibration data files will be separate PDF files copied to the Project Folder.

E. Create the Client copy/copies of the final Data Deliverable Report.

1. DEFAULT Data Deliverable Report will be a *.PDF file copied to a CD-Rom disc. NOTE: A paper Hard Copy of the Sample Summary Report and any Special Forms (i.e. Biosolids Report, Drinking Water Forms, etc.) WILL be included.
2. OPTIONAL Data Deliverable Report will be a PAPER Hard Copy.
3. Multiple copies of the Data Deliverable, in any format, are OPTIONAL.

NOTE: THE DEFAULT DATA DELIVERABLE PROVIDED TO ALL CLIENTS WILL BE A *.PDF FILE ON A CD-ROM DISC.

F. Default Data Deliverable Processing

1. On the PC Workstation (PC147), double-click on the "Project Files" short-cut icon.
   a) From the "File" drop-down menu, select "New" and then "Folder." In the New Folder text box, enter the Project Number (i.e. 66230, 66230r1 or 66230 A-B), as appropriate, ENTER.
   b) ENTER to open the file.
   c) PASTE a copy of the "Calibration Files" folder. Key F5 to position folder in the Project Folder.

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d) Copy the required Calibration Files for the Project into this Calibration Folder.

e) CLOSE all.

2. Scanning the Project.

a) First, copy the Sample Summary Report page(s) onto Eno River Labs, LLC letterhead:

(1) Select COPY;

(2) Select BYPASS paper option (make sure Bypass tray on the side of the copier contains ERL letterhead);

(3) Place the Sample Summary Report page(s) in the top feed tray and press START;

(4) Place the Sample Summary Report pages(s), in the proper order, on top of the Project.

b) You should now be ready to SCAN the final Data Deliverable package and create the final (Project #).PDF file using one of the two designated copier/scanner machines.

(1) On the copier/scanner select SCANNER; then highlight the "PC147" file destination on the small display, center front of the copier. [NOTE: The machines work best if NO MORE THAN 50 pages are loaded at one time. Highlight the "Original Settings" in lower left then select "Batch" to allow scanning of multiple parts of large projects.]

(2) Place the first set of documents in the "document feed" tray. ALWAYS START WITH PAGE 1 ON TOP; SCAN FROM PAGE 1 TO THE END

(3) Press the large green "Start" button at the bottom right.

(4) For large projects, load second set of documents and Repeat (3) above. Continue and repeat until the entire Project has been scanned. Press the "#" key, lower right. This moves the file to the PC workstation for continued processing.

3. Process the *.PDF File.

a) Move to the PC workstation.

b) Select and Double-click the "Shortcut to Scanned Files" icon.

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c) In the "Scanned Files" window, the most recently scanned file should be at the top of the files list. Highlight and double-click the first file listed to verify that it is the correct Project. This will open the file in Acrobat.

4. Enter number of pages in the Case Narrative

a) Using the "→" key, page into the document until you find "The total number of pages in this data package is:_____" (Usually, just below the signature on the 3rd or 4th page of the Case Narrative.)

b) Select the "Text Field Tool" from the toolbar.

c) Double click on the page of the Case Narrative to open a red Text Field box.

d) Click on the "Calculate" tab from the drop-down menu.

e) Click "Simplified Field Notation" and then the "Edit" button.

f) Enter the number of pages in the Project; click "OK" and "Close".

g) Using the cursor, position the red Text Field box so that the number is on the _____ line.

h) Select the "Hand Tool" from the toolbar and continue with bookmarking the Project.

5. Bookmarking the *.PDF File. [Still on the PC Workstation]

a) Beginning at Page 1, the Sample Summary Report, press "Ctrl+B" on the keyboard. This will open the Bookmarking window to the left of the document and allow you to enter the page title: "Sample Summary Report."

b) Click the "Pages" tab to the left of the window. This will switch from the Bookmarks window to a window displaying "thumbnail" images of the next several pages of the document. Click on the image of the Case Narrative page and it should appear on the right side of the window. Do "Ctrl+B" and enter the title Case Narrative for the Bookmark.

c) Alternating between the Pages and Bookmarks windows, continue to work through the document, using the Table of Contents worksheet and mark and title the Bookmarks that apply to this project as in F above. NOTE: Page through the entire document as the Bookmarks are added and scan for empty or damaged (crooked) pages.

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6. Paginating the *.PDF File. [Still on the PC Workstation]
   a) At the top tool bar, select (highlight) Document and choose the "Add Headers & Footers" option.
   b) In the Add Headers & Footers window, make the following selections:
      (1) In the "Insert Page Numbers" section, select the "Style" "1 of n" and click the "Insert" button.
      (2) In the "Insert Custom Text" section, type the method designation for the project (ie: EPA 8290, EPA 1613B, etc.) and click the "insert" button.
      (3) In the "Header" section, at the top, click on the third "Align" button to move the page numbers and method to the top right of the page.
      (4) In the "Page Options" section, adjust the Top Margin to 0.4 and the Right Margin to 0.5 inches.
      (5) Click "OK" at the bottom of the window and wait for Acrobat to paginate and number the pages.
7. Once verified, select "Save As" from the "File" menu drop-down list. Type the Project Number and hit "Enter" to save the file with the new name.
8. CLOSE file.
9. Minimize/Close Acrobat.
10. Delete the original numbered pdf file (i.e. 0123456789.pdf).
11. MOVE the Project numbered PDF file to the appropriate Project Folder.
12. CLOSE the Scanned Files folder.
13. Copy EDD file(s) from the diskette in the "A" drive to the Project Folder.
14. Copying the Project Folder to a CD-ROM Disc.
    a) OPEN the NTI CD-Maker 2000 Professional application.
    b) Select "Data CD" on the first window.
    c) Step 1 – Locate the Project folder to copy.
    d) Highlight "Local Disk (C:).
    e) In the window to the right, double-click on the "Shipping" folder; then double-click on "Scanned Files."

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f) Scroll down to and highlight the Project Number Folder to copy.

g) Placing the cursor on the highlighted folder, hold down on the left mouse button and drag a copy of the folder name to the bottom window.

h) Click on "Step 2" button.

i) When the CD Drive (D:) opens, insert a blank CD-ROM disc and close the drive tray.

j) In the window that opens, select "Test & Write" and click on "Start".

k) When the CD is recorded successfully, drive (D:) will open automatically. Click on "OK" in the pop-up window and close drive (D:) again.

l) Close the application by clicking on the "X" in the upper right corner of the screen.

m) At the "Save changes to Untitled" prompt, click "NO".

15. Verify that the Data PDF file has copied to the CD-ROM and that the "Bookmarks" are working properly ON A DIFFERENT COMPUTER WORKSTATION.

IF THE FILE WON'T OPEN, GO BACK TO (4) ABOVE AND REPEAT THE STEPS TO COPY THE PDF FILE TO CD-ROM.

a) Click on the "Bookmarks" tab on the left and test the bookmarks listed to verify that the bookmarks are working properly.

IF THE BOOKMARKS DO NOT WORK PROPERLY, GO BACK TO (3) ABOVE AND REPEAT STEPS (3) AND (4).

b) If the file opens and the bookmarks are working properly, CLOSE the application by clicking on the "X" in the upper right corner.

c) Remove the CD-ROM disc from drive D: and place CD in a disc holder.

d) Remove the EDD diskette from drive A: and place with the archive copy of the Project.

16. Prepare and apply Disc Label.

a) At the computer Main Screen, OPEN the SureThing CD Labeler application.

The program will display the last label used.

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b) Click on File in the upper left corner of the screen and from the "drop-down" menu choose "Open".

c) The "Open" window will open and display the labels available for use by Client Name. If a new label is needed, select the FORMAT file.

d) By highlighting the text in the 'gray outlined' boxes, you can change the text as needed.

(1) First, change the date to today's date.

(2) Second, replace "Company Name" with the Client's Name.

(3) Third, in the "Project #(s):" box, highlight the number and change it to the Project Number to be shipped. Also, list EDD and Calibration Data.

(4) Fourth, in the right-hand box, enter the Client's Project Name or Number, if any. If the client has not provided a project name or number, the box can be left empty OR you may insert "Dioxin Testing" or "PCB Testing" as appropriate.

e) When the label on the screen contains the corrected information, click on "Print" in the upper right of the screen.

f) The CD Label (1 of 1) window should appear.

(1) Make sure the "Printer:" is the Canon S820 on LPT1:

(2) Choose the number of copies to print (1 or 2).

(3) Click "OK"

(4) When label has printed, check the label to verify that it is correct.

g) To SAVE this new label design, click on "File" in the upper left corner and Select "Save As"

h) Enter the Client Name as the new file name and click "Save"

i) CLOSE the application by clicking the "X" in the upper right corner.

j) At the "Do you wish to save changes...?" prompt, click "Yes" to save the most current copy of the label.

17. Using the Label Application tool provided, carefully transfer the Label to the top of the CD-ROM disc. Return CD to a shipping case/envelope.

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DATA PACKAGE ASSEMBLY AND SHIPPING	
SOP No. MRG001 Version: 3	Date Revised: August 17, 2006

18. Rubber band the original documents for the Project together with the Project Folder and move to the Archiving cubicle to be packaged and Archived.

19. Place the Client's CD (with EDD (if any), the original Sample Summary Report (save copy for archiving) and any Paper Hard Copy reports (Biosolids Report, Drinking Water forms, etc.) together and move to the Shipping table.

20. Using the Fed Ex computer workstation enter the following:

    a) In the "Recipient Information" window, enter the Client Code in the Recipient ID box. TAB or ENTER.

    b) Verify the Recipient Information with the information on the Shipping Information Report. Verify that the Contact Name, Company Name, Address, City, State, ZIP and Phone Numbers are correct. Edit/Modify as needed.

    c) In the "Package and Shipment Details" window, enter:

        (1) Number of Packages

        (2) Package Weight (enter 1 for FedEx Envelopes with a Default Data Package)

        (3) Service Type. Enter the service needed to ensure the most appropriate delivery date. (Most commonly: Overnight, 2nd Day or Express Saver.)

        (4) Package Type (FedEx Envelope, FedEx Pak, FedEx Box or OTHER)

    d) In the "Billing Details" window, enter:

        (1) Bill shipment to: (Usually "Sender", if "Recipient" is selected, you must enter the recipient's FedEx Account number)

        (2) Department notes: enter 120

        (3) Customer Reference: enter Project Number

    e) Review and confirm that ALL information is complete and accurate; then hit F10. The label printer should print out shipping labels for the package.

    f) Place the small top label on the Shipping Information Report.

    g) Place the larger shipping label on the appropriate size FedEx (or OTHER) container.

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DATA PACKAGE ASSEMBLY AND SHIPPING			
SOP No.	MRG001	Version: 3	Date Revised: August 17, 2006

h) BEFORE SEALING THE FEDEX PACKAGE, A SECOND PERSON SHOULD PERFORM THE FINAL DATA QUALITY CONTROL CHECK, AS FOLLOWS:

i) THE "SAMPLE SUMMARY REPORT" should be verified against the Shipping Information Report to confirm the Project Number.

j) THE CD-ROM DISK should be verified to ensure that the (1) label identifies the proper Project Number, Company Name and Date; (2) the CD should be tested to ensure that is contains the correct PDF file, the PDF file opens and is the correct Project and the Bookmarks work properly.

k) If any EDDs are required, they should also be verified on the CD-Rom.

l) Once all have been QC checked, place the CD case/envelope into a padded brown envelope and seal.

m) Add a label: CD-ROM DATA DELIVERABLE ENCLOSED

n) Insert the CD envelope, the Sample Summary Report and any Special Reports into the shipping container and seal.

o) Take the sealed Data Deliverable Package back to the Shipping/Receiving Section and place in the "OUTBOUND" FedEx box for pick-up. {NOTE: It may sometimes be necessary to deliver an outbound package direct to the FedEx Shipping Office to ensure Overnight Delivery.}

G. OPTIONAL PAPER HARD COPY Data Deliverable Processing

1. Follow A through E above.
2. COPY the entire data package. *Set Copier to add page numbers.
3. Make one copy for each Shipping Address.
4. Keep the ORIGINAL documents for Archiving.
5. Retain the original Case Narrative top sheet (with color logo) from the original copy and exchange it with the copy in the Client's package.
6. Assemble the Client's copy/copies, the EDD diskette(s) (if any) and move to the Shipping table.
7. Rubber band the original documents for the Project together with the Project Folder and move to the Archiving cubicle to be packaged and Archived.
8. Ship as in D.7 above.

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DATA PACKAGE ASSEMBLY AND SHIPPING	
SOP No. MRG001 Version: 3	Date Revised: August 17, 2006

H. OPTIONAL Data Deliverable Processing for Contract Laboratory Program (CLP) and EPA Projects.

1. Assemble Data Package according to the DC-2 form.
2. Paginate the entire project continuously.
3. Fill out the DC-2 Form as required. [Appendix 4a/b/c]
4. Copy or Scan, as indicated in the Project Instructions, project information and communication log.

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Analyte	Concentration (ng/ml)
3,3',4,4'-PCB	2.5
3,3',4,4',5-PCB	2.5
3,3',4,4',5,5'-PCB	2.5
2,3,7,8-TCDF	0.5
1,2,3,7,8-PeCDF	0.5
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	5
2,3,4,6,7,8-HxCDF	2.5
1,2,3,7,8,9-HxCDF	2.5
1,2,3,4,6,7,8-HpCDF	2.5
1,2,3,4,7,8,9-HpCDF	2.5
OCDF	2.5
2,3,7,8-TCDD	0.5
1,2,3,7,8-PeCDD	0.5
1,2,3,4,7,8-HxCDD	5
1,2,3,7,8,9-HxCDD	2.5
1,2,3,4,6,7,8-HpCDD	2.5
OCDD	2.5
13C-3,3',4,4'-PCB	100
13C-3,3',4,4',5-PCB	100
13C-3,3',4,4',5,5'-PCB	100
13C-2,3,7,8-TCDF	100
13C-1,2,3,7,8-PeCDF	100
13C-2,3,4,7,8-PeCDF	100
13C-2,3,7,8-TCDD	100
13C-1,2,3,7,8-PeCDD	100
13C-1,2,3,7,8,9-HxCDD	100
13C-1,2,3,4,6,7,8-HpCDD	100
13C-OCDD	100
13C-1,2,3,4-TCDD	100

APPENDIX F

GANNETT FLEMING SOPs

STANDARD OPERATING PROCEDURE (SOP)
FIELD DOCUMENTATION – LOG BOOK

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 3

5.0 PROCEDURES 3

5.1 Field Book Set Up 4

5.2 Daily Entries 4

5.3 Post Field Work 5

6.0 REFERENCES 3

7.0 ATTACHMENTS 3

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for documenting observations made and data collected in the field. **A BOUND LOG BOOK IS THE LEGAL DOCUMENT FOR THE FIELDWORK PERFORMED AT A SITE. ALWAYS REMEMBER THAT YOUR NOTES MAY BE USED IN LITIGATION.**

2.0 SCOPE

This SOP provides accepted procedures for recording information collected during site investigations into bound log books. Other formats (e.g., well sampling forms, treatment system monitoring forms, well logs) may be used on a site-specific basis; however, the general procedures described are common to all field documentation efforts.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and is responsible for reviewing the field books used by the field crew on a periodic basis.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting field work.

Field Operations Leader – Is responsible for assuring that the field documentation is completed correctly.

5.0 PROCEDURES

5.1 Field Book Set Up

- Use a new, BOUND log book for each project number. Work performed under various sub-jobs in a single project number's logbook shall be at the Project Manager's discretion.
- Label the logbook cover and binding with the project name and number. Label inside cover with site information (name, address, contact(s), phone numbers, etc). This will serve as a convenient reference when performing fieldwork.
- Number and date EACH page of the log book.
- ALL entries must be made in ink.
- Record field book entries as the events occur during the day, not at the end of the day.
- Keep notes legible so that others are able to read the logbook.
- Complete each day's notes with your signature.
- Try to maximize use of each line. Cross out gaps and portions of blank pages so that notes cannot be altered.

5.2 Daily Entries

- Date the beginning of each day's notes, as well as each page used, and use MILITARY time for each entry.
- On the first day of work, reference the Work Plan/Scope of Work by title and date, and the work task(s) to be performed.
- Items that must be included in a log book:
  1. Times of arrival and departure for ALL site personnel (whether GF, client, contractor, regulatory, etc.);
  2. Weather conditions;
  3. Documentation that field instruments were calibrated. Include a list of equipment used at the site (GF's and contractors) at the beginning of each day's entry;
  4. Description of daily activities in chronological order;

5. Locations of structures, USTs, ASTs, utilities, samples collected, and any other observations that are pertinent to the task at hand;
6. Summaries of conversations with client, contractor, and/or regulatory agencies (changes to the scope of work, health and safety issues, and cost/payment issues are especially important); and
7. Notations that photos were taken and/or other important events.

5.3 Post Field Work

- Return the log book (HASP, photo disks, drawings, etc.) to the Field Operations Manager/Project Manager at the completion of fieldwork.
- Following review by the Field Operations Manager/Project Manager, return the field book to the appropriate project central file.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
SAMPLE HANDLING AND
CHAIN-OF-CUSTODY
DOCUMENTATION PROCEDURES FOR
MICHIGAN DEPARTMENT
OF ENVIRONMENTAL QUALITY PROJECTS

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 3

5.0 PROCEDURES 4

5.1 Pre Sampling Coordination with MDEQ Lab 4

5.2 Sample Documentation Procedures 5

5.3 Sample Delivery to the MDEQ Lab 5

6.0 REFERENCES 6

7.0 ATTACHMENTS 6

1.0 PURPOSE

The purpose of this SOP is to provide procedures for submitting environmental samples collected by Gannett Fleming for analysis by the Michigan Department of Environmental Quality (MDEQ) Laboratory (MDEQ Lab) or a MDEQ-approved contract laboratory.

2.0 SCOPE

This SOP summarizes MDEQ Lab-designated procedures and forms for scheduling analyses, ordering sample vials, and properly documenting sample transportation and delivery using chain of custody (COC) protocol to the MDEQ Lab. Copies of the necessary forms are included in Section 7 of this SOP. **PLEASE NOTE THAT MDEQ LAB FORMS AND PROCEDURES CHANGE FREQUENTLY. ALWAYS CHECK AND CONFIRM THAT YOU HAVE THE CURRENT VERSIONS OF FORMS AND PROCEDURES PRIOR TO ANY SAMPLING EVENT.**

COC formats other than the MDEQ Lab's are frequently used on Gannett Fleming projects; however many of the general procedures described are common to all COC documentation efforts. Proper documentation is critical to assure the quality, validity, and authenticity of data obtained from environmental samples. **IMPROPER SAMPLE DOCUMENTATION MAY RESULT IN UNUSABLE DATA.**

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for obtaining MDEQ project numbers as designated in this SOP and for ensuring that appropriate COC procedures are established at the initiation of a sampling program.

Field Technical Staff – Are responsible for following the procedures listed in this SOP.

Field Operations Leader – Is responsible for assuring that the COC field documentation is completed correctly.

5.0 PROCEDURES

5.1 Pre-Sampling Coordination with MDEQ Lab

- Review the project-specific Field Sampling Plan (FSP) and confirm the anticipated number of samples, sample matrices, sample preservation and analytical methods requirements for the sampling event.
- Complete the MDEQ Lab Sample Schedule Form (Section 7):
  - Obtain the information required to complete the top part of the form (DEQ Information) from the MDEQ Project Manager.
  - Complete the Contractor/LOE Information section as directed by the Gannett Fleming Project Manager.
  - Complete the Sample Collection Information section based on the anticipated project schedule. The MDEQ Lab requests at least two weeks lead time prior to sample submittal. Contact the MDEQ lab directly if a more rapid turnaround is required.
  - Complete the bottom section (Requested Test and Sample Number Information) as outlined in the FSP.
  - Deliver the completed form via e-mail to deq-env-labschedule@michigan.gov and disregard the addressees listed at the bottom of the form.
- Complete the Sample Bottle and Preservative Request Form (Section7)
  - Calculate the number of containers required to complete the sampling event and fill in the blanks as appropriate. Be sure to include sample labels and preservative in the Other Requested Supply box.
  - Include Gannett Fleming's shipping account (e.g., Fed Ex) and project number unless the containers will be picked up at the MDEQ Lab.
  - Fax the completed (hard copy) form to the number listed at the top of the page.
  - The MDEQ Lab requests at least two weeks lead time to prepare and deliver a container order. If quicker order processing is required, contact the MDEQ Lab directly and include the required date on the fax cover sheet.

5.2 Sample Documentation Procedures

- Select the appropriate Analysis Request Sheet based on the sample matrix (water, sediment/soil/solids, etc.). Each sample matrix will require a separate sheet. Copies of the sheets are included in Section 7 of this SOP.
- Complete the upper part of the form with the same information that was included on the Sample Schedule Form.
- Up to ten samples can be listed on each sheet on lines 1 to 10. Use multiple sheets if more than ten samples are collected during a sampling event. **ALWAYS USE INK TO COMPLETE THE ANALYSIS REQUEST SHEETS.**
- Circle the sample number at the bottom of the sheet next to the appropriate analysis or analyses required for that sample. Repeat for each sample on that sheet.
- Complete the safety information on page 2 of the sheet. For water samples, be sure to include the appropriate preservative tracking numbers at the bottom of page 2. For soil VOC samples, add the MeOH Preservative Tracking Number at the bottom of page 1.
- Complete the COC information at the bottom of each sheet. If a person other than the sampler will deliver the samples to the MDEQ Lab, then complete the COC information included at the bottom of each sheet. Include the date and time of the sample custody transfer.

5.3 Sample Delivery to the MDEQ Lab

The MDEQ Lab accepts samples either by overnight carrier (e.g., Fed Ex) or by direct drop off at the lab.

To ship samples by overnight carrier:

- Include Gannett Fleming's shipping account (e.g., Fed Ex) and project number. Please remember that Saturday deliveries are not accepted. Be sure to sign the COC.

To drop off samples at the MDEQ Lab:

- Confirm your delivery schedule with the MDEQ Lab (Sample Receiving: 517-335-9800) 24 hours prior to sample drop off. Drop off times are Monday through Friday from 7:30 AM to 5:00 PM; no holidays or weekend drop offs are accepted. After hours sample drop off is possible if arrangements are made prior to arrival. The MDEQ Lab is located at 3350 N. Martin Luther King Blvd., Lansing, MI 48906.
- You must have your Gannett Fleming picture ID card and driver license to drop off samples at the MDEQ Lab.
- Complete the sample check-in procedures with the MDEQ Lab staff. Both the person delivering the samples and the MDEQ Lab staff must sign the COC. Include the date and time of sample custody transfers to the MDEQ Lab. Ask for a copy of the completed COCs for all samples.
- Give the copies to the Field Operations Leader who will review the sheets for completeness, etc. The copies should then be placed in the project file.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

MDEQ Sample Scheduling Form [Rev.03/03/2004 (2 pages)]

MDEQ Sample Bottle and Preservation Request Form [Rev. August 2005 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Water [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Wastewater [Rev.11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – W-BacT [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Low-Level Mercury Water [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Sediment/Soil/Solids [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Organic/Oil/Coal [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – ASTM Leach/TCLP/SPLP [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Air Canister Volatiles [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Aldehyde Cartridge [Rev. 11/24/2004 (2 pages)]

MDEQ Analysis Request Sheet (COC) – Surface Coatings and Inks [Rev. 11/24/2004 (2 pages)]

ATTACHMENTS

MDEQ ENVIRONMENTAL LABORATORY SAMPLE SCHEDULING FORM

Instructions on page 2

DEQ Information

Site Code #: (If none specified, Laboratory will assign permanent site code)					
Site Name:	AY:	INDEX:	PCA:	Proj:	Ph:
Program or Section Name:	Circle one:	1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal		
DEQ Project Manager Name:		E-Mail Address: @mi.gov			
Division:	District / Office:		Telephone Number: ( ) - ext:		

Report Mailing Address:	Attention:	Invoice Address:	Attention:
	Street:		Street:
	P.O. Box:		P.O. Box:
	City, State, Zip:		City, State, Zip:

Designated Overflow Laboratory:	**Accept HT Code?** ☐ Yes ☐ No

Contractor / LOE Information

Firm Name:	Telephone Number: ( ) - ext:
Contractor E-Mail Address for final reports: 1. 2.	Contact Person:

Sample Collection Information

Anticipated Delivery Week: **Anticipated Delivery Date:**	**Sample Hazard (if known):** None

Requested Test and Sample Number Information

Matrix	Test(s) Name (see next page for available tests)	# of Samples	Matrix	Test(s) Name (see next page for available tests)	# of Samples
(EXAMPLE) Water	(EXAMPLE) pH, VOC, BOD, MI10 Metals, PCB	(EXAMPLE) 12	(EXAMPLE) Sediment	(EXAMPLE) MI10 Metals, PCB, KJEL N, Tot. P	(EXAMPLE) 7
Matrix			Matrix		
Matrix			Matrix		
Matrix			Matrix		
Matrix			Matrix		

ADDITIONAL INFORMATION:

NOTE: A hard copy report will be sent ONLY to the MDEQ Project Manager. All other copies will be e-mailed to the e-mail addresses entered above.

SAVE THIS FILE AND E-MAIL COMPLETED FORM TO DULIBANR@michigan.gov AND COPY TO FELDPAUB@michigan.gov

(For assistance call (517) 335-9800)

INSTUCTIONS:

1. **SITE CODE ID**: A site code ID is required. Each division/program may create a unique ID up to 8 alpha/numeric characters in length. It must be unique! i.e....RRD001BC (for RRD, site 001, Bay City). The client information provided will be assigned to each site code in the database. The laboratory will assign a site code if not provided on the sample request paperwork.
2. **DEQ INFORMATION:** If you are an LOE filling out this form, you must obtain the information from the MDEQ Project Manager. They will provide the Site Code ID, AY, INDEX, PCA, Proj. & Ph codes.
3. **INVOICE ADDRESS:** This is required. If all invoices are to be sent to your division Administrative staff, enter Admin. Staff name, Division Initials, & Constitution Hall (i.e. Karen Kalinowski, WD, CH. We will complete the invoice address information.

Highlighted tests must be scheduled on Sample Scheduling Form

WATER MATRIX – AVAILABLE TESTS

ORGANIC	GENERAL CHEMISTRY	INORGANIC
VOA VOLATILES (624/8260) -Full List -BTEX/MTBE only ON PESTICIDES/PCBS 608/8081/8082) -Pesticides & PCBs -Pesticides only -PCBs only ****** NPDES ONLY****** -Scan 3 (NPDES Only) BNA BASE NEUTRAL & ACIDS (625/8270) -BNAcids -PNAs only -BNs only SPECIAL REQUESTS Library Search Volatiles Semivolatiles Other (Specify)	DO -Diss Oxygen GN -NO2, o-Phos -Residue SS -BOD Tot 5 day -BOD Carb 5 day CA -Chlorophyll GA -COD -TOC -NO3 + NO2, NH3 -KJEL N, Tot P GB -Total CN -Amenable CN GG -Phenolics OG -Oil & Grease	MA -Total Metals MAD - Diss-Field Filtered **ICP-MS (200.8/6020)** Cd Cr Cu Ni Pb Zn As Ba Se Ag Co Mn Sb Sr Tl Al Be Mo Ti V **ICP (200.7/6010)** B Fe Li **Flame AA (200/7000 Series)** Ca Mg Na K Hardness **Cold Vapor AA (245.1/7470/7471)** Hg MN pH, Conductance Cl, SO_4, Total Alk HCO_3 / CO_3 Cr^{+6} -Low Level Hg

SEDIMENT MATRIX – AVAILABLE TESTS

VOA VOLATILES *(MeOH/8260) -Full List -BTEX/MTBE only OS PESTICIDES/PCBS (8081/8082) - Pesticides & PCBs -Pesticides only -PCBs only BNA BASE NEUTRAL & ACIDS (8270) - BNAs -PNAs only -BNs only	SPECIAL REQUESTS Library Search (Qualitative) Volatiles Semivolatiles Fingerprint GS GENERAL CHEMISTRY - COD -KJEL N, Tot. P -Phenolics -Total CN - % Total Solids	**ICP (6010)** Cd Cr Cu Ni Pb Zn Ba Co Mn Fe Li Al Be Mo Sr Ti V Pb (both fine & coarse) **Graphite Furnace AA** As Ag Se Tl **Flame AA (7000 Series)** Ca Mg Na K **Cold Vapor AA** Hg -% Total Solids

Oil / PRODUCT

OL VOLATILES (8260) -Volatile Full List -BTEX/MTBE only PESTICIDES/PCBS (8081/8082) -Pesticides & PCBs -Pesticides only - PCBs only	BASE NEUTRAL & ACIDS (8270) -BNAs -PNAs only -BNs only ****SPECIAL REQUESTS**** Library Search (Qualitative) Volatiles Semivolatiles HW -Flashpoint -Solubility	MO (METALS-OIL) **ICP (6010)** Cd Cr Cu Ni Pb Zn Ba Co Mn Fe Li Al Be Mo Ti V **Cold Vapor AA** Hg – Mercury **Hydride AA (7061)** As - Arsenic -% Cl -BTU -% Sulfur -% Ash -% Moisture

MDEQ ENVIRONMENTAL LABORATORY

Sample Bottle and Preservative Request Form

Contact : Barry Baker (bakerbg@michigan.gov)
Phone (517)335-9686
Fax (517)335-9551

Requested by:	*Phone Number:*	*Date(s) Scheduled at MDEQ Laboratory*	TODAY'S DATE
E-mail			
Division/District or Company name	*Site or Project*	PLEASE ALLOW AT LEAST 2 WEEKS FOR PREPARATION	PICK-UP DATE

	Bottle Code	Parameter Group	Plastic Containers: 500 mL White	250 mL White	Avail CN Kits[1]	250 mL Brown	Glass Containers: 40 mL Septum Vial	MeOH Kit[1]	1000 mL Amber	250 mL (8oz) Wide	250 mL Narrow	250 mL SC CAP	Preservatives	Check if Needed
WATER	DO	Dissolved Oxygen											DO KIT[3]	
	GN	Gen Chem/Neutral Ortho-phos Nitrite, BOD, Silica, Residues												
	GA	Gen Chem/Acidic COD, TOC, Ammonia, Kjel N, Tot Phos , Nitrate + Nitrite											H2SO4	
	GG	Gen Chem/ Phenolics-Glass											H2SO4	
	GCN	Available CN											AVAIL.CN KIT[5]	
	GB	Gen Chem/Basic Total & Amenable Cyanide											10 N NaOH	
	S	Sulfide											1 M ZnAC 10 N NaOH	
	CA	Chlorophyll a											1% MgCO3	
	MA	Metals/Total Acidic Cd,Cr,Cu,Pb,Zn,As,Ba,Se,Ag,Hg, Ni,Co,Mn,Sb,Sr,Tl,Al,Be,Mo,Ti,V. B,Fe,Li,Ca,Mg,Na,K,											1:1 HNO3	
	MAD	Metals/Acidic Dissolved Parameter List Same as MA, Field Filtered											1:1 HNO3	
	MD	Metals/Dissolved Parameter List Same as MA, Lab Filtered												
	MN	Minerals/Neutral pH, Conduct., Cr+6, Chloride, Sulfate, Alk , Carbonate, Bicarbonate												
	OG	Oil and Grease	**OG samples require 2 x 250mL jars per sample**										H2SO4	
	VOA	Volatiles 8260/624	**VOA requires 3 vials[4]**										1:1 HCL	
	VOA	Trip blanks	**# of Trip blanks needed**											
	ON	PCB/Pesticides 608/8081/8082	**ON samples require 2 ambers[2]**											
	BNA	BNA/PNA/BN/Acids 8270/625	**BNA samples require 2 ambers[2]**											
SOIL	MS	Metals List Same as MA w/out B, Sb												
	GS	Gen Chem/ TP, Kjel-N,Phenolics, COD, Total & Avail Cyanide												
	VOA	Volatiles MeOH/8260[1]											MeOH	
	VOA	Trip Blanks	**# of trip blanks needed**											
	OS/BNA	PCB/Pesticides/BNA/PNA/BN 8270/8081/8082												
OIL	MO	Metals/Oil Liq & Solid Waste List Same as MA w/out Se,Ag,Sb,Sr,Tl,B												
	OL	Volatiles/PCB/Pesticides/BNA/BN 8260/8270/8081/8082												
	HW	Flash Point/ Solubility												
	MX	Metals/TCLP/SPLP/ASTM for MI-10												
	OX	TCLP/SPLP Volatiles 8260												

Other Requested Supplies (labels, coolers, etc.):

Please include field QC in the bottle count

TOTAL REQUESTED													

PREPARED BY:_____

Refer to back of form for collection and preservation information.

[1]MeOH Kit includes 1-tared vial, 1-10mL MeOH tube, 1-capped syringe, & 1-syringe label.

[2]See note #14 on reverse side.

[3]DO Kit: DO-1 & DO-2 reagent, must request H_2SO_4 (unless you already have it)

[4]EDB (8011) requires a 4th vial.

[5]Available Cyanide Kit: $PbCO_3$, NaOH, filter/plunger apparatus, and vials.

Do not pre-preserve bottles

August, 2005

COLLECTION AND PRESERVATION OF WATER, SEDIMENT, AND OIL SAMPLES

	BOTTLE CODE	PARAMETER GROUP	NOTES	BOTTLE TYPE	SIZE/COMMENTS	COOL TO 4 C° X = YES	PRESERVATIVE	AMOUNT	MAXIMUM HOLDING TIME
	DO	DISSOLVED OXYGEN	1	GLASS	250 mL GLASS STOPPER	X	FIX ON SITE (WINKLER)		8 HR
	GN	GEN CHM/NEUTRAL	2,3	PLASTIC	500 mL	X			2, 7, or 28 DAYS
	GA	GEN CHM/ACIDIC	3,4	PLASTIC	500 mL	X	H2SO4 TO pH < 2	10 DROPS/ 500 mL	28 DAYS
	GG	GEN CHM/PHENOLICS	5	GLASS	250 mL SCREW CAP	X	H2SO4 TO pH<2	5 DROPS/ 250 mL	28 DAYS
	GB	GEN CHM/BASIC	3,6 7,8	PLASTIC	250 mL OR 500 mL	X	10N NaOH TO pH=12	10 DROPS/ 250 mL	14 DAYS (24 HR)
W	GCN	GEN CHM/BASIC AVAIL CYANIDE	19	PLASTIC	50 mL VIAL	X	PbCO3 FILTER 10N NaOH TO pH=12	2 DROPS/ 50 mL	14 DAYS
A	S	SULFIDE	1	PLASTIC	250 mL	X	2N ZnAC. 10N NaOH TO pH>9	10 DROPS 2 DROPS/ 250 mL	7 DAYS
T	CA	CHLOROPHYLL A	9	PLASTIC	250 mL	X	1% MgCO3	5 DROPS/ 250 mL	2 DAYS
E	MA	METALS/TOTAL ACIDIC	10	PLASTIC	500 mL		1:1 HNO3 TO pH<2	5 mL/ 500 mL	28 DAYS, 6 MO
R	MAD	METALS/ACIDIC FIELD FILTERED	10,11	PLASTIC	500 mL		FILTER ON SITE THEN ADD 1:1 HNO3 TO pH<2	5 mL/ 500mL	28 DAYS, 6 MO
	MD	METALS/LAB FILTERED	11	PLASTIC	500 mL	X	LAB FILT & PRES.		W/IN 24 HRS
	MN	MINERAL/NEUTRAL	12	PLASTIC	500 mL	X			W/IN 24 HRS, 2 DAYS, 14 & 28 DAYS
	OG	OIL & GREASE		GLASS	2x250mL W.M.	X	H2SO4 to pH<2	10 DROPS/250mL	28 DAYS
	VOA	VOLATILES 8260/624	13	GLASS	2-40mL SEPTUM VIALS	X	1:1 HCl TO pH<2	5 DROPS/VIAL	14 DAYS
	ON	PCB/PESTICIDES 608/8081/8082	14,17,18	GLASS	2-1000mL AMBER	X			7 DAYS
	BNA	BNA/PNA/BN/ACIDS 625/8270	14,18	GLASS	2-1000mL AMBER	X			7 DAYS
S	MS	METALS		GLASS	250 mL W.M.	X			
O	GS	GEN CHEM		GLASS	250mL W.M.	X			
I	VOA	VOLATILES MeOH/8260	16	GLASS	MeOH Kit	X	METHANOL	10g/10mL MeOH	14 DAYS
L	OS/BNA	PCB/PESTICIDES/BNA/PNA/BN 8270/8081/8082		GLASS	250mL W.M.	X			14 DAYS
O	MO	METALS		GLASS	250 mL W.M.	X			
I	OL	VOLATILES/PCB/PESTICIDES/BNA/BN	15	GLASS	250 mL W.M.	X			
L	HW	FLASH POINT		GLASS	250mL W.M.	X			
	MX	METALS/TCLP/SPLP/ASTM for MI10		GLASS	250mL W.M.	X			
	OX	TCLP/SPLP VOLATILES 8260		GLASS	250 mL SEPTUM JARS	X			14 DAYS

NOTES:

1 EXTRA CARE SHOULD BE TAKEN DURING COLLECTION SO THAT THE SAMPLE IS NOT AERATED BEFORE PRESERVATION.

2 GN, GEN CHM/NEUTRAL, INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES: SETTLEABLE RESIDUE, NITRITE, ORTHOPHOSPHATE, BOD, AND TURBIDITY (2 DAYS); TOTAL, FILTERABLE, NONFILTERABLE AND VOLATILE RESIDUES (7 DAYS); SILICATES (28 DAYS).

3 ADD SUFFIX "D" TO BOTTLE CODE WHEN SAMPLE IS FIELD FILTERED.

4 EXCESS ACID PRESERVATIVE WILL CAUSE INTERFERENCE...COUNT DROPS CAREFULLY, CHECK pH, ADD MORE ACID IF NECESSARY (pH=2). GA INCLUDES CHEMICAL OXYGEN DEMAND (COD), TOTAL ORGANIC CARBON (TOC), NITRATE PLUS NITRITE, AMMONIA, KJELDAHL NITROGEN, AND TOTAL PHOSPHORUS.

5 CHLORINATED SAMPLES FOR PHENOLS SHOULD BE COLLECTED IN A SEPARATE BOTTLE AND DECHLORINATED WITH 141N FAS (FERROUS AMMONIUM SULFATE, USUALLY ONE DROP) BEFORE PRESERVATION (USE BOTTLE CODE GP).

6 GB INCLUDES TOTAL CYANIDE, AND CYANIDE AMMENABLE TO CHLORINATION (FREE). HOLDING TIME IS 24 HOURS IF SULFIDES ARE PRESENT.

7 CHLORINATED SAMPLES FOR CYANIDES MUST BE DECHLORINATED WITH ASCORBIC ACID (0.6 G/L) IMMEDIATELY AFTER COLLECTION AND THEN PRESERVED WITH NaOH

8 THE PROPER CONTAINER DEPENDS ON PARAMETERS REQUESTED. 250 ML FOR TOTAL ONLY, 500 ML FOR AMENABLE

9 IF SAMPLE IS FILTERED ON SITE AND THE MEMBRANE FILTER ADDED TO 90% ACETONE (SUPPLIED BY THE LAB) AND REFRIGERATED, HOLDING TIME IS ONE MONTH. STORE FILTERED SAMPLE IN THE DARK AND ON ICE.

10 RECOMMENDED MAXIMUM HOLDING TIME FOR MERCURY, SODIUM, POTASSIUM, MAGNESIUM, CALCIUM (28 DAYS); OTHER METALS (6 MONTHS).

11 IF FIELD FILTRATION IS NOT AVAILABLE, SEND UNFILTERED SAMPLE TO THE LAB AS SOON AS POSSIBLE (WITHIN 24 HOURS). DO NOT ADD ACID TO DISSOLVED METAL IF UNFILTERED.

12 MN, MINERALS/NEUTRAL INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES: pH (ANALYSES SHOULD BE PERFORMED IMMEDIATELY ON SITE); HEXAVALENT CHROMIUM (24 HOURS); ALKALINITIES (CO3, HCO3, TOTAL ALK) (14 DAYS); SPECIFIC CONDUCTANCE, CHLORIDE, SULFATE (28 DAYS)

13 FILL BOTTLE COMPLETELY (NO AIR BUBBLES) AND MAKE SURE TEFLON SIDE OF SEPTUM FACES SAMPLES DUPLICATE VIALS REQUIRED

14 IF BOTH ON AND BNA ARE COLLECTED,COLLECT A MAXIMUM OF 3 AMBERS PER SAMPLE IDENTIFICATION.

15 INCLUDES PETROLEUM HYDROCARBONS, SPILL IDENTIFICATION.

16 WEIGH OUT 10 GRAMS OF SOIL AND ADD TO A 40mL TARED VIAL OPEN THE 10 mL METHANOL TUBE AND ADD TO THE VIAL. FILL, CAP, AND LABEL THE SYRINGE WITH SOIL SAMPLE.

17 LOW LEVEL PCB BY SPECIAL REQUEST ONLY. COLLECT 3 AMBERS PER SAMPLE.

18 COLLECT 3 AMBERS PER SAMPLE PER PARAMETER GROUP FOR QA/QC FOR ONE SAMPLE IN TWENTY

19 WITHIN 15 MINUTES OF COLLECTION POUR APPROX 50 ML OF SAMPLE INTO PBCO3 VIAL. MIX. FILTER USING FILTER/PLUNGER APPARATUS. DECANT LIQUID ABOVE FILTER/PLUNGER INTO A NEW TUBE, PRESERVE WITH 10N NAOH TO pH 12.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB WORK ORDER #

MATRIX=WATER

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded
		2. CMI (Non RRD)	6. RRD-LUST - Federal
		3. NPDES	7. RRD-SUPERFUND- Federal
		4. OTHER-list here -	

DIVISION	DISTRICT/OFFICE	MDEO PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO yes, which parameters?

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY:	INDEX:	PCA:
			PROJECT:		PH:

OVERFLOW LAB (Required for Funded RRD & CMI samples)

1ST CHOICE | 2ND CHOICE

COLLECTED BY: PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:

1.)

2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (8260)

Full List 1 2 3 4 5 6 7 8 9 10

BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (8081/8082)

Pesticides & PCBs 1 2 3 4 5 6 7 8 9 10

Pesticides only 1 2 3 4 5 6 7 8 9 10

PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)

BNAs 1 2 3 4 5 6 7 8 9 10

PNAs only 1 2 3 4 5 6 7 8 9 10

BNs only 1 2 3 4 5 6 7 8 9 10

ACIDs only 1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)

Volatiles 1 2 3 4 5 6 7 8 9 10

Semivolatile 1 2 3 4 5 6 7 8 9 10

FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxygen 1 2 3 4 5 6 7 8 9 10

GN NO_2, o-Phos 1 2 3 4 5 6 7 8 9 10

Residue SS 1 2 3 4 5 6 7 8 9 10

Residue TDS 1 2 3 4 5 6 7 8 9 10

_____ 1 2 3 4 5 6 7 8 9 10

BOD Tot 5 day 1 2 3 4 5 6 7 8 9 10

BOD Carb 5 day 1 2 3 4 5 6 7 8 9 10

Turbidity 1 2 3 4 5 6 7 8 9 10

CA Chlorophyll 1 2 3 4 5 6 7 8 9 10

GA COD 1 2 3 4 5 6 7 8 9 10

TOC 1 2 3 4 5 6 7 8 9 10

NO3 + NO2, NH3 1 2 3 4 5 6 7 8 9 10

KJEL N, Tot P 1 2 3 4 5 6 7 8 9 10

S Sulfide 1 2 3 4 5 6 7 8 9 10

GP Phenolics 1 2 3 4 5 6 7 8 9 10

GB Total CN 1 2 3 4 5 6 7 8 9 10

Amenable CN 1 2 3 4 5 6 7 8 9 10

GCN Available CN 1 2 3 4 5 6 7 8 9 10

OG Oil & Grease 1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals 1 2 3 4 5 6 7 8 9 10

MAD Diss-Field Filtered 1 2 3 4 5 6 7 8 9 10

MD Diss-Lab Filtered 1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No.

MICH TEN METALS 1 2 3 4 5 6 7 8 9 10

(As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn)

ICP-MS (200.8/6020)

Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10

As Ba Se Ag 1 2 3 4 5 6 7 8 9 10

Co Mn Sb Sr Tl 1 2 3 4 5 6 7 8 9 10

Al Be Mo Ti V 1 2 3 4 5 6 7 8 9 10

ICP (200.7/6010)

B Fe Li 1 2 3 4 5 6 7 8 9 10

Flame AA (200/7000 Series)

Ca Mg Na K 1 2 3 4 5 6 7 8 9 10

Hardness 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)

Hg 1 2 3 4 5 6 7 8 9 10

MN pH, Conductance 1 2 3 4 5 6 7 8 9 10

Cl, SO_4, Total Alk 1 2 3 4 5 6 7 8 9 10

HCO_3, CO_3 1 2 3 4 5 6 7 8 9 10

Cr^{+6} 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

****NPDES ONLY****

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=WASTEWATER

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded
		2. CMI (Non RRD)	6. RRD-LUST - Federal
		3. NPDES	7. RRD-SUPERFUND- Federal
		4. OTHER-list here -	

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY: INDEX:	PCA
			PROJECT:	PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (624)
- -VOC - Full List 1 2 3 4 5 6 7 8 9 10
- -BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (608)
- -Scan 3 1 2 3 4 5 6 7 8 9 10
- -PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (625)
- -BNAs 1 2 3 4 5 6 7 8 9 10
- -PNAs only 1 2 3 4 5 6 7 8 9 10
- -BNs only 1 2 3 4 5 6 7 8 9 10
- -ACIDs only 1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)
- -Volatiles 1 2 3 4 5 6 7 8 9 10
- -Semivolatiles 1 2 3 4 5 6 7 8 9 10
- -FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxygen 1 2 3 4 5 6 7 8 9 10

GN NO_3,o-Phos 1 2 3 4 5 6 7 8 9 10
- Residue SS 1 2 3 4 5 6 7 8 9 10
- Residue TDS 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10
- BOD Tot 5 day 1 2 3 4 5 6 7 8 9 10
- BOD Carb 5 day 1 2 3 4 5 6 7 8 9 10
- Turbidity 1 2 3 4 5 6 7 8 9 10

CA Chlorophyll 1 2 3 4 5 6 7 8 9 10

GA COD 1 2 3 4 5 6 7 8 9 10
- TOC 1 2 3 4 5 6 7 8 9 10
- NO3 NO2,NH3 1 2 3 4 5 6 7 8 9 10
- KL N,Tot P 1 2 3 4 5 6 7 8 9 10

S Sulfide 1 2 3 4 5 6 7 8 9 10

GP Phenolics 1 2 3 4 5 6 7 8 9 10

GB Total CN 1 2 3 4 5 6 7 8 9 10
- Amenable CN 1 2 3 4 5 6 7 8 9 10

GCN Available CN 1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals 1 2 3 4 5 6 7 8 9 10
MAD Diss-Field Filtered 1 2 3 4 5 6 7 8 9 10
MD Diss-Lab Filtered 1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No

ICP-MS (200.8/6020)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- As Ba Se Ag 1 2 3 4 5 6 7 8 9 10
- Co Mn Sb Sr Tl 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Ti V 1 2 3 4 5 6 7 8 9 10

ICP (200.7/6010)
- B Fe Li 1 2 3 4 5 6 7 8 9 10

Flame AA (200/7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10
- Hardness 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- Hg 1 2 3 4 5 6 7 8 9 10

MN pH,Conductance 1 2 3 4 5 6 7 8 9 10
- Cl, SO_4, Total Alk 1 2 3 4 5 6 7 8 9 10
- HCO_3, CO_3 1 2 3 4 5 6 7 8 9 10
- Cr^6 1 2 3 4 5 6 7 8 9 10

OG Oil & Grease 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flamable?	YES	NO
3	Are samples acidic prior to preservation (pH < 2)?	YES	NO
4	Are samples caustic prior to preservation (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO
10	List additional suspected hazard information.		

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

W-BacT

MATRIX=WATER

LAB WORK ORDER #

SITE CODE NUMBER | SITE NAME | CIRCLE ONE: 1. NO SITE FUNDING CMI (Non RRD) 2. 3. NPDES 4. OTHER-list here -

DIVISION | DISTRICT/OFFICE | MDEQ PROJECT MANAGER | E-MAIL ADDRESS | PHONE | ACCEPT HT CODES? YES / NO If yes, which parameters?

PRIMARY CONTACT PERSON | CONTRACT FIRM NAME (if applicable) | PHONE | AY: | INDEX: | PCA: | PROJECT: | PH:

OVERFLOW LAB (Required for Funded RRD & CMI samples)
1ST CHOICE | 2ND CHOICE

COLLECTED BY: | PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1.)
2.)

****** SAFETY INFORMATION REQUIRED ******
SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

GENERAL CHEMISTRY

CA	Chlorophyll	1 2 3 4 5 6 7 8 9 10
DO	Diss Oxygen	1 2 3 4 5 6 7 8 9 10
GN	NO_2, o-Phos	1 2 3 4 5 6 7 8 9 10
	Residue SS	1 2 3 4 5 6 7 8 9 10
	Residue TDS	1 2 3 4 5 6 7 8 9 10
	BOD Tot 5 day	1 2 3 4 5 6 7 8 9 10
	BOD Carb 5 day	1 2 3 4 5 6 7 8 9 10
	Turbidity	1 2 3 4 5 6 7 8 9 10
GA	COD	1 2 3 4 5 6 7 8 9 10
	TOC	1 2 3 4 5 6 7 8 9 10
	NO3 + NO2, NH3	1 2 3 4 5 6 7 8 9 10
	KJEL N, Tot P	1 2 3 4 5 6 7 8 9 10

INORGANIC

↓↓↓Circle Metal and Corresponding Sample No. ↓↓↓

MA	Total Metals	1 2 3 4 5 6 7 8 9 10
	ICP-MS (200.8/6020)	
	Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
	As Ba Se Ag	1 2 3 4 5 6 7 8 9 10
	Co Mn Sb Sr Tl	1 2 3 4 5 6 7 8 9 10
	Al Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
	ICP (200.7/6010)	
	B Fe Li	1 2 3 4 5 6 7 8 9 10
	Flame AA (200/7000 Series)	
	Ca Mg Na K	1 2 3 4 5 6 7 8 9 10
	Hardness	1 2 3 4 5 6 7 8 9 10
	Cold Vapor AA (245.1/7470/7471)	
	Hg	1 2 3 4 5 6 7 8 9 10

MN	pH, Conductance	1 2 3 4 5 6 7 8 9 10
	Cl, SO_4, Total Alk	1 2 3 4 5 6 7 8 9 10
	HCO_3, CO_3	1 2 3 4 5 6 7 8 9 10
	Cr^{+6}	1 2 3 4 5 6 7 8 9 10

MICROBIOLOGICAL TESTS

NPEC	E coli	1 2 3 4 5 6 7 8 9 10

▶ NOTE: 6 Hour Hold Time!!

OTHER TESTS: LIST HERE

_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	Date / Time	RECEIVED BY / ORGANIZATION	Date / Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=LL HG Water

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:		
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded	
		2. CMI (Non RRD)	6. RRD-LUST - Federal	
		3. NPDES	7. RRD-SUPERFUND- Federal	
		4. OTHER-list here -		

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY	INDEX.	PCA.
			PROJECT:		PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******
SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (8260)
- Full List 1 2 3 4 5 6 7 8 9 10
- BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (8081/8082)
- Pesticides & PCBs 1 2 3 4 5 6 7 8 9 10
- Pesticides only 1 2 3 4 5 6 7 8 9 10
- PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)
- BNAs 1 2 3 4 5 6 7 8 9 10
- PNAs only 1 2 3 4 5 6 7 8 9 10
- BNs only 1 2 3 4 5 6 7 8 9 10
- ACIDs only 1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)
- Volatiles 1 2 3 4 5 6 7 8 9 10
- Semivolatiles 1 2 3 4 5 6 7 8 9 10
- FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxgen 1 2 3 4 5 6 7 8 9 10

GN NO_3,o-Phos 1 2 3 4 5 6 7 8 9 10
- Residue SS 1 2 3 4 5 6 7 8 9 10
- Residue TDS 1 2 3 4 5 6 7 8 9 10
- 1 2 3 4 5 6 7 8 9 10
- BOD Tot 5 day 1 2 3 4 5 6 7 8 9 10
- BOD Carb 5 day 1 2 3 4 5 6 7 8 9 10
- Turbidity 1 2 3 4 5 6 7 8 9 10

CA Chlorophyll 1 2 3 4 5 6 7 8 9 10

GA COD 1 2 3 4 5 6 7 8 9 10
- TOC 1 2 3 4 5 6 7 8 9 10
- NO3-NO2,NH3 1 2 3 4 5 6 7 8 9 10
- TKN,Tot P 1 2 3 4 5 6 7 8 9 10

S Sulfide 1 2 3 4 5 6 7 8 9 10

GP Phenolics 1 2 3 4 5 6 7 8 9 10

GB Total CN 1 2 3 4 5 6 7 8 9 10
- Amenable CN 1 2 3 4 5 6 7 8 9 10

GCN Available CN 1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals 1 2 3 4 5 6 7 8 9 10
MAD Diss-Field Filtered 1 2 3 4 5 6 7 8 9 10
MD Diss-Lab Filtered 1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No

ICP-MS (200.8/6020)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- As Ba Se Ag 1 2 3 4 5 6 7 8 9 10
- Co Mn Sb Sr Tl 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Ti V 1 2 3 4 5 6 7 8 9 10

ICP (200.7/6010)
- B Fe Li 1 2 3 4 5 6 7 8 9 10

Flame AA (200/7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10
- Hardness 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- Hg

LL Hg Low Level Mercury (1631)
- Total/Acid Added 1 2 3 4 5 6 7 8 9 10
- Total/ No Acid 1 2 3 4 5 6 7 8 9 10
- Diss/Acid Added 1 2 3 4 5 6 7 8 9 10
- Diss/No Acid Added 1 2 3 4 5 6 7 8 9 10

MN pH,Conductance 1 2 3 4 5 6 7 8 9 10
- Cl, SO_4, Total Alk 1 2 3 4 5 6 7 8 9 10
- HCO_3, CO_3 1 2 3 4 5 6 7 8 9 10
- Cr^6 1 2 3 4 5 6 7 8 9 10

OG Oil & Grease 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Goldenrod

LAB ORDER #

MATRIX=SEDIMENT/SOIL/SOLIDS

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded
		2. CMI (Non RRD)	6. RRD-LUST - Federal
		3. NPDES	7. RRD-SUPERFUND- Federal
		4. OTHER-list here -	

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY. INDEX PROJECT:	PCA PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES *(MeOH/8260)
- VOC - Full List 1 2 3 4 5 6 7 8 9 10
- BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

OS PESTICIDES/PCBS (8081/8082)
- Pesticides & PCBs 1 2 3 4 5 6 7 8 9 10
- Pesticides only 1 2 3 4 5 6 7 8 9 10
- PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)
- BNAs 1 2 3 4 5 6 7 8 9 10
- PNAs only 1 2 3 4 5 6 7 8 9 10
- BNs only 1 2 3 4 5 6 7 8 9 10

ORGANIC SPECIAL REQUESTS

Library Search (Qualitative)
- Volatiles 1 2 3 4 5 6 7 8 9 10
- Semivolatiles 1 2 3 4 5 6 7 8 9 10
- FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

GS
- COD 1 2 3 4 5 6 7 8 9 10
- [illegible] N,Tot P 1 2 3 4 5 6 7 8 9 10
- Phenolics 1 2 3 4 5 6 7 8 9 10
- Total CN 1 2 3 4 5 6 7 8 9 10
- % Total Solids 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10 Hg

INORGANIC

Circle Requested Metal and Corresponding Sample No.

MICH TEN METALS 1 2 3 4 5 6 7 8 9 10
(As,Ba,Cd,Cr,Cu,Pb,Hg,Se,Ag,Zn)

ICP (6010)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- Ba Co Mn Fe Li 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Sr Ti V 1 2 3 4 5 6 7 8 9 10
- Pb (both fine & coarse) 1 2 3 4 5 6 7 8 9 10

Graphite Furnace AA (7000 Series)
- As Ag Se Tl 1 2 3 4 5 6 7 8 9 10

Flame AA (7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- 1 2 3 4 5 6 7 8 9 10

% Total Solids 1 2 3 4 5 6 7 8 9 10
_ 1 2 3 4 5 6 7 8 9 10

***MeOH Preservative Tracking Number** FL -

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO
10	List additional suspected hazard information.		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Yellow

LAB ORDER #

MATRIX=ORGANIC/OIL/COAL

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded
		2. CMI (Non RRD)	6. RRD-LUST - Federal
		3. NPDES	7. RRD-SUPERFUND- Federal
		4. OTHER-list here -	

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY. INDEX PROJECT:	PCA PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

OL VOLATILES (8260)

Volatile Full List	1 2 3 4 5 6 7 8 9 10
BTEX/MTBE/TMB only	1 2 3 4 5 6 7 8 9 10

PESTICIDES/PCBS (8081/8082)

Pesticides & PCBs	1 2 3 4 5 6 7 8 9 10
Pesticides only	1 2 3 4 5 6 7 8 9 10
PCBs only	1 2 3 4 5 6 7 8 9 10

BASE NEUTRAL & ACIDS (8270)

BNAs	1 2 3 4 5 6 7 8 9 10
PNAs only	1 2 3 4 5 6 7 8 9 10
BNs only	1 2 3 4 5 6 7 8 9 10

******ORGANIC SPECIAL REQUESTS******

Library Search (Qualitative)	
Volatiles	1 2 3 4 5 6 7 8 9 10
Semivolatiles	1 2 3 4 5 6 7 8 9 10
FingerPrint	1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

HW

Flashpoint	1 2 3 4 5 6 7 8 9 10
Solubility	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

INORGANIC

MO

Circle Requested Metal and Corresponding Sample No.

ICP (6010)	
Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Ba Co Mn Fe Li	1 2 3 4 5 6 7 8 9 10
Al Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
Cold Vapor AA (7470/7471)	
Hg - Mercury	1 2 3 4 5 6 7 8 9 10
Hydride AA (7061)	
As - Arsenic	1 2 3 4 5 6 7 8 9 10
Fuel Analyses	
% Cl	1 2 3 4 5 6 7 8 9 10
BTU	1 2 3 4 5 6 7 8 9 10
% Sulfur	1 2 3 4 5 6 7 8 9 10
% Ash	1 2 3 4 5 6 7 8 9 10
% Moisture	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO
10	List additional suspected hazard information.		

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Blue

LAB ORDER #

MATRIX=ASTM LEACH / TCLP / SPLP

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES 4. OTHER-list here -	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY	INDEX	PCA
			PROJECT:		PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC — GENERAL CHEMISTRY — INORGANIC

Circle Requested Parameter and Corresponding Sample No.

OX

TCLP Volatiles	1 2 3 4 5 6 7 8 9 10
SPLP Volatiles	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

GS

ASTM Leach (Neutral Leach)	1 2 3 4 5 6 7 8 9 10
Ortho P, NO_2	1 2 3 4 5 6 7 8 9 10
COD	1 2 3 4 5 6 7 8 9 10
TOC	1 2 3 4 5 6 7 8 9 10
NO_3+NO_2, NH_3	1 2 3 4 5 6 7 8 9 10
Kjel N, Tot. P	1 2 3 4 5 6 7 8 9 10
Phenolics	1 2 3 4 5 6 7 8 9 10
Cyanide	1 2 3 4 5 6 7 8 9 10
% Total Solids	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

MS

ASTM Leach (Neutral Leach)	
Cl SO4 Alk	1 2 3 4 5 6 7 8 9 10
Cr^{+6}	1 2 3 4 5 6 7 8 9 10
Ca Mg Na K	1 2 3 4 5 6 7 8 9 10
Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Fe Co Li Mn	1 2 3 4 5 6 7 8 9 10
Al Ba Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
As Ag Se Sb Tl	1 2 3 4 5 6 7 8 9 10
Hg	1 2 3 4 5 6 7 8 9 10
% Total Solids	1 2 3 4 5 6 7 8 9 10

MX

TCLP Metals	1 2 3 4 5 6 7 8 9 10
SPLP Metals	1 2 3 4 5 6 7 8 9 10
ICP (6010)	
Ba Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Graphite Furnace AA (7000 Series)	
As Ag Se	1 2 3 4 5 6 7 8 9 10
Cold Vapor AA (7470/7471)	
Hg	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

_____

_____

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_____

_____

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY

Pink

ENVIRONMENTAL LABORATORY

ANALYSIS REQUEST SHEET

MATRIX=AIR CANISTER VOLATILES

LAB ORDER #

SITE CODE NUMBEI	SITE NAME	CIRCLE ONE:	1. NO SITE 2. CMI (Non 3. NPDES 4. OTHER-list	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO
			@mi.gov		

PRIMARY CONTACT PERSON	PHONE	AY:	INDEX:	PCA:

OVERFLOW LAB (Required for RRD & CMI samples)		PROJECT:	PH:
1ST CHOICE	2ND CHOICE:	E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:	
COLLECTED BY:	PHONE:		

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		CANISTER NUMBER	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				

****INFORMATION BELOW FOR FIELD STAFF ONLY****

GENERAL INFORMATION

AIRS NO.:	SAMPLER NO:

SAMPLING INFORMATION

Canister Pressure

1st CANISTER:	2nd CANISTER:
START:	START:
STOP:	STOP:

Timer Settings

C1 (PUMP)		C2 (VALVE)	
START:	DAY:	START:	DAY:
STOP:	DAY:	STOP:	DAY:
VERIFIED:		COMMENTS:	

ain-of-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=ALDEHYDE CARTRIDGE

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:		
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded	
		2. CMI (Non RRD)	6. RRD-LUST - Federal	
		3. NPDES	7. RRD-SUPERFUND- Federal	
		4. OTHER-list here -		

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO
			@michigan.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY: INDEX:	PCA
			PROJECT:	**PH:**

OVERFLOW LAB (**Required for RRD & CMI samples**)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE:	2ND CHOICE:	1.)
COLLECTED BY:	**PHONE:**	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		FIELD ID OR DESCRIPTION	SAMPLE COLLECTION DATE	CARTRIDGE LOT NUMBER	INTAKE BLACK BALL ROTAMETER FLOW *PRE* VALUE	*POST*	SAMPLE INFORMATION
01	AA						
02	AA						
03	AA						
04	AA						
05	AA						
06	AA						

SAMPLER #: _____

ROTAMETER #: _____

CARTRIDGE LOT #: _____

AVERAGE

Pressure (mm Hg): _____

Temperature (Degrees Centigrade): _____

Total Elapsed Time (Minutes): _____

If AVERAGES are filled in you do *not* have to fill in Pre and Post Sampling Info

PRE-SAMPLING INFO

DATE/TIME INSTALLED: _____

BAROMETRIC PRESSURE (mm Hg): _____

TEMPERATURE (Degrees Centigrade): _____

ELAPSED TIME (Minutes): _____

POST-SAMPLING INFO

DATE/TIME REMOVED: _____

BAROMETRIC PRESSURE (mm Hg): _____

TEMPERATURE (Degrees Centigrade): _____

ELAPSED TIME (Minutes): _____

CARTRIDGE LABELING INSTRUCTIONS:

1. Label foil pouch with sample date, site name/ID, your initials, and the sample origin and include the following:

PRIMARY CARTRIDGE (PORT #1) = #1

PRIMARY CARTRIDGE (PORT #1) BACKUP = #1-B

COLLOCATED CARTRIDGE (PORT #2) = #2

COLLOCATED CARTRIDGE (PORT #2) BACKUP = #2-B

FIELD BLANK = FB

2. Do not write on the actual cartridge.

3. List units used for barometric pressure as mm Hg.

4. List units of temperature as degrees C.

5. Temperature should reflect outside ambient conditions

6. Use black ball in rotameter to measure flow through cartridge.

FOR CO-LOCATED RUN, MEASURE FLOW OF EACH CARTRIDGE

*IF THE SAMPLE IS COLLECTED IN THE VAN DENOTE THIS ON LABEL.

Chain-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Green

LAB ORDER #

MATRIX=SURFACE COATINGS & INKS

SITE CODE NUMBER | SITE NAME | CIRCLE ONE: 1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES 4. OTHER-list here - 5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION | DISTRICT/OFFICE | MDEQ PROJECT MANAGER | E-MAIL ADDRESS @mi.gov | PHONE | ACCEPT HT CODES? YES / NO

PRIMARY CONTACT PERSON | CONTRACT FIRM NAME (if applicable) | PHONE | AY. | INDEX: | PCA: | PROJECT: | PH:

OVERFLOW LAB (**Required for RRD & CMI samples**)

1ST CHOICE: | 2ND CHOICE.

COLLECTED BY: | PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:

1.)

2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
	AA				
7	AA				
8	AA				
9	AA				
10	AA				

INORGANIC

VOC (lb/gal) 1 2 3 4 5 6 7 8 9 10

Density (lb/gal) 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

STANDARD OPERATING PROCEDURE (SOP)
FIELD, TRIP, AND EQUIPMENT BLANKS

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 3

5.0 PROCEDURES 4

5.1 Field Book Set Up 4

5.2 Daily Entries 4

5.3 Post Field Work 4

6.0 REFERENCES 4

7.0 ATTACHMENTS 4

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for collecting and using trip, field, and equipment blanks.

2.0 SCOPE

This SOP provides accepted procedures for collecting and using trip, field, and equipment.

3.0 GLOSSARY

Trip Blank – A water or methanol sample prepared in the laboratory that accompanies the sample containers and collected samples. Used to identify volatile organic compound (VOC) sample contamination due to transport.

Field Blank – A water or methanol sample collected in the field under similar circumstances to the sample collection. Used to identify contamination due to sampling methods.

Equipment Blank – A water sample collected from field equipment. Used to identify contamination due to improperly decontaminated equipment.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and followed.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

Field Operations Leader – Is responsible for assuring that the blanks are collected and used correctly.

5.0 PROCEDURES

5.1 Trip Blank

- Keep the trip blank in the same container as the VOC sample containers during transport to the site and sample collection.
- Log the trip blank on the chain-of-custody, requesting VOC analysis.
- Keep one trip blank in each cooler containing VOC samples.

5.2 Field Blank

- Review each project's Field Sampling Plan (FSP) for any site-specific requirements.
- While at the site, collect the field blank in as similar a process as the samples are collected.
- For water blanks, use deionized or distilled water.
- Log the field blank on the chain-of-custody, requesting the appropriate analyses then place the blank in a cooler with ice.

5.3 Equipment Blank

- Review each project's FSP for any site-specific requirements.
- Decontaminate the equipment to be tested.
- Pour deionized or distilled water over or through the equipment, as appropriate.
- Log the field blank on the chain-of-custody, requesting the appropriate analyses, then place the blank in a cooler with ice.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
FIELD INSTRUMENT CALIBRATION

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 3

5.0 PROCEDURES 3

5.1 PID and FID Calibration 4

5.2 Flow-Through Ground Water Monitoring Equipment 5

5.3 Hand-Held Ground Water Monitoring Equipment 6

6.0 REFERENCES 3

7.0 ATTACHMENTS 3

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for calibrating commonly used field instruments. **THE USER SHOULD ALWAYS REVIEW AND FOLLOW THE INSTRUMENT MANUFACTURER'S OPERATING INSTRUCTIONS. IN CASES WHERE THE MANUFACTURER'S INSTRUCTIONS DIFFER WITH THESE STANDARD OPERATING PROCEDURES (SOPS), THE MANUFACTURER'S INSTRUCTIONS HAVE PRECEDENCE.**

2.0 SCOPE

This SOP provides accepted procedures for calibrating commonly used field instruments, including photoionization detectors (PIDs), flame ionization detectors (FIDs), and ground water monitoring equipment.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and is responsible for reviewing the field books and/or calibration logs used by the field crew on a periodic basis.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

Field Operations Leader – Is responsible for assuring that the field calibration is completed correctly.

5.0 PROCEDURES

5.1 PID and FID Calibration

PIDs and FIDs should be calibrated before each sampling event. If a sampling event lasts more than one day, they should be calibrated daily prior to sampling activities. **ALWAYS RECORD A CALIBRATION EVENT IN THE PROJECT LOG BOOK.**

- Turn on the PID/FID and let it warm up. If using a FID, do not forget to start the flame.
- Determine that the proper calibration gas and concentration is available. If not, either obtain the correct calibration gas and/or concentration or set the PID to the new calibration gas and/or concentration following the manufacturer's instructions.
- Follow the manufacturer's instructions to enter the CALIBRATION MODE.
- Calibration usually requires two gases, a "0.0" concentration (fresh air) and the span gas (usually 100.0 parts per million [ppm] isobutylene for PIDs and 1,000 ppm methane for FIDs). Calibrate first to fresh air away from fumes, contamination, gas pumps, etc.
- Depending on the instrument, either attach flow regulator to the span gas cylinder or release some of the span gas into the tedlar bag included with the PID/FID.
- When prompted, attach the span gas to the PID/FID and allow it to calibrate (usually about 30 seconds).
- If calibration was successful, exit calibration mode and record the results. If calibration was not successful, attempt the calibration again.
- If the re-calibration attempt is not successful, contact the Project Manager and do not use the equipment unless instructed.

5.2 Flow-Through Ground Water Monitoring Equipment

Flow-through ground water monitoring equipment is designed to be integrated with the pump to form a single system. Most flow-through systems measure several parameters at once by having several probes united in a probe bundle. Ground water monitoring equipment should be calibrated before each sampling event. If a sampling event lasts more than one day, it should be calibrated daily prior to sampling activities.

- Depending on the equipment used, one or more calibration solutions will be required. If the solutions are not pre-made, mix the required solutions according to the manufacturer's instructions.
- Decontaminate the equipment and calibration container(s) following the manufacturer's instructions. The calibration container(s) will hold the calibration fluid.
- Pour the calibration fluid(s) into the calibration container(s). If using more than one calibration fluid, make sure to pour each fluid into the appropriate container.
- Enter the calibration mode of the equipment.
- Carefully place the probe bundle into the first calibration container. Make sure enough fluid is present to cover the required probes. Be aware that some models also require that certain probes NOT be in the fluid.
- If required by the manufacturer, continue calibrating with the additional fluids.
- Decontaminate the probe bundle.
- Once finished, properly dispose of the calibration fluids. Some fluids are designed to be re-used and should be saved in clean, marked containers.
- If calibration was successful, exit calibration mode and record the results in the field logbook and calibration log book, if available. If calibration was not successful, attempt the calibration again.
- If the re-calibration attempt is not successful, contact the project manager and do not use the equipment unless instructed.

5.3 Hand-Held Ground Water Monitoring Equipment

Hand-held ground water monitoring equipment is designed to screen a sample of ground water placed in a container. Depending on the equipment, the container may be a part of the unit or it may be a separate container into which a probe is inserted. Most hand-held units measure one to three parameters at a time. Ground water monitoring equipment should be calibrated before each sampling event. If a sampling event lasts more than one day, it should be calibrated daily prior to sampling activities.

- Depending on the equipment used, usually two or more calibration solutions will be required. If the solutions are not pre-made, mix the required according to the manufacturer's instructions.
- Decontaminate the equipment following the manufacturer's instructions. If the unit has a probe that is inserted into another container, make sure a clean container is available. It is advisable to use new laboratory-cleaned containers when possible.
- Enter the calibration mode of the equipment.
- Pour the calibration fluid(s) into the calibration container(s). If using more than one calibration fluid, make sure to pour each fluid into the appropriate container. If the container is part of the unit, pour the first calibration fluid into the container.
- Carefully place the probe into the first calibration container.
- If required by the manufacturer, continue calibrating with the additional fluids.
- Once finished, properly dispose of the calibration fluids. Some fluids are designed to be re-used and should be saved in clean, marked containers.
- Decontaminate the probe or container.
- If calibration was successful, exit calibration mode and record the results in the field logbook and calibration log book, if available. If calibration was not successful, attempt the calibration again.
- If the re-calibration attempt is not successful, contact the project manager and do not use the equipment unless instructed.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
LOW-FLOW PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

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TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 4

5.0 PROCEDURES 4

5.1 Equipment 4

5.2 Preliminary Site Activities 5

5.3 Purging and Sampling Procedures 6

6.0 REFERENCES 10

7.0 ATTACHMENTS 10

1.0 PURPOSE

The purpose of this procedure is to provide an approved method for conducting low-flow ground water sampling to ensure data validity and data usability during site investigations.

2.0 SCOPE

This SOP provides a procedure for the collection of ground water samples from wells with short-screened intervals using low stress (low-flow) purging and sampling techniques. The goal of a ground water sampling program is to collect ground water samples that are geochemically "representative" of aquifer conditions at the time the sample is collected. All sampling techniques will alter a ground water composition to some extent. However, a properly designed sampling program will minimize these impacts, especially with regard to the properties or analytes of concern to the sampling program. The low-flow approach may not be the appropriate or the best choice for sampling your site. However, in most geologic settings, the low-flow approach will provide representative ground water samples from permanent and temporary ground water monitoring wells.

A review of the information contained in this SOP will facilitate planning of the field sampling effort by describing standard sampling techniques and provide instructions for sampling team members. The techniques described shall be followed whenever applicable, noting that specific conditions may require adjustments in methodology. Review the project Field Sampling Plan (FSP) prior to initiating field work for additional guidance.

This SOP does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate sampling procedures are established, for reviewing the sampling procedures used by the field crew and for performing in-field spot checks of sampling procedures.

Field Operations Leader – Is responsible for selecting and detailing the specific ground water sampling techniques and equipment to be used, documenting these in the Work Plan for the activity, and properly briefing the site sampling personnel.

Field Technical Staff – Are responsible for the proper acquisition of the ground water samples.

5.0 PROCEDURES

5.1 Equipment

- Adjustable rate, positive displacement pumps (e.g., low flow-rate submersible centrifugal or bladder pumps constructed of stainless steel or Teflon®) or peristaltic pumps for shallow wells. The pump should be easily adjustable and capable of operating reliably at lower flow rates between 100 milliliters per minute (mL/min) and 500 mL/min although higher flow rates may be used if appropriate for site geology. Adjustable rate peristaltic pumps may be used with caution when testing for volatile organic compounds (VOCs). Bailers are inappropriate for use with the low-flow sampling method.
- Tubing: Tubing used in purging and sampling each well must be dedicated to the individual well. Once properly located, moving the pump in the well should be avoided. Consequently, the same tubing should be used for purging and sampling. Teflon®, Teflon®-lined polyethylene, or polyethylene tubing must be used to collect samples for organic analysis as provided in Michigan Department of Environmental Quality – Remediation and Redevelopment Division (MDEQ-RRD) Operational Memorandum #2, Attachment #5. For samples collected for inorganic analysis, Teflon® or Teflon®-lined polyethylene, polyvinyl chloride (PVC), Tygon®, or polyethylene tubing may be used. The tubing wall thickness should be maximized (⅜ to ½ inch) and the tubing length should be minimized (i.e. do not have excess tubing

outside of the well). Pharmaceutical grade tubing should be used for the section around the rotor head of the peristaltic pump to minimize gaseous diffusion.

- Polyethylene sheeting and appropriate sampling gloves.
- Water level measuring device (+/- 0.01 foot accuracy; electronic preferred for tracking water level drawdown during all pumping operations).
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (e.g., generator (located downwind); car/marine battery; nitrogen tank; etc).
- Purge criteria parameter monitoring instruments for one or more of the following stability parameters: pH, turbidity, specific conductance, temperature, redox potential (Eh) and/or dissolved oxygen (DO).
- Nylon stay-ties.
- Decontamination supplies, as appropriate.
- Project log book(s).
- Sample Bottles. It is recommended that preservatives are added to sample bottles prior to field activities to reduce potential error or introduction of contaminants.
- Sample preservation supplies (as required by the analytical method; see previous bullet).
- Sample tags or labels, chain-of-custody.
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Approved FSP and/or Work Plan.

5.2 Preliminary Site Activities

1. Check the condition of the monitoring well for damage and evidence of tampering, and record pertinent observations.
2. In order to maintain a clean work area, lay out a sheet of polyethylene on which to place sampling and monitoring equipment.

3. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing) use the north side of well casing and record this in the log book.
4. Measure and record the depth to water (to +/- 0.01 foot) in all wells to be sampled before installing the pump or tubing. Care should be taken to minimize disturbance to the water column and to any particulates attached to the sides or at the bottom of the well. To avoid disturbing any accumulated sediment and to prevent mixing of stagnant water with water in the screened interval, the total depth of a well should be measured a minimum of one day in advance of purging, or after sampling the well.

5.3 Purging and Sampling Procedures

The following describes the procedure for the low-flow purging and sampling method. Personal protective equipment will be used in accordance with the requirements of the site-specific Health and Safety Plan. Wells should be sampled in the order of least contaminated to most contaminated, as determined from prior sampling data (if available) or other available information.

1. Attach and secure the tubing to the low-flow pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties. For peristaltic pump operation, lower only the tubing into the well and attach pharmaceutical-grade polyethylene tubing to the portion to be attached to the pump rotor.
2. Pump, safety cable, tubing and electrical lines should be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well, or at a location determined to either be a preferential flow path or zone where contamination is present. The pump intake should be kept a minimum of two feet, if possible, above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well. Secure the pump and tubing to the well casing to prevent slippage of the tubing into the well during purging and sampling.

3. Measure the water level again with the pump in the well before starting the pump. Start the pump at the lowest rate possible while measuring the drawdown continuously. Avoid surging water from the well. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface. Adjust the pumping rate such that there is little or no water level drawdown in the well (less than 0.3 foot) and the water level should stabilize. If the minimum drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging without dewatering the well screen, if possible, until indicator parameters stabilize. Water level measurements should be made continuously. Pumping rate changes (both time and rate) should be recorded in the project log book. Precautions should be taken to avoid pump suction loss or air entrainment. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and ensure stabilization of indicator parameters.

   If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump intake but the operator should attempt to maintain a steady flow rate with the pump to the extent practicable. In these low-yielding wells, where 100 ml/min exceeds the entrance rate of ground water into the well, it is important to avoid complete dewatering of the well screen interval. In these cases, samples may then be collected even though the indicator field parameters have not stabilized.
4. While purging the well, monitoring of water quality indicator parameters should include one or more of the following (see the project FSP): turbidity, specific conductance, pH, DO, temperature, and/or Eh, which must be collected every three to five minutes until all of the parameters have stabilized. Water quality parameter monitoring instrumentation must be calibrated following the manufacturer's instructions and results documented in the project log book. Stabilization is achieved when three successive readings are within:

- ±0.1 for pH;
- ±3 percent for conductivity and temperature;
- ±10 mV for Eh;
- ±10 percent or less than 10 NTU for turbidity; and/or
- ±10 percent for DO.

Turbidity and DO are typically the last parameters to stabilize. If the parameters have stabilized, but the turbidity is not in the range of 5 to 10 NTU, and total metals are required in the sampling plan, then review Step 6 for appropriateness in meeting the site data needs. Otherwise, record turbidity and collect the sample.

Stabilization of indicator parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels less than 10 NTU and a stable drawdown of less than 0.3 feet, while desirable, is not mandatory. It should be noted that natural turbidity levels in ground water may exceed 10 NTU (Puls and Barcelona, 1996).

If after one hour of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken:

- Continue purging until stabilization is achieved;
- Discontinue purging, do not collect any samples, and record in the log book that stabilization could not be achieved (the documentation must describe attempts to achieve stabilization); or
- As discussed in #3 above, discontinue purging, collect samples, and provide a full explanation of attempts to achieve stabilization in the log book.

5. Once stabilization has been documented, volatile organic compound (VOC) samples and redox sensitive (e.g., Fe^{+2}, CH_4) parameter samples should be immediately collected directly into pre-preserved sample containers as discussed in the FSP. All

sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

Samples requiring pH adjustment should have their pH checked to assure that the proper pH has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative required to be added to the sample containers prior to sampling.

6. If the turbidity measurements do not approach 10 NTU, consider collecting both filtered and unfiltered samples for metals analysis (if metals analysis is required by the sampling plan). Naturally occurring turbidity can exceed 10 NTU. Filtered metal samples are to be collected with an in-line filter. A high capacity, in-line 0.45-micron particulate filter (or other as discussed in the project FSP) must be pre-rinsed according to the manufacturer's recommendations, or with approximately 1 liter of ground water following purging and prior to sampling. The sample must be preserved immediately after filtration.
7. The sample must be labeled as defined in the FSP and Quality Assurance Project Plan (QAPP) and/or Sampling Plan as each sample is collected. All samples should be placed into a cooler with proper temperature control as outlined in the FSP/QAPP.

   After collection of the samples, the tubing from the pump should be properly discarded or dedicated to the well for re-sampling (by hanging the tubing inside the well).
8. Secure (close and lock) the well.

Trip blanks, field blanks, duplicates, and matrix spike/matrix spike duplicate samples should be collected and analyzed as outlined in the site specific field sampling plan.

6.0 REFERENCES

Puls, R.W., and Barcelona, M.J., 1996, Low-flow (minimal drawdown) Ground-Water Sampling Procedures, USEPA-ORD, EPA/546/S-95/504.

USEPA Region I, 1996, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells, SOP #1 Revision #2, July 30, 1996.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
MAXIPROBE™ GROUNDWATER SAMPLING

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 3
5.0 PROCEDURES 3
5.1 Equipment and Materials 3
5.2 Ground Water Sampling 4
6.0 REFERENCES 4
7.0 ATTACHMENTS 5
Attachment A: BESST, Inc. MaxiProbe™ Soil and Groundwater Mode Written SOPs.

1.0 PURPOSE

The purpose of this procedure is to provide a guide for collecting representative ground water samples from specific aquifer intervals by using the MaxiProbe™ groundwater sampling system.

2.0 SCOPE

These procedures are relevant when a contractor is hired to perform MaxiProbe™ sampling.

3.0 GLOSSARY

MaxiProbe™ Sampler – The MaxiProbe™ is an in-situ sampling device which allows the simultaneous collection of either in-situ soil gas with soil core or in-situ liquid with soil core.

4.0 RESPONSIBILITIES

Field Operations Leader – Is responsible for overall management of field activities and ensuring that the appropriate sampling procedures are being implemented.

Field Technical Staff – The field technical staff directly oversees the sampling procedures and directs the collection of, packaging, and shipping of water samples. Such duties may also be performed by project engineers or other qualified field personnel.

5.0 PROCEDURES

Detailed procedures are provided in Attachment A. Review prior to initiating field activities and discuss with the Field Operations Leader.

5.1 Equipment and Materials

- Project log book;
- Work Plan with site map;
- Photoionization detector (PID) or flame ionization detector (FID);
- Laboratory sampling equipment (bottles, labels, chain-of-custody forms, coolers, etc.)
- Bailers and bailer cord;

- Water level indicator;
- Plastic sheeting;
- Gloves;
- Buckets;
- Tool box;
- Health and Safety Plan;
- Trash bags;
- Ziplock bags;
- Ice;
- Paper towels;
- Permanent Markers (Sharpies); and
- Traffic cones.

5.2 Ground Water Sampling

Ground water sample collection is detailed in Attachment A. At a minimum, the following information should be recorded for each sample obtained using this SOP:

- Sample ID;
- Depth to water (DTW) immediately after screen deployment;
- DTW before retracting the rod string;
- Length of time purging;
- Method of purging and sampling;
- Number and type of bottles collected;
- Sample collection time; and,
- Results from headspace screening.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

Attachment A: BESST, Inc. MaxiProbe™ Soil and Groundwater Mode Written SOPs.

ATTACHMENT A

BESST, INC. MAXIPROBE™ SOIL AND GROUNDWATER MODE WRITTEN SOPS

BESST, INC.

Geo-Environmental Subsurface Sampling Technologies
"Sample Quality You Can Trust"

MAXIPROBE™

Soil and Groundwater Mode Written SOPs

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STANDARD OPERATING PROCEDURES FOR IN-SITU SAMPLING WITH THE MAXIProbe®

(Collecting Soil and Ground Water Simultaneously)

TABLE OF CONTENTS

1.0 INTRODUCTION.....2

2.0 DESCRIPTION.....2

3.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode - *Using Nitrogen Back Pressurization With Groundwater Canister and Cased Hole or Mud Rotary Drilling Applications*.....3

4.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode – *Using Nitrogen Back Pressurization With the Water Canister and Vacuum Assist (Cased Hole or Mud Rotary Drilling Application)*.....8

5.0 ASSEMBLY AND OPERATION: Water Canister Not Required - Soil/Groundwater Mode - *Using Peristaltic Pump to Pump Groundwater to Surface (Cased Hole or Mud Rotary Drilling Application)*.....8

6.0 ASSEMBLY AND OPERATION: *Soil/Groundwater Mode - Using Up-Hole Hammer, Hollow NW Rods and Sample Bailer (Cased Hole or Mud Rotary Drilling Applications)*.....8

7.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode - *Using Up-Hole Hammer, NW Rods/Bailer and Peristaltic Pump (Cased Hole or Mud Rotary Drilling Applications*.....9

8.0 DECONTAMINATION.....9

STANDARD OPERATING PROCEDURES FOR IN-SITU SAMPLING WITH THE MAXIProbe®

(Collecting Soil and Ground Water Simultaneously)

1.0 INTRODUCTION

The SimulProbe® is an in-situ sampling device which allows the simultaneous collection of either in-situ soil gas with soil core or in-situ liquid with soil core. The purpose of the tool is to collect soil samples simultaneously with liquid or gas which are directly correlative and can be economically collected in one sampling event. The directly correlative nature of the fluids and solids provides more accurate interpretations about:

(1) The relationship between contaminant distribution and stratigraphic characteristics

(2) The opportunity to compare contaminant concentration in gas and liquid with that found in directly correlative soil core.

2.0 DESCRIPTION

The MaxiProbe® (see schematic) is shaped much like a split spoon sampler, but has some distinct differences. A listing of the tool's important dimensions are presented below:

(1) 3.38 inches outside diameter (OD) along the length of the entire tool; excluding the cutting edge of the Drive Shoe.
(2) The inside diameter (ID) of the core barrel is 2.5 inches.
(3) The core barrel length is 18 inches.
(4) The Drive Shoe length is 3 inches.
(5) The 2 liter stainless steel water canister is a 19 inch long modular unit to the base unit

3.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode - *Using Nitrogen Back Pressurization With Groundwater Canister and Cased Hole or Mud Rotary Drilling Applications*

3.1 Place clean Teflon Tubes along the slots in the edges of the Core Barrel Primary Half and push Teflon Tubes into the fluid pathway holes at the top of the slots. The lower end of the Teflon Tubes should end about 1/4 inch short of the lower end of the slots.

3.2 Insert a reed valve into the Core Barrel Primary Half fluid displacement port at top of the Core Barrel.

3.3 Place 3 Core Sleeves into the Core Barrel Primary Half.

Note: **Do not** use standard 6"-long core sleeves as they will not allow the MaxiProbe® Drive Shoe to fully close. (STI MaxiProbe core sleeves are 5 and 13/16 inches long.)

3.5 Place the Core Barrel Cover Half over Core Barrel Primary Half, making sure that the Teflon Tubes are in the grooves between the core barrel halves

3.6 Clamp the core barrel halves together using the chain vise on the driller's breakdown rack. This allows the Coupling to be easily screwed into place.

3.7 Place the Circular Screen over circumferential channel and fluid entry ports at the bottom of core barrel. The circumferential channel is the channel on the outside of the core barrel halves just above the threads to which the Coupling is later attached.

3.8 If using the MaxiProbe® Drive Shoe Extension Assembly, then in addition to the Circular Screen, you will also use the 4-inch Extension Screen. The Extension Screen is first slid onto the grooved Extension Coupling until is seats against the raised lip at the down-hole end of the Extension Coupling. The Extension Coupling is then screwed onto the bottom threads of the Maxi Core Barrel. As you screw on the Extension Coupling and Screen, you will notice how the Extension Screen rotates over the Circular Screen – providing a double filter to the Fluid Entry Ports near the base of the Maxi Core Barrel. Assemble the remaining parts of the Drive Shoe Extension Assembly as you would for the Short Maxi Shoe Assembly (Sections 3.9 through 3.12). If you are not using the Drive Shoe Extension Assembly, then continue on to Section 3.9 below. If you are using the Drive Shoe Extension Assembly, then continue to Section 3.11.

3.9 Screw the Coupling onto the bottom of the core barrel, being careful to keep you fingers back from the sharp edges of the screen.

3.10 Insert the Shoe Sleeve, male threads first, into the bottom (threaded end) of the Cover Sleeve. Attach this assembly to the bottom of the core barrel by screwing it into the Coupling. (See schematic)

3.11 Insert the Sample Catcher (fingers first) into the down-hole end of the Shoe Sleeve. When you feel a little resistance to entry as the finger come into contact with the inside of the Shoe Sleeve, just continue to push firmly and the Sample Catcher will seat into place. This procedure works for the Extension Shoe Sleeve as well.

3.12 Screw the Drive Shoe onto the bottom of the Cover Sleeve.

3.13 Place a Reed Valve onto the single barb nipple at the bottom of the Water Canister Base.

3.14 Place a black o-ring above the threads of the Water Canister Base.

3.15 Screw the Water Canister Base into the top of the Core Barrel Primary Half.

3.16 Place a Black O-Ring above the threads at the bottom of the Water Canister and screw the Water Canister into the Water Canister Base.

3.17 Wrap Teflon tape around the threads of the Upper Reed Valve Support and screw it into the base of the Sampler Head.

3.18 Wrap Teflon tape around the threads of the Hex plug and screw it into the center of the Upper Reed Valve Support

3.19 Place a Black O-Ring above the Sampler Head's threads and screw the Sampler Head into the top of the Water Canister.

3.20 Close the Drive Shoe and pull a Rubber Gooch Tube over the junction between the Core Barrel and the Drive Shoe.

3.21 Push and snap Yellow Diaphragm (hydrostatic heads of 50 feet or less) into cutting edge of Drive Shoe. Use the Ceramic Diaphragm for pressures greater than 50 feet of hydrostatic head.

3.22 Roll on latex Condom from shoe along length of probe. Be careful not to rest the weight of the probe on the Swage-lok connector during this procedure. Place the second Gooch tube over the Condom along the bottom of the drive shoe. This serves as a bumper to protect the Condom as the tool is lowered into the bore hole.

3.23 Attach MaxiProbe® to one-foot AW rod. Be careful not to rest weight of probe on Condom covered shoe while attaching the AW rod and to the drive hammer

3.24 Attach Soil Gas Line to the Swage-lok connector at top of the Sampler Head.

3.25 Connect the AW adapter pin and rod to the top of the Sampler Head. The Driller then raises the Maxi tool with the winch line and lowers it a few feet into the casing.

3.26 Attach the up-hole end of the spool to the inert gas tank regulator. The three-way valve handle on the side of the Hose Spool should be pointed towards regulator line.

3.27 With the probe suspended a few feet down inside the casing, pressurize the water canister. The rule of thumb for pressurizing is to assume 60 PSI/100 feet of hydrostatic head (pure water is approximately 43 PSI/100 feet; the additional pressure assumes suspended and dissolved solids and thus increased specific gravity). See attached tables from Groundwater and Wells, Driscoll, 1987, pages 938 and 939 **Note: for safety, the MaxiProbe® should always be pressurized and de-pressurized inside the casing.**

3.28 Observe line pressure gauge on regulator When line pressure is equal to 60 PSI/100 feet of hydrostatic head (0.6 PSI/ft), close 3-way valve on hose spool to trap pressure. Closed position is when the valve handle is at 90 degrees to 3-way valve's body. The 3-way valve is attached to the side of the hose reel and is the up-hole terminus for the Teflon line. The line is attached to the center port on the "T" shaped valve. One of the two side ports is connected to the Nitrogen gas supply and the second is attached to a short (2.5') length of Teflon line. This short length is used for the inverted soda bottle method described in section 5.22. If the valve is positioned halfway between these two ports, which is 90 degrees to the 3-way valve's body, all three ports are closed to each other Pointing the

valve handle at either of the two side ports connects the central port to that side port.

3.29 Disconnect the Teflon line from the regulator and hook it onto the side of the spool.

3.30 Slowly lower the MaxiProbe® to the bottom of the bore hole and hammer it 2-1 inches into subsurface to collect the soil core.

3.31 Pull the MaxiProbe® back 2 to 3 inches to retract the sliding Drive Shoe and expose the Circular Screen.

3.32 Open valve to allow pressure bleed off through the short length of Teflon tube attached to the valve.

3.33 Allow water to enter tool under ambient hydrostatic pressure. After the initial pressure bleed off, the fill rate can be observed by placing the open end of the Teflon tube into a bucket of water. For fast to moderate fill rates, the end of the Teflon tube can be placed inside an inverted water filled bottle inside the bucket (i.e. one liter plastic soda bottle). When the bottle is full of air displaced from ground water entering the Water Canister it can be reused for additional volume measurements.

3.34 After sufficient water sample has been collected, re-pressurize the MaxiProbe® by following steps in Sections 3.26 through 3.29.

3.35 Pull the MaxiProbe® to a few feet below the top of the casing and de-pressurize. **Note: for safety, the MaxiProbe® should always be pressurized and de-pressurized inside the casing.**

3.36 Remove the MaxiProbe® from the casing and stand it vertically on ground.

3.37 To remove water canister, unscrew the Water Canister Base from the Core Barrel Primary Half (using spanner wrenches). Keep the Water Canister upright to minimize sample agitation, and insert a short length of 1/4-inch OD Teflon tube through the bottom of the Reed Valve to drain and collect a water sample from the bottom of the Water Canister.

3.38 Disassemble the core barrel using MaxiProbe® wrenches and remove the soil core.

4.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode – *Using Nitrogen Back Pressurization With the Water Canister and Vacuum Assist (Cased Hole or Mud Rotary Drilling Application)*

Instructions are the same as above with the additional step of using a peristaltic or vacuum pump to lift water into the water canister. Vacuum assist is not recommended when sampling for volatile compounds.

5.0 ASSEMBLY AND OPERATION: Water Canister Not Required - Soil/Groundwater Mode - *Using Peristaltic Pump to Pump Groundwater to Surface (Cased Hole or Mud Rotary Drilling Application)*

This is a shallow (less than 25 feet) groundwater sampling technique for non-VOC sample collection. There is no Water Canister required when it is thought that the formation permeability is sufficient to allow water to be drawn through a peristaltic pump.

The peristaltic pump technique will only work if the piezometric water level of the formation being sampled is 25 feet or less below the ground surface. Note: Suspended and dissolved solids will increase the fluid specific gravity and thus reduce the effective depth range of a peristaltic pump.

6.0 ASSEMBLY AND OPERATION: *Soil/Groundwater Mode - Using Up-Hole Hammer, Hollow NW Rods and Sample Bailer (Cased Hole or Mud Rotary Drilling Applications)*

6.1 Assemble the MaxiProbe® as in Section 3.0 of the Soil/Soil Gas SOP.

6.2 Attach a hollow NW rod to the top of the MaxiProbe® using a hollow NW/AW pin converter. This will allow fluids to pass through the Upper Reed Valve port at the bottom of the Sampler Head and into the hollow NW rods for collection by bailer.

6.3 Lower the MaxiProbe® to the bottom of the bore hole, adding more NW rods as needed. **Use O-rings or Teflon paste between NW rod connections to prevent cross contamination from bore hole fluids.**

6.4 Drive the MaxiProbe® 21 inches using an up-hole hammer on the top of the NW rod string.

6.5 Retract the MaxiProbe® 2 to 3 inches to expose the Circular Screen. The water sample will flow into the hollow NW rods.

6.6 Lower a decontaminated water level sensor inside the NW rods to determine when there is enough water to collect a sample.

6.7 Collect the water sample using a Teflon bailer.

6.8 Withdraw the MaxiProbe® and collect the soil core sample.

7.0 ASSEMBLY AND OPERATION: Soil/Groundwater Mode - *Using Up-Hole Hammer, NW Rods/Bailer and Peristaltic Pump (Cased Hole or Mud Rotary Drilling Applications)*

The NW Rods/Bailer and Peristaltic Pump water sampling methods can be combined when sampling protocols include the collection of samples for volatile compounds and the sampled formations have shallow (<25' BGS) piezometric water levels.

7.1 Follow the instructions for sampling using hollow NW rods and a bailer, except add a peristaltic vacuum line to the Swagelok fitting on top of the Sampler Head.

7.2 Once the MaxiProbe® has been hammered into place and opened, the first sample should be collected by bailer for volatile compounds

7.3 Subsequent samples can then be collected by peristaltic pump.

8.0 DECONTAMINATION

Follow procedures specified in site specific work plan and/or quality assurance project plan for standard operating procedures for sampling device decontamination. Always use a new consumable kit for each sample. Reuse of consumables may result in cross contamination of samples through incomplete decontamination or from leakage through damaged O-Rings and Reed Valves.

STANDARD OPERATING PROCEDURE (SOP)
DECONTAMINATION OF
SAMPLING AND FIELD EQUIPMENT

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 3
5.0 PROCEDURES 3
5.1 Specifications for Cleaning Materials 4
5.2 Handling and Containers for Cleaning Solutions 4
5.3 Standard Field Cleaning Procedures 5
5.3.1 General Information 5
5.3.2 Field Equipment Cleaning Procedures 6
5.3.3 Downhole Drilling Equipment 9
6.0 REFERENCES 11
7.0 ATTACHMENTS 11

1.0 PURPOSE

The purpose of these procedures is to provide a general methodology, protocol, and reference information on the proper decontamination procedures to be used for sampling and field equipment in the field.

2.0 SCOPE

These procedures address accepted methods for the decontamination of non-disposable sampling and field equipment commonly used by Gannett Fleming personnel. The SOP is not intended to cover all types of equipment that may be used on a project. If you are planning on using non-disposable equipment that is not included in this SOP, consult with the Project Manager and review the appropriate equipment manual for proper decontamination methods prior to initiating field activities.

3.0 GLOSSARY

Terms are defined in the Procedures section.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with these guidelines.

Field Operations Leader – Is responsible for ensuring that equipment used in the field has been properly decontaminated.

Field Technical Staff – Are responsible for following procedures listed in this SOP and for confirming and communicating any site-specific variations from the SOP prior to conducting fieldwork.

5.0 PROCEDURES

Whenever possible and practicable, Gannett Fleming will use disposable sampling equipment. However, when the use of disposable equipment is not possible or feasible, Gannett Fleming will use the following procedures to decontaminate field equipment.

In order to assure that chemical analysis results are reflective of the actual concentrations present at sampling locations, chemical sampling and field analysis equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e., between sample points), and at the conclusion of the sampling program. This will minimize the potential for cross-contamination between sample points and the transfer of contamination off site.

5.1 Specifications for Cleaning Materials

Specifications for standard cleaning materials referred to in this SOP are as follows:

- Soap shall be a standard brand of phosphate-free laboratory detergent such as Liquinox® or Alconox®. Use of other detergent must be justified and documented in the project log books and inspection or investigative reports.
- Disinfectant soap shall be a standard brand of disinfectant cleaner.
- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.
- Deionized water is tap water that has been treated by passing through a standard deionizing resin column. Analyte free water obtained by other methods may be acceptable. Confirm with the Field Operations Leader prior to use.

Laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination.

5.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
- Disinfectant soap should be kept in clean containers until use. It should be poured directly from the container.

- Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
- Deionized water must be stored in clean glass, stainless steel, or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.

Note: Hand pump sprayers generally are not acceptable storage or application containers for the above materials (with the exception of tap water). This also applies to stainless steel sprayers. All hand sprayers have internal oil coated gaskets and black rubber seals that may contaminate the solutions.

5.3 Standard Field Cleaning Procedures

These cleaning procedures are intended for use by field personnel for cleaning sampling and other equipment in the field.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for Data Quality Objectives (DQO) definitive data collection. Deviations from these procedures should be approved by the Project Manager and documented in the approved Field Sampling Plan, field records, and investigative reports.

Below are the materials, methods, and procedures to be used when cleaning sampling and other equipment in the field.

5.3.1 General Information

Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigation-derived waste (IDW), including used wash water and rinse water will be determined on a project-specific basis. Field Technical Staff are responsible for obtaining this information from the Field Operations Leader.

Equipment Contaminated with Concentrated Wastes

Equipment used to collect samples of hazardous materials, toxic wastes, or materials from hazardous waste sites, RCRA facilities, or in-process waste streams should be field-cleaned before returning from the study. At a minimum, this should consist of washing with soap, rinsing with tap water, and rinsing with deionized water. More stringent procedures may be required based on site conditions and/or at the discretion of the Project Manager.

Safety Procedures for Field Cleaning Operations

Some of the materials used to implement the cleaning procedures outlined in this SOP can be harmful if used improperly. Caution should be exercised by all field personnel and all applicable safety procedures should be followed. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- Safety glasses with splash shields or goggles, and nitrile gloves will be worn.
- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted.

Additional requirements may be imposed by the Health and Safety Plan (HASP) for the sampling event.

Handling of Cleaned Equipment

After field cleaning, equipment should be handled only by personnel wearing clean gloves to prevent recontamination. In addition, the equipment should be moved away (preferably upwind) from the cleaning area to prevent recontamination. If the equipment is not to be immediately reused it should be covered with plastic sheeting or wrapped in aluminum foil to prevent recontamination. The area where the equipment is kept prior to reuse must be free of contaminants.

5.3.2 Field Equipment Cleaning Procedures

Sufficient clean equipment should be transported to the field so that an entire study can be conducted without the need for field cleaning. However, this is not possible for some specialized items such as hand-augers, well drilling rigs, soil coring rigs, and other large pieces of field equipment. In addition, particularly during large scale studies, it is not practical or possible to transport all of the

precleaned field equipment required into the field. The following procedures are to be utilized when equipment must be cleaned in the field.

Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- The pad should not leak excessively.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined. Often a metal horse watering trough will suffice in place of a pad.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.
- Water should be removed from the decontamination pad frequently.
- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. If applicable, the pit or sump should be backfilled with the appropriate material designated in the Work Plan, but only after all waste/rinse water has been pumped into containers for disposal.

"Classic Parameter" Sampling Equipment

"Classic Parameters" are analyses such as, but are not limited to, oxygen demand, dissolved oxygen, nutrients, certain inorganics, sulfide, and flow measurements. For routine operations involving classic parameter analyses, water quality sampling equipment (e.g., Kemmerers, buckets, dissolved oxygen dunkers, and dredges) may be cleaned with the tap water or deionized water between sampling locations. A brush may be used to remove deposits of material or sediment, if necessary.

If tap or deionized water is used, the water quality sampling equipment should be flushed at the next sampling location with the substance (water) to be sampled prior to sample collection.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

The previously described procedures are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

Sampling Equipment for the Collection of Trace Organic and Inorganic Compounds

The following procedures are to be used for all sampling equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

1. Clean with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam-cleaned (soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad or trough. PVC or plastic items should not be steam-cleaned.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

Water Level Indicators and Oil/Water Interface Meters

1. Wash with soap and tap water.
2. Rinse with tap water.
3. Rinse with analyte free water.

Submersible Pump Cleaning Procedures

CAUTION - To avoid damaging the submersible pump:

- Never run pump when dry.
- Never switch directly from the forward to the reverse mode without pausing in the "OFF" position.

The submersible pump should be cleaned prior to use and between each monitoring well. The following procedure is required:

1. Pump a sufficient amount of soapy water through the hose to flush out any residual purge water.
2. Using a brush, scrub the exterior of the contaminated hose and pump with soapy water. Rinse the soap from the outside of the hose with tap water. Rinse the hose with analyte-free water and recoil.
3. Pump a sufficient amount of tap water through the hose to flush out all the soapy water (approximately one gallon).
4. Pump a sufficient amount of analyte-free water through the hose to flush out the tap water, then purge with the pump in the reverse mode.
5. Rinse the outside of the pump housing and hose with analyte-free water (approximately 1/4 gallon).
6. Place pump and reel in clean plastic bag.

5.3.3 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses, and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. Tap water (potable) brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank of sufficient size so that drilling activities can proceed without

having to stop and obtain additional water. A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2,500 psi and producing hot water and/or steam (greater than 200°F), with a soap compartment, should be obtained.

Preliminary Cleaning and Inspection

The drill rig should be clean of any contaminants that may have been transported from another hazardous waste site, to minimize the potential for cross-contamination. Confirmation of this should be obtained from the driller. Further, the drill rig itself should not serve as a source of contaminants. In addition, associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.
- Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam-cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other hazardous waste sites before being brought on site.
- Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can supply materials without the printing and/or writing if specified when ordered.
- The drill rig and other equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.
- PVC or plastic materials such as tremie tubes should be inspected. Items that cannot be cleaned are not acceptable and should be discarded.

Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam-cleaned (soap and high pressure hot water) between boreholes.

Field Cleaning Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be cleaned as outlined previously.

1. Clean with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam-cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad or trough. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
2. Rinse thoroughly with tap water.
3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

When there is concern for low level contaminants it may be necessary to clean this equipment between borehole drilling and/or monitoring well installation using the procedure outlined previously for equipment used for trace analysis.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
GEOPROBE® SCREEN POINT 15/16 GROUNDWATER SAMPLING

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 3
5.0 PROCEDURES 4
5.1 Equipment and Materials 4
5.2 Screen Point Advancement 5
5.3 Ground Water Sampling 5
6.0 REFERENCES 6
7.0 ATTACHMENTS 6

1.0 PURPOSE

The purpose of this procedure is to provide a guide for collecting representative ground water samples from specific intervals by using the Geoprobe® Screen Point (SP) 15/16.

2.0 SCOPE

These procedures are relevant when a contractor is hired to perform Geoprobe® SP 15/16 sampling. Similar equipment, including the Hydropunch® System, may be used on Gannett Fleming projects. The general procedures described here may be relevant to sampling with these other systems. Check the specific users manual to confirm prior to conducting the ground water sampling event.

3.0 GLOSSARY

Screen Point (SP) 15 Sampler – A protected screen, direct push ground water sampler for use in unconsolidated materials. The screen consists of up to 41 inches of 0.004-inch slot stainless steel mesh with an inside diameter of 0.625 inches. The system requires the use of 1.0 or 1.25-inch steel rods. Disposable polyvinyl chloride (PVC) screens are also available.

Screen Point (SP) 16 Sampler – A slightly larger (heavy duty) assembly than the Screen Point 15. While the screen is identical to the Screen Point 15, the sampler sheath is designed for use with 1.5-inch rods.

4.0 RESPONSIBILITIES

Field Operations Leader – responsible for overall management of field activities and ensuring that the appropriate sampling procedures are being implemented.

Field Technical Staff – directly oversees the sampling procedures and directs the collection of, packaging, and shipping of water samples. Such duties may also be performed by project engineers or other qualified field personnel.

5.0 PROCEDURES

The SP 15/16 sampler is an effective tool used for the collection of ground water samples. The sampler consists of a screen assembly, sampler sheath, drive head, and an expendable drive point. The entire assembly is advanced into the subsurface using a Geoprobe® and/or other direct push system. When the assembly has been advanced to the required depth, the screen is exposed by retracting the sampler sheath. Ground water can then enter the sampler and be collected. Detailed procedures are provided in Geoprobe® Technical Bulletin No. 95-1500, titled "Geoprobe® Screen Point 15 and Screen Point 16 Groundwater Samplers" (Attachment A).

5.1 Equipment and Materials

- Project log book;
- Work Plan with site map;
- Laboratory sampling equipment (bottles, labels, chain-of-custody forms, coolers, etc.);
- Water level indicator;
- Plastic sheeting;
- Gloves;
- Buckets;
- Tool box;
- Health and Safety Plan;
- Trash bags;
- Zip lock bags;
- Ice;
- Paper towels;
- Permanent markers (Sharpies); and
- Traffic cones.

5.2 Screen Point Advancement

The SP 15/16 Groundwater Sampler is driven into the subsurface using a Geoprobe® or similar machine. Additional probe rods are subsequently added and driven until the desired sampling interval is reached. The sampling intervals are site-specific and will be outlined in the Project Field Sampling Plan (FSP). Once at the desired depth interval, extension rods are sent down-hole until the leading control rod contacts the bottom of the sampler screen. The tool string is then retracted about four feet while the screen is held in place with the extension rods. As the tool string is retracted, the expendable point is released from the sampler sheath, exposing the stainless steel or disposable PVC screen. The tool string and sheath may be retracted the full length (41 inches) of the screen or as little as a few inches if a small sampling interval is desired. Detailed procedures are provided in the Geoprobe® Technical Bulletin No. 95-1500, titled "Geoprobe® Screen Point 15 and Screen Point 16 Groundwater Samplers" (Attachment A).

5.3 Ground Water Sampling

Measure the ground water level immediately after retracting the rods and exposing the screen and record the values in the log book. Insert the sample tubing through the annular space of the drive rods. Leave approximately five feet of tubing extending out of the tool string. Insert a new piece of tubing into the peristaltic pump and attach one end to the sample tubing. Turn on the peristaltic pump and purge the interval for a minimum of five minutes or until the selected indicator parameters have stabilized. Document all readings in the project log book. Water will then be diverted into the sample containers. Label the samples and put on ice immediately after sampling. Depending on the analysis (field vs. fixed-base), packaging requirements may differ. Refer to the Project FSP. Measure the ground water level after sampling, and record the value in the project log book.

If the water level remains below approximately 25 feet below ground surface before or during purging, an alternative method of collecting a ground water sample must be used. These may include using a bailer or pneumatic bladder pump. See Attachment A for details. Ground water

samples collected with ten feet of the ground water table may require the use of temporary well screens instead of the SP 15/16 apparatus.

At a minimum, the following information should be recorded for each sample obtained using this SOP:

- Sample ID;
- Depth to water (DTW) immediately after screen deployment;
- DTW before retracting the rod string;
- Length of time purging;
- Method of purging and sampling;
- Indicator parameter measurements;
- Number and type of bottles collected; and
- Sample collection time.

After collecting the ground water sample, the tool string will be extracted from the borehole. Ensure that all non-disposable parts of the sampling assembly are thoroughly decontaminated after each use. Have the Geoprobe® operator scrub all metal parts using a stiff, long-bristled brush and a non-phosphate soap solution. Rinse with distilled water before reassembly.

6.0 REFERENCES

Kejr Engineering, Inc., 1997. *Geoprobe® Systems 98-99.* Salina, Kansas.

7.0 ATTACHMENTS

Attachment A: "Geoprobe® Screen Point 15 and Screen Point 16 Groundwater Samplers". Geoprobe® Technical Bulletin No. 95-1500.

ATTACHMENT A
GEOPROBE® SCREEN POINT 15 AND SCREEN POINT 16 GROUNDWATER SAMPLERS

GEOPROBE® SCREEN POINT 15 AND SCREEN POINT 16 GROUNDWATER SAMPLERS

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 95-1500

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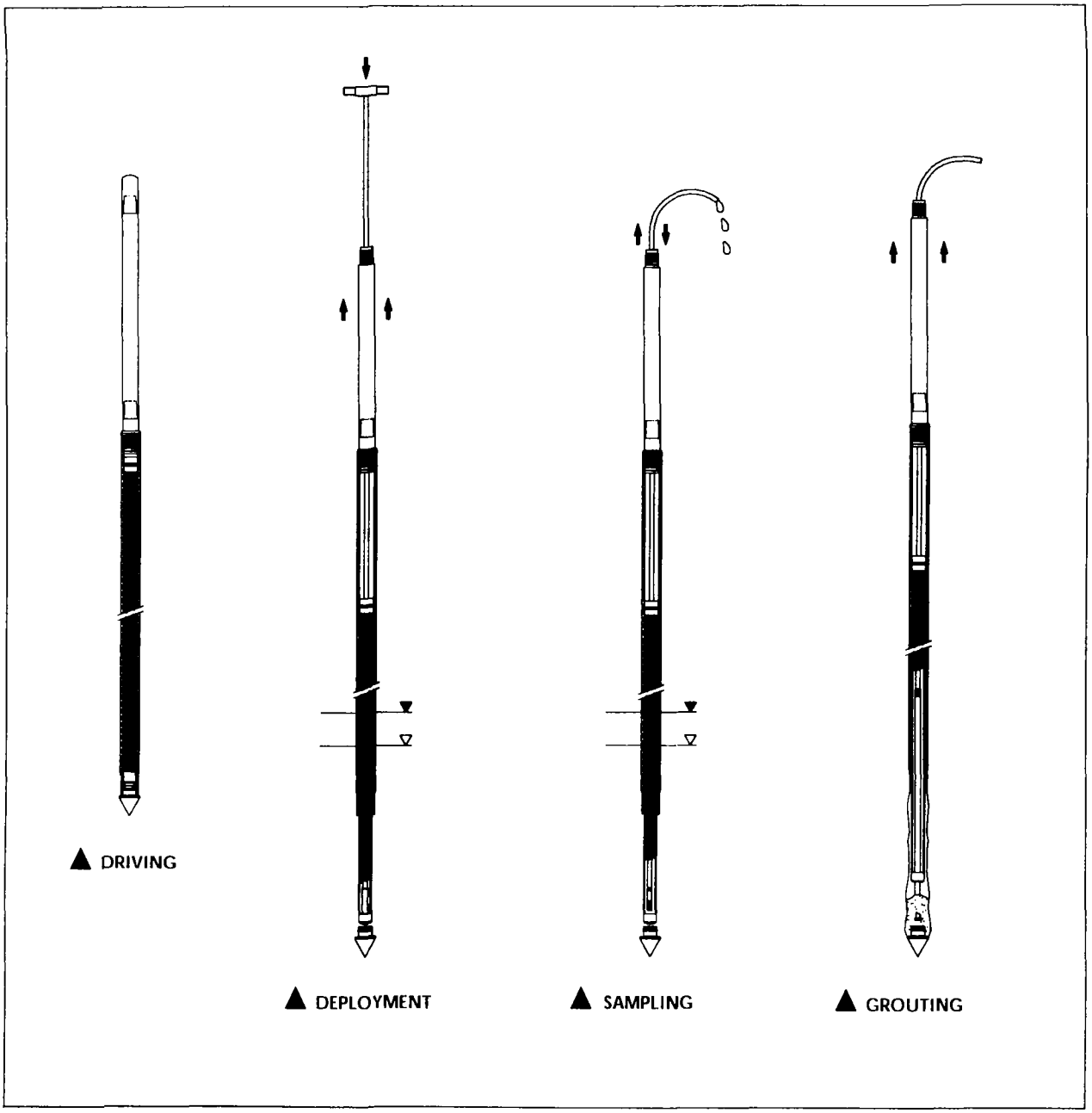

GEOPROBE SCREEN POINT 15 / SCREEN POINT 16 GROUNDWATER SAMPLERS

A DIVISION OF KEJR, INC.

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Screen Point 15 and Screen Point 16 Groundwater Samplers manufactured under U.S. Patent 5,612,498

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1.0 OBJECTIVE

The objective of this procedure is to drive a sealed stainless steel or PVC screen to depth, deploy the screen, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 15 and Screen Point 16 Groundwater Samplers enable the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 BACKGROUND

2.1 Definitions

Geoprobe®: A brand name of high quality, hydraulically powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe tools are used to perform soil core and soil gas sampling, groundwater sampling and monitoring, soil conductivity and contaminant logging, grouting, and materials injection.

Screen Point 15 (SP15) Groundwater Sampler: A direct push device consisting of a PVC or stainless steel screen that is driven to depth within a sealed, steel sheath and then deployed for the collection of representative groundwater samples. The assembled SP15 Sampler is approximately 50.5 inches (1283 mm) long with an OD of 1.5 inches (38 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. The Screen Point 15 Groundwater Sampler is used primarily with 1.25-inch probe rods and machines equipped with a GH40 Series (GH40, GH41, or GH42) Hydraulic Hammer.

Screen Point 16 (SP16) Groundwater Sampler: A direct push device consisting of a PVC or stainless steel screen that is driven to depth within a sealed, steel sheath and then deployed for the collection of representative groundwater samples. The assembled SP16 Sampler is approximately 51.5 inches (1308 mm) long with an OD of 1.625 inches (41 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. The Screen Point 16 Groundwater Sampler is designed for use with 1.5-inch probe rods and machines equipped with the more powerful GH60 Hydraulic Hammer. Operators with GH40 Series hammers may chose to use this sampler in soils where driving is difficult.

Rod Grip Pull System: An attachment mounted on the hydraulic hammer of a direct push machine which makes it possible to retract the tool string with extension rods or flexible tubing protruding from the top of the probe rods. The Rod Grip Pull System includes a pull block with rod grip jaws and two support straps that are bolted directly to the machine. A removable handle assembly straddles the tool string while hooking onto the pull block to effectively grip the probe rods as the hammer is raised. A separate handle assembly is required for each probe rod diameter.

2.2 Discussion

In this procedure, the assembled Screen Point 15 or Screen Point 16 Groundwater Sampler (Fig. 2.1A) is threaded onto the leading end of a Geoprobe probe rod and advanced into the subsurface with a Geoprobe direct push machine. Additional probe rods are added incrementally and advanced until the desired sampling interval is reached. While the sampler is advanced to depth, O-ring seals at each rod joint, the drive head, and the expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods (Fig. 2.1B). As the tool string is retracted, the expendable point is released from the sampler sheath. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

There are three types of screens that can be used in both the Screen Point 15 and Screen Point 16 Groundwater Samplers. Two of the these, a stainless steel screen with a standard slot size of 0.004 inches (0.10 mm) and a PVC screen with a standard slot size of 0.010 inches (0.25 mm), are recovered with the tool string after sampling. The third screen is also manufactured from PVC with a standard slot size of 0.010 inches (0.25 mm), but is designed to be left downhole when sampling is complete. This disposable screen has an exposed screen length of approximately 43 inches (1092 mm). The two screens that are recovered with the sampler both have an exposed screen length of approximately 41 inches (1041 mm). Alternate slot sizes and lengths may be custom ordered. Contact Geoprobe Systems for available options.

An O-ring on the head of the non-disposable screens maintains a seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen. Disposable screens do not require an O-ring because the tolerance between the screen head and sampler sheath is near that of the screen slot size.

The screens are constructed such that flexible tubing, a mini-bailer, or a small-diameter bladder pump can be inserted into the screen cavity. This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screens allows the user to grout as the sampler is extracted for further use.

Groundwater samples can be obtained in a number of ways. A common method utilizes polyethylene or Teflon® tubing and a Tubing Bottom Check Valve (GW42). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down. If oscillating the tubing is undesirable (such as when sampling for volatiles analysis), lower the check valve and tubing to the bottom of the sampler without the check ball. Then drop the check ball into the tubing from the ground surface. The ball will seat in the check valve and trap the sample in the tubing. Collect the sample by withdrawing and draining the tubing.

An alternative means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). Another technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

The latest option for collecting groundwater from the SP15 and SP16 samplers is to utilize Geoprobe's GW1400 Series Pneumatic Bladder Pump. This type of pump is preferred for low-flow sampling (EPA 1996). It provides minimal disturbance of the sample because fluid is pushed, not drawn or vacuumed, to the surface. Turbidity is low and loss of volatile contaminants is negligible.

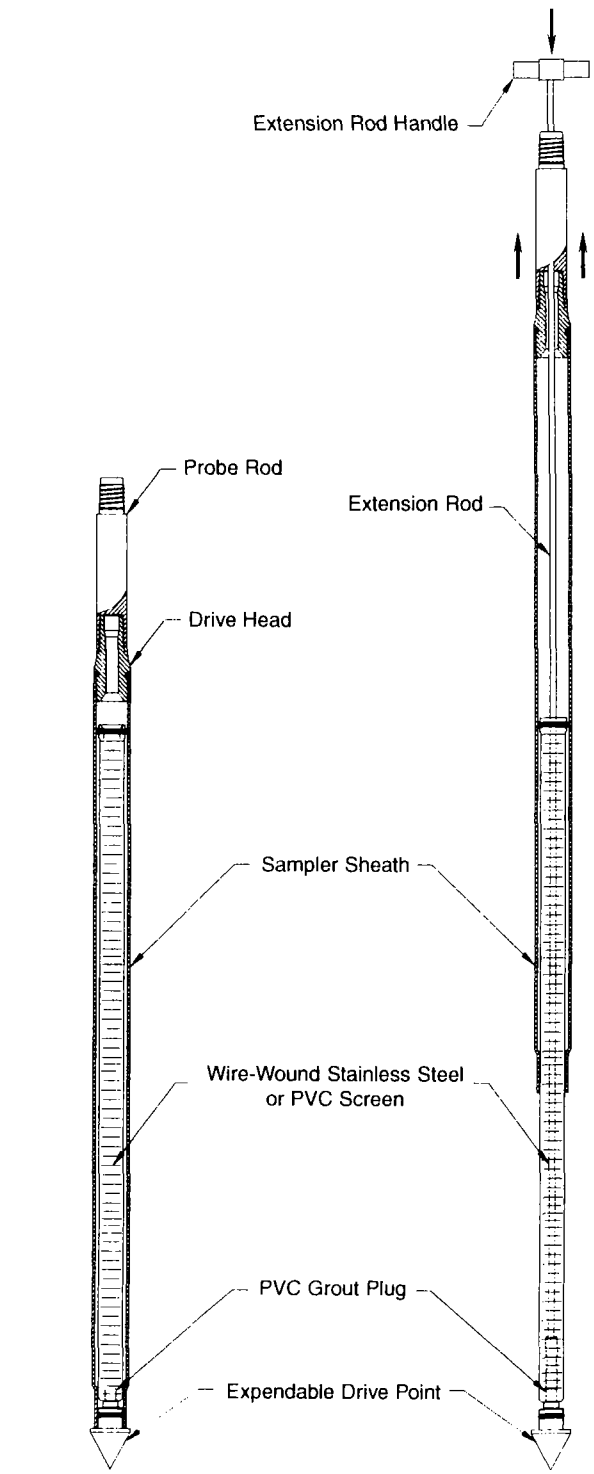


FIGURE 2.1
Screen Point 15 / Screen Point 16 Groundwater Sampler

3.0 REQUIRED EQUIPMENT

The following equipment can be used to successfully recover representative groundwater samples with the Geoprobe Screen Point 15 and Screen Point 16 Groundwater Samplers. Refer to Figure 3.1 for identification of the specified SP15 sampler parts and Figure 3.2 for identification of the SP16 sampler parts.

Screen Point 15 Groundwater Sampler Parts	**Quantity**	**Part Number**
SP15 Sampler Sheath	-1-	GW1510
Drive Head, 0.625-inch bore, 1.25-inch rods	-1-	GW1512
Drive Head, 0.5-inch bore, 1.25-inch rods	-1-	GW1513
O-ring Service Kit, 1.25-inch rods (100 of each O-ring)	-1-	GW1505K
Screen Point 15 Groundwater Sampler Kit, 1.25-inch Probe Rods		*GW1512K*

Screen Point 16 Groundwater Sampler Parts	**Quantity**	**Part Number**
SP16 Sampler Sheath	-1-	15187
Drive Head, 0.625-inch bore, 1.5-inch rods	-1-	15188
O-ring Service Kit, 1.5-inch rods (100 of each O-ring)	-1-	GW1505K
Screen Point 16 Groundwater Sampler Kit, 1.5-inch Probe Rods		*15770*

Accessories for SP15 and SP16 Samplers	**Quantity**	**Part Number**
Screen, Wire-Wound Stainless Steel, 4-Slot	-1-	GW1520
Screen, PVC, 10-Slot	-1-	GW1530
Screen, Disposable, PVC, 10-Slot	Variable	16089
Screen Push Adapter	-1-	GW1535
Grout Plug Push Adapter	-1-	GW1540
Grout Nozzle	-1-	GW1545
Grout Plugs, PVC (Pkg. of 25)	-1-	GW1551K
Expendable Drive Points, Steel, 1.625-inch OD (Pkg. of 25)	-1-	GW1555K
Expendable Drive Points, Aluminum, 1.625-inch OD (Pkg. of 25)	-1-	GW1555ALK
Expendable Drive Points, Steel, 1.75-inch OD (Pkg. of 25)	-1-	17066K

Geoprobe Tools	**Quantity**	**Part Number**
Drive Cap, 1.25-inch probe rods	-1-	AT1200
Pull Cap, 1.25-inch probe rods	-1-	AT1204
Probe Rod, 1.25-inch x 48-inch*	Variable	AT1248
O-rings for 1.25-inch Probe Rods (Pkg. of 25)	Variable	AT1250R
Drive Cap, 1.5-inch probe rods, (for GH40 Series Hammer)	-1-	15590
Drive Cap, 1.5-inch probe rods, Threadless, (for GH60 Hammer)	-1-	12787
Pull Cap, Slotted, 1.5-inch probe rods	-1-	15164
Probe Rod, 1.5-inch x 60-inch**	Variable	11121
O-rings for 1.5-inch Probe Rods (Pkg. of 25)	Variable	15389
Extension Rod, 48-inch***	Variable	AT671
Extension Rod, 60-inch***	Variable	AT10073
Extension Rod Coupler	Variable	AT68
Extension Rod Handle	-1-	AT69
Extension Rod Jig	-1-	AT690
Quick Link Extension Rod Connectors	Variable	AT694K
Rod Grip Pull System, 1.25-inch Probe Rods (for GH40 Series Hammer)	-1-	GH1250K
Rod Grip Pull Handle, 1.5-inch Probe Rods (for GH40 Series Hammer)	-1-	GH1555
Rod Grip Pull Handle, 1.5-inch Probe Rods (for GH60 Hammer)	-1-	15554
Water Level Meter	-1-	GW2000

* Geoprobe 1.25-inch OD probe rods are also available in lengths of 36 inches, 60 inches, and 1 meter.
** Geoprobe 1.5-inch OD probe rods are also available in lengths of 1 meter and 48 inches.
*** Geoprobe extension rods are also available in lengths of 36 inches and 1 meter.

Additional Tools	**Quantity**
Adjustable Wrench	-1-
Pipe Wrenches	-2-

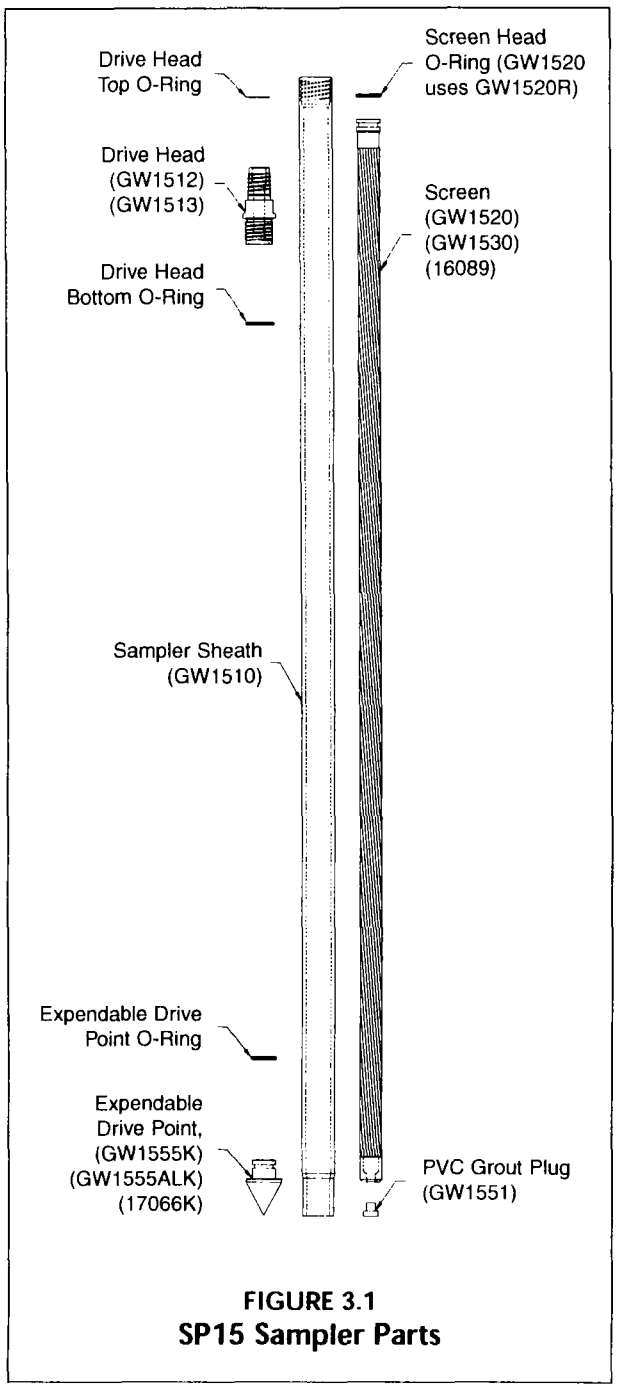


FIGURE 3.1
SP15 Sampler Parts

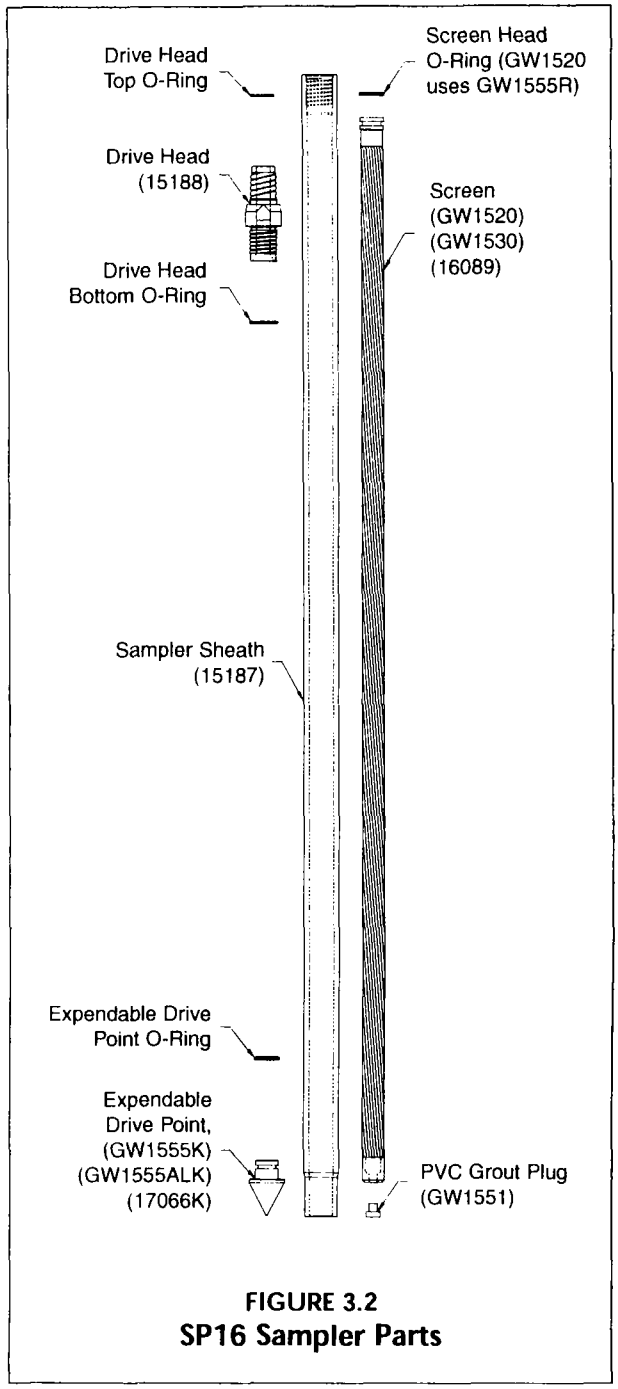


FIGURE 3.2
SP16 Sampler Parts

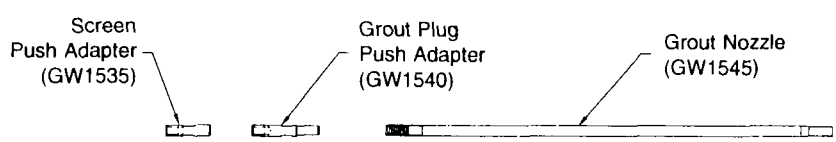


FIGURE 3.3
SP15 / SP16 Accessories

4.0 OPERATION

4.1 Basic Operation

The basic operation of the Screen Point 15 and Screen Point 16 Groundwater samplers is identical. Subtle differences in the design of the SP16 sampler make it more durable than the earlier SP15 system. Operators of GH60-equipped machines should always utilize SP16 tooling. Operators of machines equipped with GH40 Series hammers may also choose SP16 tooling when sampling in difficult probing conditions.

The SP15 and SP16 samplers utilize a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a watertight sheath which keeps contaminants out of the system as the sampler is driven to depth.

Once the desired sampling interval is reached, extension rods equipped with a screen push adapter are inserted down the inside diameter of the probe rod string. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods. At this point the system is ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

4.2 Sampler Options

A 1.75-inch OD Expendable Drive Point (17066K) and Disposable PVC Screen (16089) provide the operator with two useful options. The 1.75-inch drive point may be used when soil conditions make it difficult to remove the SP16 sampler after driving to depth with a GH60-equipped machine. The disposable PVC screen may be left downhole after sampling (when regulations permit) to eliminate the time required for screen decontamination.

4.3 Decontamination

In order to collect representative groundwater samples, all sampler parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff, long-bristle brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

4.4 SP15 Sampler Assembly (Figure 4.1)

Part numbers are listed for a standard SP15 sampler using 1.25-inch probe rods. Refer to Page 6 for screen and drive head alternatives.

1. Install an O-ring on a steel expendable drive point (GW1555K). Firmly seat the expendable point in the necked end of a sampler sheath (GW1510).

2. Place a PVC grout plug (GW1551) in the lower end of a wire-wound stainless steel screen (GW1520). Install a GW1520R O-ring in the groove on the upper end of the screen.

3. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Lubricate the O-ring with clean distilled water if needed. Ensure that the expendable point was not displaced by the screen.

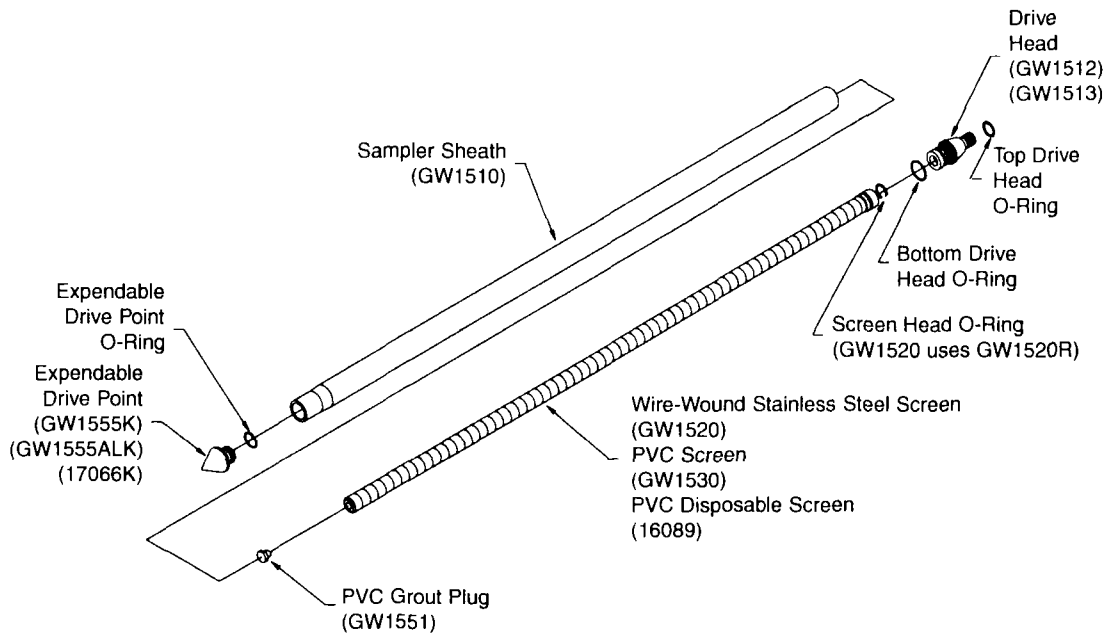


FIGURE 4.1
Screen Point 15 Groundwater Sampler Assembly

4. Install a bottom O-ring on a drive head (GW1513). Thread the drive head onto the sampler sheath. Attach a drive cap (AT1200) to the top of the drive head. Ensure that the threads engage completely. Tighten with an adjustable wrench if necessary.

Sampler assembly is complete.

4.5 SP16 Sampler Assembly (Figure 4.2)

Part numbers are listed for a standard SP16 sampler using 1.5-inch probe rods. Refer to Page 6 for screen alternatives.

1. Install an O-ring on a steel expendable drive point (GW1555K). Firmly seat the expendable point in the necked end of a sampler sheath (15187).

2. Place a PVC grout plug (GW1551) in the lower end of a wire-wound stainless steel screen (GW1520). Install a GW1555R O-ring in the groove on the upper end of the screen.

3. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Ensure that the expendable point was not displaced by the screen.

4. Install a bottom O-ring on a drive head (15188). Thread the drive head onto the sampler sheath. Attach a drive cap (12787 or 15590) to the top of the drive head. Ensure that the threads engage completely. Tighten with an adjustable wrench if necessary.

Sampler assembly is complete.

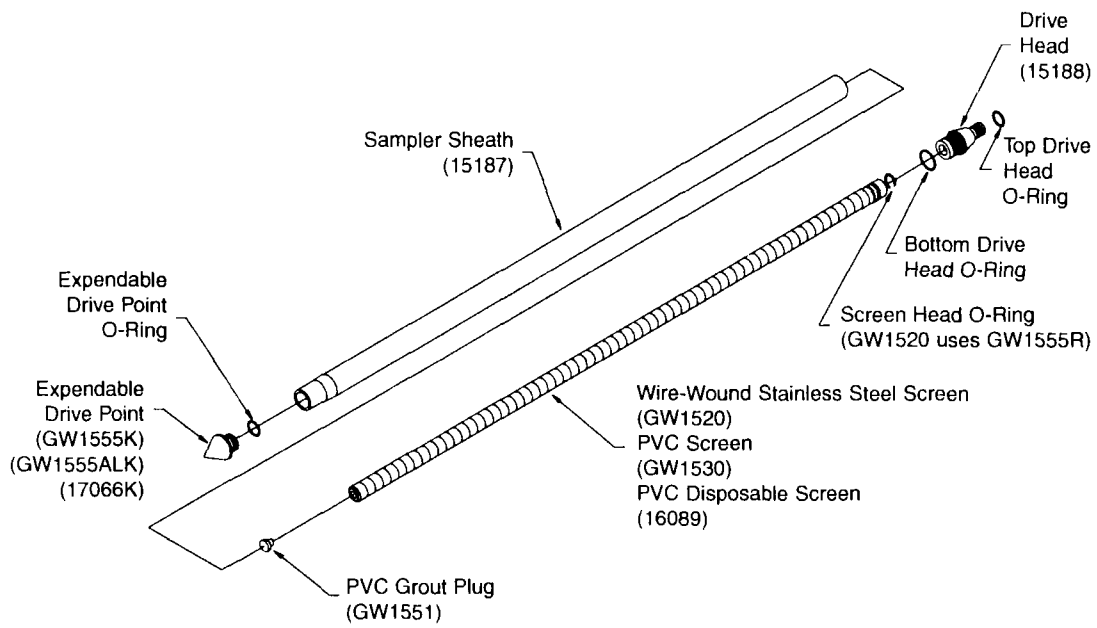


FIGURE 4.2
Screen Point 16 Groundwater Sampler Assembly

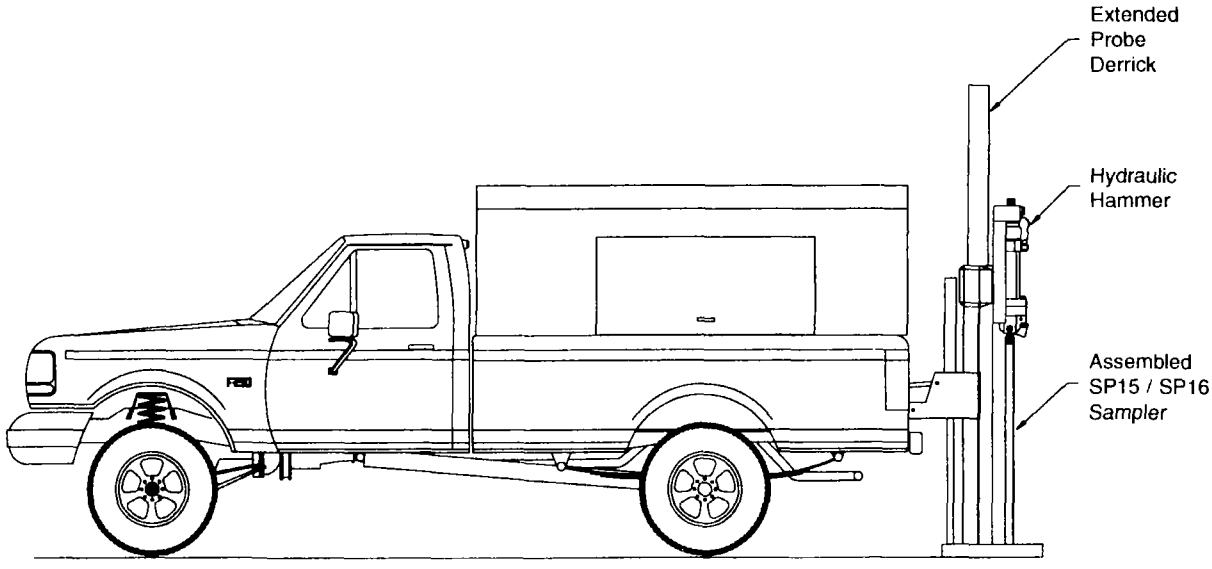


FIGURE 4.3
Screen Point 15 / Screen Point 16 Groundwater Sampler in Driving Position

4.6 Advancing the SP15 / SP16 Sampler

To provide adequate room for screen deployment with the Rod Grip Pull System, the probe derrick should be extended a little over halfway out of the carrier vehicle when positioning for operation.

1. Begin by placing the assembled sampler (Fig. 2.1.A) in the driving position beneath the hydraulic hammer of the direct push machine as shown in Figure 4.3.

2. Advance the sampler with the throttle control at slow speed for the first few feet to ensure that the sampler is aligned properly. Switch the throttle to fast speed for the remainder of the probe stroke.

3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the drive head. Distilled water may be used to lubricate the O-ring if needed. Add a probe rod (1.25- or 1.5-inch OD, length to be determined by operator) and reattach the drive cap to the rod string. Drive the sampler the entire length of the new rod with the throttle control at fast speed.

4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.

5. Remove the drive cap and retract the probe derrick away from the tool string.

4.7 Screen Deployment

1. Thread a screen push adapter (GW1535, Fig. 4.4) on an extension rod of suitable length (AT67, AT671, AT10073, or AT675). Attach a threaded coupler (AT68) to the other end of the extension rod. Lower the extension rod inside of the probe rod taking care not to drop it down the tool string. An extension rod jig (AT690, Fig. 4.4) may be used to hold the rods.

2. Add extension rods until the adapter contacts the bottom of the screen. To speed up this step, it is recommended that Extension Rod Quick Links (AT694K, Fig. 4.4) are used at every other rod joint.

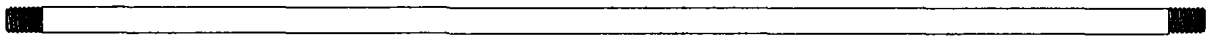
3. Ensure that at least 48 inches (1219 mm) of extension rod protrudes from the probe rod. Thread an extension rod handle (AT-69, Fig. 4.3) on the top extension rod.

4. Maneuver the probe assembly into position for pulling. Refer to Figures 4.5 and 4.6 for positioning of the rod grip pull system for units equipped with GH40 Series and GH60 hammers.

5. Raise (pull) the tool string while physically holding the screen in place with the extension rods (Fig. 4.7.B). A slight knock with the extension rod string will help to dislodge the expendable point and start the screen moving inside the sheath.

   Raise the hammer and tool string about 44 inches (1118 cm) if using a GW1520 or GW1530 screen. At this point the screen head will contact the necked portion of the sampler sheath (Fig. 4.7.C.) and the extension rods will rise with the probe rods. Use care when deploying a PVC screen so as not to break the screen when it contacts the bottom of the sampler sheath.

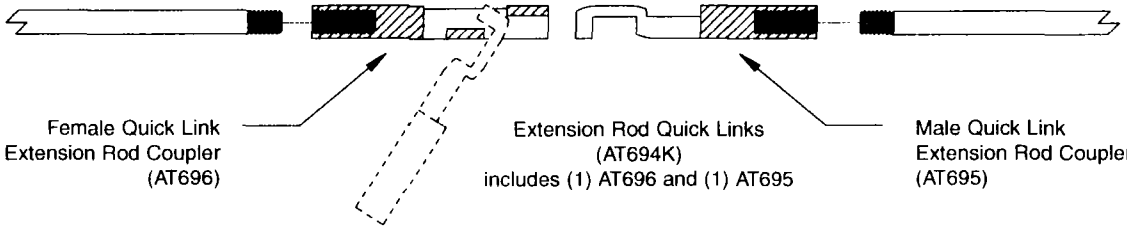
   The disposable screen (16089) will extend completely out of the sheath if the tool string is raised more than 45 inches (1143 mm). Measure and mark this distance on the top extension rod to avoid losing the screen during deployment.

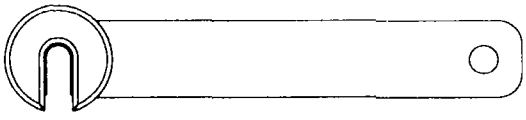


Extension Rod, 36-inch (AT67), 48-inch (AT671), 60-inch (AT10073), or 1-meter (AT675)

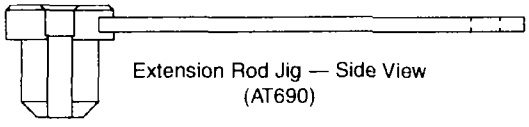
Grout Plug Push Adapter
(GW1540)

Screen Push Adapter
(GW1535)

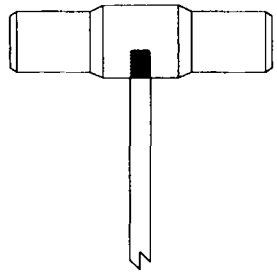




Extension Rod Jig — Top View
(AT690)



Extension Rod Jig — Side View
(AT690)



Extension Rod Handle
(AT69)

FIGURE 4.4
Geoprobe Extension Rods and Accessories

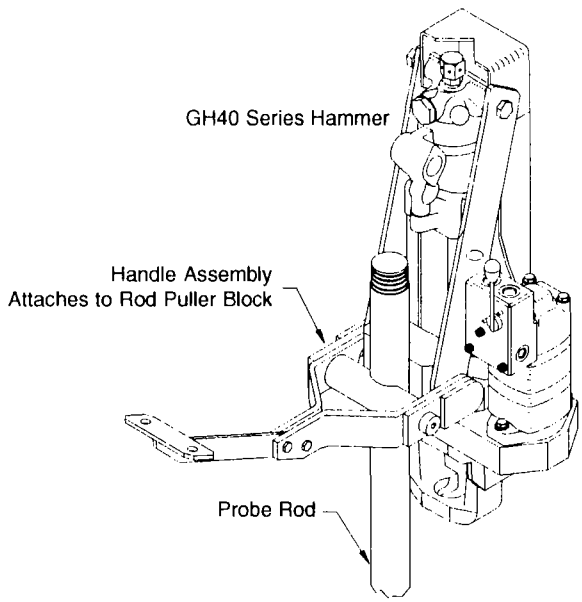


FIGURE 4.5
Rod Grip Pull System for Units Equipped With a GH40 Series Hammer

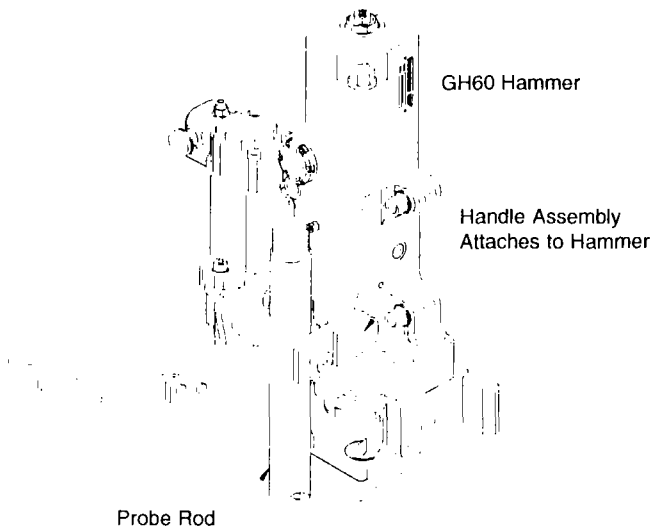


FIGURE 4.6
Rod Grip Pull System for Units Equipped With a GH60 Hammer

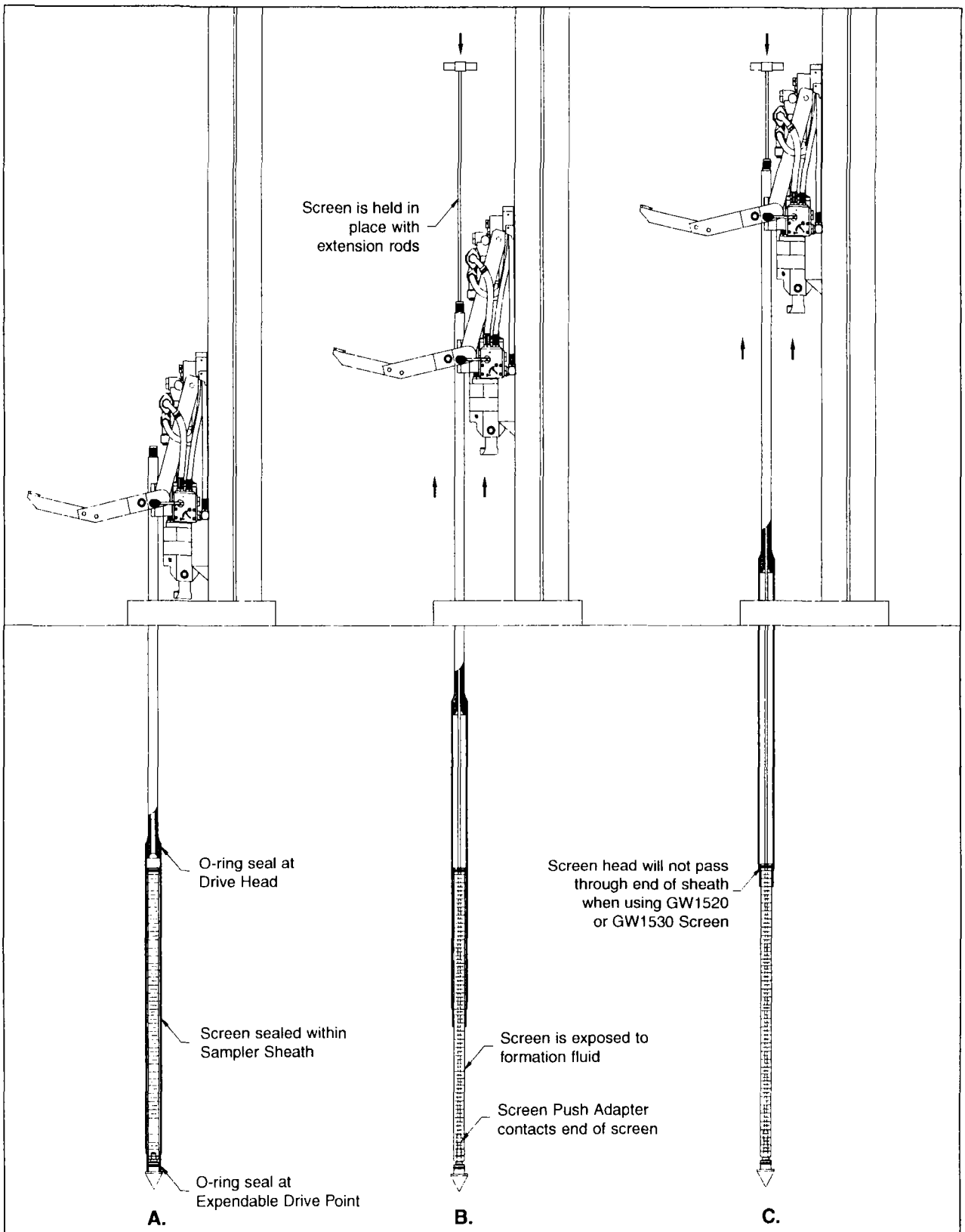


FIGURE 4.7
Screen Deployment for SP15 / SP16 Sampler

6. Remove the rod grip handle, lower the hammer assembly, and retract the probe derrick. Remove the top extension rod (with handle) and top probe rod. Finally, extract all extension rods.

7. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing bottom check valve assembly, bladder pump, or other acceptable small diameter sampling device.

   When inserting tubing or a bladder pump down the rod string, ensure that it enters the screen interval. The leading end of the tubing or bladder pump will sometimes catch on the edge of the screen head opening giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing or bladder pump past the lip and into the screen.

4.8 Abandonment Grouting for GW1520 and GW1530 Screens

The SP15 and SP16 Samplers can meet ASTM D 5299 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of GW1520 and GW1530 screens. A GS500, GS1000, or GS2000 Grout Machine is then used to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling. Attach the rod grip puller to the top probe rod. Raise the tool string approximately 4 to 6 inches (102 to 152 cm) to allow removal of the grout plug.

2. Thread the Grout Plug Push Adapter (GW1540, Fig. 4.4) onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the grout plug at the bottom of the screen. Attach the handle to the top extension rod. When the extension rods are slightly raised and lowered, a relatively soft rebound should be felt as the adapter contacts the grout plug. This is especially true when using a PVC screen.

3. Place a mark on the extension rod even with the top of the probe rod. Apply downward pressure on the extension rods and push the grout plug out of the screen. The mark placed on the extension rod should now be below the top of the probe rod. Remove all extension rods.

   Note: When working with a stainless steel screen, it may be necessary to raise and quickly lower the extension rods to jar the grout plug free. When the plug is successfully removed, a metal-on-metal sensation may be noted as the extension rods are gently "bounced" within the probe rods.

4. A Grout Nozzle (GW1545) is now connected to High-Pressure Nylon Tubing (11633) and inserted down through the probe rods to the bottom of the screen (Fig. 4.8). It may be necessary to pump a small amount of clean water through the tubing during deployment to jet out sediments that settled in the bottom of the screen. Resistance will sometimes be felt as the grout nozzle passes through the drive head. Rotate the tubing while moving it up-and-down to ensure that the nozzle has reached the bottom of the screen and is not hung up on the drive head.

   Note: All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 20 feet is generally enough.

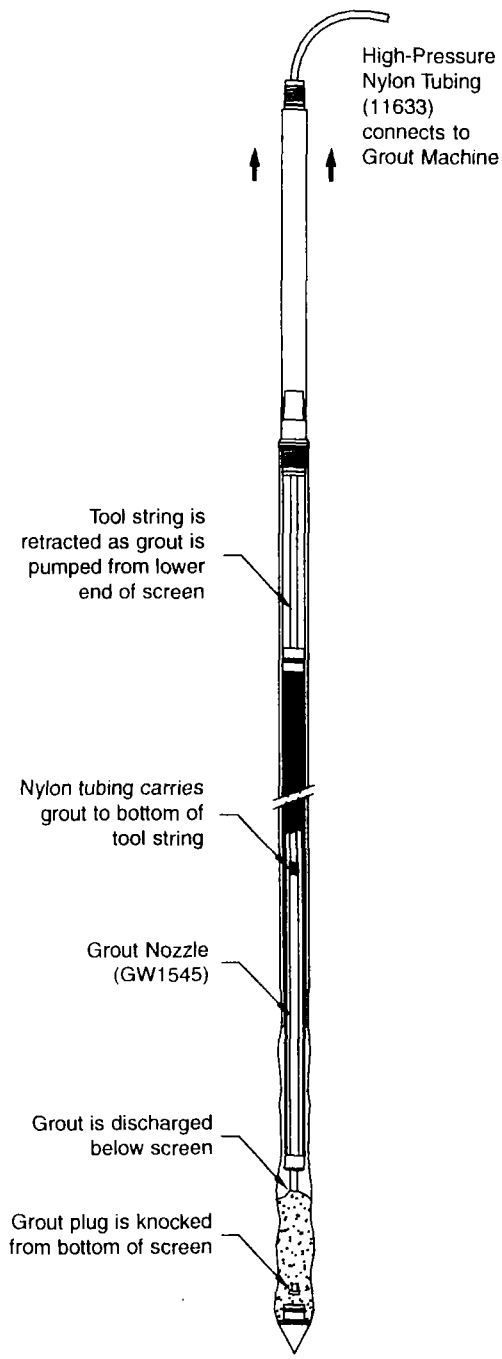


FIGURE 4.8
Grouting the SP15 / SP16 Sampler With GW1520 or GW1530 Screen

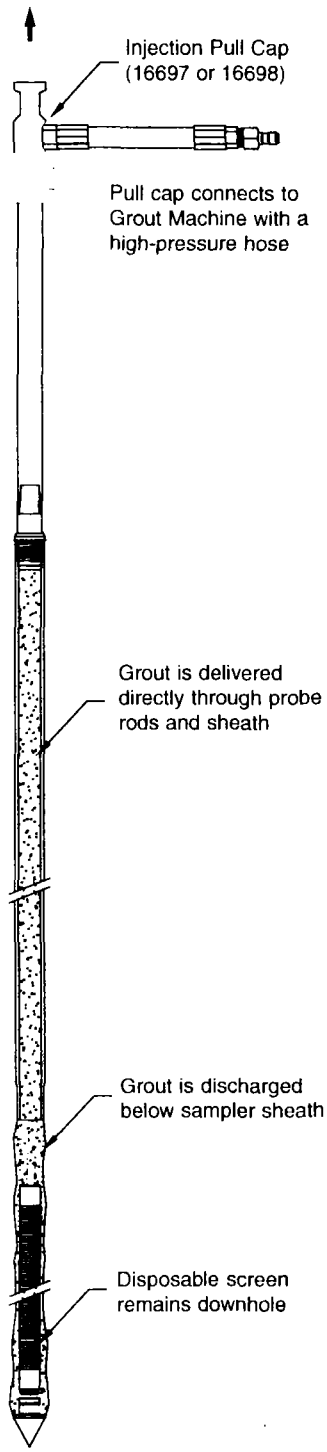


FIGURE 4.9
Grouting the SP15 / SP16 Sampler With 16089 Disposable Screen

5. Operate the grout pump while pulling the first rod with the rod grip pull system. Coordinate pumping and pulling rates so that grout fills the void left by the sampler. After pulling the first rod, release the rod grip handle, fully lower the hammer, and regrip the tool string at the second probe rod. Unthread the top probe and slide it over the tubing placing it on the ground near the end of the tubing.

6. Repeat Step 5 until the sampler is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.

7. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

4.9 Abandonment Grouting for the 16089 Disposable Screen

ASTM D 5299 requirements can also be met for the SP15 / SP16 samplers when using the 16089 disposable screen. Because the screen remains downhole after sampling, the operator may choose either to deliver grout to the bottom of the tool string with nylon tubing or pump grout directly through the probe rods using an Injection Pull Cap (16697 or 16698). A GS500, GS1000, or GS2000 Grout Machine is needed to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling with the rod grip puller.

2. Thread the screen push adapter onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the bottom of the screen. Attach the handle to the top extension rod.

3. The disposable screen must be extended at least 46 inches (1168 mm) to clear the bottom of the sampler sheath. Considering the length of screen deployed in Section 4.7, determine the remaining distance required to fully extend the screen from the sheath. Mark this distance on the top extension rod.

4. Pull the tool string up to the mark on the top extension rod while holding the disposable screen in place.

   The screen is now fully deployed and the sampler is ready for abandonment grouting. Apply grout to the bottom of the tool string during retrieval using either flexible tubing (as described in Section 4.8) or an injection pull cap (Fig. 4.9). This section continues with a description of grouting with a pull cap.

5. Remove the rod grip handle and maneuver the probe assembly directly over the tool string. Thread an Injection Pull Cap (16697 or 16698) onto the top probe rod and close the hammer pull latch over the top of the pull cap.

6. Connect the pull cap to a Geoprobe grout machine using a high-pressure grout hose.

7. Operate the pump to fill the entire tool string with grout. When a sufficient volume has been pumped to fill the tool string, begin pulling the rods and sampler while continuing to operate the grout pump. Considering the known pump volume and sampler cross-section, time tooling withdrawal to slightly "overpump" grout into the subsurface. This will ensure that all voids are filled during sampler retrieval.

   The grouting process can lubricate the probe hole sufficiently to cause the tool string to slide back downhole when disconnected from the pull cap. Prevent this by withdrawing the tool string with the rod grip puller while maintaining a connection to the grout machine with the pull cap.

4.10 Retrieving the Screen Point 15 Sampler

If grouting is not required, the Screen Point 15 sampler can be retrieved by pulling the probe rods as with most other Geoprobe applications. The Rod Grip Pull System should be used for this process as it allows the operator to remove rods without completely releasing the tool string. This avoids having the probe rods fall back downhole when released during the pulling procedure. A standard Pull Cap (AT1204 or 15164) may still be used if preferred. Refer to the Owner's Manual for your Geoprobe direct push machine for specific instructions on pulling the tool string.

5.0 REFERENCES

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Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe® Systems.

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STANDARD OPERATING PROCEDURE (SOP)
SAMPLING OF GROUND WATER MONITORING WELLS
USING A DISPOSABLE BAILER

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 4
5.0 PROCEDURES 4
5.1 Equipment 4
5.2 Preliminary Site Activities 5
5.3 Purging and Sampling Procedures 5
6.0 REFERENCES 8
7.0 ATTACHMENTS 8

1.0 PURPOSE

The purpose of this procedure is to provide an approved method for collecting a representative ground water sample using a disposable bailer and to ensure data validity and data usability during site investigations.

2.0 SCOPE

This SOP provides a procedure for the collection of ground water samples from wells with short screened intervals using a disposable bailer for purging and sampling. The goal of a ground water sampling program is to collect ground water samples that are geochemically "representative" of aquifer conditions at the time the sample is collected. All sampling techniques will alter a ground water composition to some extent. However, a properly designed sampling program will minimize these impacts, especially with regard to the properties or analytes of concern to the sampling program. Ground water sampling using a bailer may not be the appropriate or the best choice for sampling your site. However, in some geologic settings, especially from wells screened at the ground water interface ("water table wells"), the bailer approach will provide representative ground water samples from permanent and temporary ground water monitoring wells.

A review of the information contained in this SOP will facilitate planning of the field sampling effort by describing standard sampling techniques and provide instructions for sampling team members. The techniques described shall be followed whenever applicable, noting that specific conditions may require adjustments in methodology. Review the project Field Sampling Plan (FSP) prior to initiating field work for additional guidance.

This SOP does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate sampling procedures are established, for reviewing the sampling procedures used by the field crew, and for performing in-field spot checks of sampling procedures.

Field Operations Leader – Is responsible for selecting and detailing the specific ground water sampling techniques and equipment to be used, documenting these in the Work Plan/FSP for the activity, and properly briefing the site sampling personnel.

Field Technical Staff – Are responsible for the proper acquisition of the ground water samples.

5.0 PROCEDURES

5.1 Equipment

- New, clean, disposable bailers.
- Polyethylene sheeting and sampling gloves.
- Water level measuring device (+/- 0.01 foot accuracy; electronic preferred for tracking water level drawdown during all purging operations).
- Purge criteria parameter monitoring instruments for one or more of the following stability parameters: pH, turbidity, specific conductance, temperature, redox potential (Eh) and/or dissolved oxygen (DO), as appropriate and as outlined in the project FSP.
- Decontamination supplies, as appropriate.
- Log book(s).
- Sample Bottles. It is recommended that preservatives are added to sample bottles prior to field activities to reduce potential error or introduction of contaminants.
- Sample preservation supplies (as required by the analytical method).
- Sample tags or labels, chain of custody.
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Approved project FSP.

5.2 Preliminary Site Activities

1. Check the condition of the monitoring well for damage and evidence of tampering, and record pertinent observations.
2. In order to maintain a clean work area, lay out a sheet of polyethylene on which to place sampling and monitoring equipment.
3. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing) use the north side of well casing and describe in the log book.
4. Measure and record the depth to water to the nearest 0.01 foot (prior to purging) in all wells to be sampled. Care should be taken to minimize disturbance to the water column and to any particulate attached to the sides or at the bottom of the well. Consequently, in order to avoid disturbing any accumulated sediment and to prevent mixing of stagnant water with water in the screened interval, the total depth of a well should be measured a minimum of one day in advance of purging, or following the well sampling, if well construction documentation is not available.
5. Calculate the volume of water present in the well and multiply by three to five to determine the volume of water to be purged from each well.

5.3 Purging and Sampling Procedures

Lack of consistency in bailing technique can be a major source of bias in analyses from ground water samples collected using a bailer. When possible, the same field personnel should sample all wells at a site. If more than one sampler is used, the sampler for each well must be documented in the project log book.

The following describes the procedure for the bailer purging and sampling method. Personal protective equipment will be used in accordance with the requirements of the site-specific Health and Safety Plan. Wells should be sampled in the order of least contaminated to most contaminated.

1. Measure a length of suspension line (nylon rope) sufficient to lower the bailer to the desired sampling depth and to secure the line to the bailer.
2. Tie one end of the rope securely to the top of the bailer and the other end to a stationary object.
3. **Gently** lower the bailer to the desired sampling depth, allowing the bailer to fill with water.
4. Carefully remove the bailer and empty the water into a clean bucket.
5. Repeat, while keeping the technique as consistent as possible, until approximately three to five well volumes of water have been removed from the well, or the water quality parameters stabilize as follows.

   Monitored water quality indicator parameters should include at least one of the following: turbidity, specific conductance, pH, DO, temperature, and redox potential. Water quality parameter monitoring instrumentation must be calibrated following the manufacturer's instructions and results documented in the project log book. The water quality parameters must be collected approximately every ½ well volume until the selected parameters have stabilized. Stabilization is achieved when three successive readings are within:

   - ±0.1 for pH;
   - ±3 percent for conductivity and temperature;
   - ±10 mV for redox potential;
   - ±10 percent or less than 10 NTU for turbidity; and/or
   - ±10 percent for DO.

   Turbidity and DO are typically the last parameters to stabilize, especially with bailer purging and developing. If the parameters have stabilized, but the turbidity is not in the range of 5 to 10 NTU, and total metals are required in the sampling plan, then review Step 7 for appropriateness in meeting the site data needs. Otherwise, record turbidity and collect the sample.

Stabilization of indicator parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels less than 10 NTU and a stable drawdown of less than 0.3 feet, while desirable, is not mandatory. It should be noted that natural turbidity levels in ground water may exceed 10 NTU (Puls and Barcelona, 1996).

If after removing three to five well volumes, the indicator field parameters have not stabilized, one of three optional courses of action may be taken:

- Continue purging until stabilization is achieved;
- Discontinue purging, do not collect any samples, and record in the log book that stabilization could not be achieved (the documentation must describe attempts to achieve stabilization); or
- Discontinue purging, collect samples, and provide a full explanation of attempts to achieve stabilization in the logbook.

6. Once stabilization has been documented, volatile organic compound (VOC) samples and redox-sensitive (e.g., Fe^{+2}, CH_4) parameter samples should be immediately collected directly into pre-preserved sample containers.

   Samples requiring pH adjustment should have their pH checked to assure that the proper pH has been obtained. For VOC samples, this will require that a test sample be collected to determine the amount of preservative required to be added to the sample containers prior to sampling.

7. If the turbidity measurements do not approach 10 NTU, consider collecting both filtered and unfiltered samples for metals analysis (if metals analysis is required by the sampling plan). Naturally occurring turbidity can exceed 10 NTU. Filtered metal samples are to be collected with an in-line filter. A high capacity, in-line 0.45-micrometer particulate filter (or other as discussed in the project FSP) must be pre-rinsed according to the manufacturer's recommendations, or with approximately

one liter of ground water following purging and prior to sampling. After the sample is filtered it must be preserved immediately.

8. As each sample is collected, the sample should be labeled as defined in the project FSP and Quality Assurance Project Plan (QAPP). All samples should be placed into a cooler with proper temperature control as outlined in the QAPP.

   After collection of the samples, the used bailer should be properly discarded or dedicated to the well for re-sampling (by hanging the bailer inside the well). If the bailer is re-used, always replace the bailer cord prior to each sampling event.

9. Secure (close and lock) the well.

Trip blanks, field blanks, duplicates, and matrix spike/matrix spike duplicate samples should be collected and analyzed as outlined in the site specific field sampling plan.

6.0 REFERENCES

ASTM D 6699-01 "Standard Practice for Sampling Liquids Using Bailers"

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
FIELD SCREENING FOR VOLATILE ORGANIC COMPOUNDS

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TABLE OF CONTENTS

1.0 PURPOSE 2

2.0 SCOPE 2

3.0 GLOSSARY 2

4.0 RESPONSIBILITIES 2

5.0 PROCEDURES 2

5.1 Required Apparatus and Materials 4

5.2 Field Screening Procedure 4

6.0 REFERENCES 2

7.0 ATTACHMENTS 2

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for field screening soil samples for the presence of volatile organic compounds (VOCs).

2.0 SCOPE

This SOP provides a standardized procedure for field screening soil samples. Field screening provides a rapid, semi-quantitative means of identifying sub intervals of a larger soil core, test pit wall, etc., that are most appropriate for collection and submittal for analytical testing. Field screening results are not a substitute for laboratory testing and should be used only for evaluating samples from a given site collected and screened under similar conditions. The screening results are a function of contaminant volatility, relative response of the screening instrumentation to the contaminants, ambient temperature, and humidity, as well as differences in the contaminant concentrations between samples. Please review the project specific Work Plan and/or Field Sampling Plan (FSP) for additional guidance prior to conducting the sampling event.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and is responsible for reviewing the field books and/or chains of custody used by the field crew on a periodic basis.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

Field Operations Leader – Is responsible for assuring that the soil samples are field screened correctly.

5.0 PROCEDURES

5.1 Required Apparatus and Materials

- Personal Protective Equipment – Safety glasses and nitrile gloves.
- Plastic bags – Resealable.
- Photoionization detector (PID) or flame ionization detector (FID).

5.2 Field Screening Procedure

- Refer to Gannett Fleming SOP MI-S-3 "Field Instrument Calibration" for PID and FID calibration procedures. The PID or FID must be calibrated prior to field screening soil samples. Document the calibration in the project log book and/or instrument log book.
- Note – Soil used for field screening must not be used for laboratory analysis.
- Collect a small amount of the soil to be field screened. The amount of sample used will depend on the amount of soil available; no more than a small handful (approximately ten cubic centimeters) is required. Use a consistent amount for each interval that is screened. If a soil core is collected, cut open the liner length-wise and remove the top of the liner. Remove sufficient sample for field screening and replace the top of the liner. Wrap core in aluminum foil and place in a cool, shaded place until field screening of VOCs is complete.
- Place the soil in a re-sealable plastic bag and close the bag, trapping air in with the soil sample.
- Allow the soil sample to equilibrate. Do not place the bag in direct sunlight. If the ambient temperature is cold, the bag may need to be placed inside the field vehicle to warm. In general, equilibration should last five to ten minutes. Keep the equilibration time as consistent as possible from sample to sample.
- Poke the sampling tip of the PID/FID through the bag, being careful to keep the tip away from the soil.
- Record the high reading for the sample in the field log book and/or boring logs.
- Dispose of the soil at the site and dispose of the bag appropriately.

- Zero the PID/FID prior to field screening the next sample.
- Following completion of the field screening for VOCs, collect soil samples for laboratory analysis following the procedures outlined in Gannett Fleming SOPs MI-S-11 titled "Collection of Soil Samples for Volatile Organic Compound Analysis" and MI-S-10 titled "Collection of Soil Samples".

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
COLLECTION OF SOIL SAMPLES

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TABLE OF CONTENTS

1.0 PURPOSE 3

2.0 SCOPE 3

3.0 GLOSSARY 3

4.0 RESPONSIBILITIES 3

5.0 PROCEDURES 3

5.1 Required Apparatus and Materials 3

5.2 Sample Collection Procedure 4

5.3 Shipping 5

6.0 REFERENCES 5

7.0 ATTACHMENTS 5

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for collecting soil samples for laboratory analysis. A more detailed description of collecting and preserving soil samples for volatile organic compound analysis, is provided in to Gannett Fleming SOP MI-S-11 "Collection and Preservation of Soil Samples for Volatile Organic Compound Analysis."

2.0 SCOPE

This SOP provides accepted procedures for collecting soil samples for laboratory analysis. Please review the site-specific project Work Plan and/or Field Sampling Plan (FSP) prior to sampling for additional guidance.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and is responsible for reviewing the field books and/or chains of custody used by the field crew on a periodic basis.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

Field Operations Leader – Is responsible for assuring that the soil samples are collected correctly.

5.0 PROCEDURES

5.1 Required Apparatus and Materials

- Personal Protective Equipment – Safety glasses and nitrile gloves.
- Plastic bags – Resealable.
- Sample containers.
- Coolers.
- Ice.

5.2 Sample Collection Procedure

- Prepare a temperature blank using water if the laboratory did not provide one.
- Place ice into a re-sealable plastic bag. Ice should be double-bagged to prevent leakage.
- Label the appropriate sample containers. If collecting soil samples for VOC analysis, refer to Gannett Fleming SOP MI-S-11 "Collection and Preservation of Soil Samples for Volatile Organic Compound Analysis" for further details.
- Obtain the soil-sampling device (split-spoon, plastic liner, hand auger, etc.). Complete headspace field screening as described in Gannett Fleming SOP MI-S-9 or as provided in the project FSP.
- Open the sampling device, if appropriate. If cutting open a plastic liner, be careful because sharp edges can be created.
- The soil sample should be collected as soon as possible after the soil is removed from the ground. Place the soil sample into the appropriate container(s) as listed in the project FSP. In general, non-preserved samples should completely fill the container. Preserved samples should have the appropriate mass placed in the container.
- Clean the threads of the sample container(s) and replace the lid.
- Place the sample containers in a cooler with ice. Unless required by project-specific requirements, all sample containers for one sample should be placed in the same cooler.
- Decontaminate the sampling area prior to collecting the next sample.
- All sample containers are to be recorded on the chain-of-custody (COC) which is placed in the cooler with the sample containers. If containers for a single sample are placed in separate coolers, the appropriate containers must be logged on the COC in each cooler.
- Place the COC within a re-sealable plastic bag within the appropriate cooler.

5.3 Shipping

- Refer to Gannett Fleming SOP MI-S-11 "Collection and Preservation of Soil Samples for Volatile Organic Compound Analysis" for shipping requirements for methanol-preserved samples. Refer to the Gannett Fleming SOP MI-S-1 "Sample Handling and Chain-of-Custody Documentation Procedures for Michigan Department of Environmental Quality Projects."
- Securely place the sample containers in the cooler. Large containers should be wrapped in bubble wrap. Add padding if required.
- Place the ice bag(s) on top of the sample containers.
- Place the COC bag on top of the ice.
- Secure the cooler with packing tape and a custody seal.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
COLLECTION AND PRESERVATION OF
SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUND ANALYSIS

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TABLE OF CONTENTS

1.0 PURPOSE 2

2.0 SCOPE 2

3.0 GLOSSARY 2

4.0 RESPONSIBILITIES 2

5.0 PROCEDURES 2

5.1 Health and Safety 3

5.2 Required Apparatus and Materials 4

5.3 Sample Collection and Preservation Procedure 5

5.4 Shipping 6

6.0 REFERENCES 2

7.0 ATTACHMENTS 2

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for collecting and preserving soil samples for volatile organic compound (VOC) analysis.

2.0 SCOPE

This SOP provides accepted procedures accepted by the Michigan Department of Environmental Quality (MDEQ) for collecting and preserving soil samples for VOC analysis. The procedures described are also applicable to samples collected for submittal to non-MDEQ laboratories. See the project Work Plan or Field Sampling Plan (FSP) for additional guidance.

3.0 GLOSSARY

VOCs – A group of organic compounds that readily volatilize. Common VOCs include benzene, toluene, ethylbenzene, and xylene isomers (BTEX).

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and is responsible for reviewing the field books and/or chains of custody used by the field crew on a periodic basis.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

Field Operations Leader – Is responsible for assuring that the VOC soil samples are collected and preserved correctly.

5.0 PROCEDURES

5.1 Health and Safety

- Methanol is a toxic and flammable liquid.
- A Material Safety Data Sheet (MSDS) for methanol should accompany the staff in the field.
- Wear safety glasses and nitrile gloves when using methanol.

- Store and handle in a ventilated area away from sources of ignition and extreme heat.
- In the event of eye contact, immediately flush the eye with large amounts of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. SEEK MEDICAL ATTENTION IMMEDIATELY.

5.2 Required Apparatus and Materials

- Absorbent material – Sufficient to completely absorb all the methanol in case of breakage.
- Calibration weight – Near to or equal to the target sample weight (10 grams [g]).
- Certified methanol – Provided by the laboratory.
- Field balance – Capable of measuring +/- 0.2 g.
- Hazardous waste warning label – Warning of methanol preservative.
- Methanol sampling kits.
- Personal Protective Equipment – Safety glasses and nitrile gloves.
- Plastic bags – Resealable.
- Sub-coring device – A syringe-like device provided by the laboratory.
- Wide-mouth jar – For holding methanol tubes during transport to site. Other containers may be substituted as long as the methanol tubes or ampoules are protected during transport.
- Wide-mouth jar – For preventing contamination of the balance.
- VOC syringe label – Methanol resistant.
- VOC vials – Pre-weighed Vials with Teflon™-lined septa. Some laboratories provide vials with the methanol already in the vial.

5.3 Sample Collection and Preservation Procedure

- Note – Collect field and trips blanks in accordance with Gannett Fleming SOP MI-S-2 "Field, Trip, and Equipment Blanks."
- Record the tracking or lot numbers of the methanol in the field log book. If more than one lot is present, track which samples are preserved with each lot.
- Calibrate the field balance in accordance with the manufacturer's instructions.
- Prepare a temperature blank using water if the laboratory did not provide one.
- Prepare a sufficient number of methanol field blanks (one per cooler and at least one per lot).
- Calibrate the syringe to estimate the amount of soil required. Using soil not needed for a sample, place 10 g of soil in the syringe. Add or remove soil until 10 g is reached. After calibration, extrude the soil at the site and discard the syringe.
- Place a wide-mouth jar on the balance.
- Record the sampling location, date, and time in the log book. Do not add any labels, stickers, etc. to the pre-weighed sample vials.
- Place a syringe in the wide-mouth jar on the balance and zero the balance.
- If the syringe has a cap, remove the cap.
- Collect the soil sample, using the amount estimated by the calibration step.
- If the syringe has a cap, replace the cap and place the syringe in the jar on the balance.
- The target mass is 10 g per 10 milliliters (mL) of methanol. If more sample is required, add it to the syringe. If excess sample is present, extrude some.
- Open the pre-weighed vial, placing the cap in a safe, clean location.
- Place the end of the syringe in the vial and carefully extrude the soil sample.
- If a few drops of methanol splash out, there will be no significant difference in the results. However, if a significant amount of methanol is lost, another sample must be collected.
- Clean any soil from the sample vial threads and cap the vial.

- Gently swirl the sample vial for about 10 seconds to break up the soil. DO NOT SHAKE.
- Place the sample vial in a plastic bag on ice in a cooler.
- Attached the methanol warning sticker to the bag.
- Using the same syringe, collect more soil from the sampling interval and cap the syringe. If the syringe does not have a cap, collect the additional soil in a two-ounce or larger sample jar.
- Label the syringe or sample jar with the sample identification and place the capped syringe in the plastic bag with the pre-weighed vial. This sample is for dry weight determination.
- Decontaminate the jar and balance appropriate to the amount and type of contamination.
- Unused methanol must be returned to the laboratory for proper disposal.

5.4 Shipping

- The shipping of methanol is regulated by the United States Department of Transportation (USDOT) under Title 49 of the Code of Federal Regulations. The amount of methanol used for sample preservation falls within the requirements for exemption for small quantities.
- The maximum volume of methanol in a single sample container (vial) cannot exceed 30 ml.
- The sample container cannot be completely full of methanol.
- Sufficient absorbent material must be placed within the container (cooler) to absorb the entire methanol content in case of breakage.
- Each cooler must contain less than 500 ml methanol in total.
- Each cooler must be labeled as containing less than 500 ml of methanol.
- The cooler weight cannot exceed 64 pounds.

6.0 REFERENCES

Michigan Department of Environmental Quality – Remediation and Redevelopment Division (MDEQ-RRD) Operational Memorandum 2, Attachment 6: *Sampling Methods for Volatile Organic Compounds*, dated October 22, 2004.

7.0 ATTACHMENTS

None.

GANNETT FLEMING STANDARD OPERATING PROCEDURE (SOP) INSTALLATION OF CONVENTIONAL GROUND WATER MONITORING WELLS

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 4
5.0 PROCEDURES 4
5.1 Pre-Mobilization Activities 4
5.2 Borehole Installation and Soils Logging 5
5.3 Well Construction and Installation 5
5.4 Surface Completion 6
5.5 Well Development 6
6.0 REFERENCES 6
7.0 ATTACHMENTS 7

1.0 PURPOSE

The purpose of this procedure is to describe the installation and construction of conventional ground water monitoring wells using hollow-stem augers to create the borehole.

2.0 SCOPE

This procedure gives technical guidance on the construction and installation of conventional ground water monitoring wells using hollow-stem augers. The procedural description is general since the actual well construction details, including the screen and casing material, length of screen, screen depth, sampling requirements, etc., will be project-specific due to differences in site geology and the contaminants present.

3.0 GLOSSARY

Auger Flights – Winding metal strips welded to the auger sections that carry cuttings to the surface when the auger is rotated.

Bentonite – A hydrous aluminum silicate available in powder, granular, or pellet form that, when hydrated, provides a tight seal between the well casing and the borehole wall. Bentonite may also be used in a two to five percent mixture with Portland cement to form a grout seal that expands as the material hardens.

Casing – A solid piece of pipe, typically steel, stainless steel, or polyvinyl chloride (PVC), used to keep a well open in either unconsolidated materials or unstable rock and as a means to contain zone-isolation materials such as cement grout and bentonite.

Cutter Head – An auger bit that is attached to the leading auger flight section and cuts a hole for the auger to follow. The bit may be either a coring head or a full-face bit.

Drilling Log – The primary record of daily drilling activity that may include blow counts, lithology encountered, well construction specification, depth to water, subcontractor, and other pertinent information.

Split Spoon Sampler – A core barrel that can be opened to remove samples. This is a sampling method commonly used with auger drilling. The split spoon sampler is advanced into the subsurface in front of the augers by repeatedly dropping a 140-pound hammer raised 30 inches.

4.0 RESPONSIBILITIES

Field Operations Leader – Is responsible for ensuring that field personnel have been trained in the use of this procedure. The Field Operations Leader should also determine the disposal methods for Investigation Derived Waste (IDW) products generated by drilling, such as drill cuttings and well development water, as well as any specialized supplies or logistical support required for the drilling operations. These activities should be documented in the project log book.

Field Geologist – Is responsible for monitoring drilling activities and documenting observations made during drilling in a project log book. The Field Geologist will generate a detailed boring log for each test hole. This log shall include a description of materials, samples, method of sampling, blow counts, and/or other pertinent drilling and testing information.

5.0 PROCEDURES

These procedures provide a general overview of the different components involved in the successful installation of a conventional ground water monitoring well. The procedures include pre-mobilization activities, borehole installation and soil logging, well construction and installation, surface completion, and well development.

5.1 Pre-Mobilization Activities

The pre-mobilization activities are typically summarized in the project Work Plan. The Work Plan should provide detailed information on drilling requirements, methods, and objectives. The Work Plan should provide the driller and with the following information:

- Known geologic characteristics;
- Anticipated total depth of each well;
- Well construction materials (e.g. PVC, stainless steel, etc.);
- Screen slot size;
- Anticipated length of screen and casing;
- Existing surface at each well location (e.g. concrete, asphalt, grass);
- Preferred auger size (outside and inside diameter);
- Soil and ground water sampling requirements;
- Surface completion requirements; and

- Well development specifications.

There may be other considerations to discuss with the driller prior to mobilization, including soil cuttings and development water handling and disposal requirements, access limitations to well locations, staging areas, etc. Prior to mobilization, confirm that the appropriate access and construction permits have been obtained and utility mark outs (e.g., MISS DIG, JULIE) have been completed. **It is critical that complete utility investigation and mark out be completed prior to mobilization.**

5.2 Borehole Installation and Soils Logging

Before drilling can commence in areas adjacent to subsurface utilities or where little information regarding utility locations is available, borehole clearance procedures must be performed with a hand auger. Project-specific exceptions to this requirement can occur if sufficient information regarding the locations of the utilities is available. If required, advance the hand auger to a minimum depth of five feet below ground surface (bgs) and record any observations in the project log book. Augering may commence after completing the clearance procedure. Drill cuttings brought to the surface by the augers should be collected in United States Department of Transportation (DOT)-compliant containers, such as 55-gallon steel drums. Augers should be stopped at the first sampling depth if sampling is required. Soil samples are collected using a split spoon sampler, either continuously or at predetermined depths, and the cores described (logged) by the Field Geologist. Pertinent information must be recorded on the drilling log and in the project log book. Refer to the project Work Plan and/or Quality Assurance Project Plan (QAPP) for any additional requirements including volatiles (headspace) screening and sample collection for laboratory analysis, etc. The ground water monitoring well is installed inside of the augers as described in the following section after the augers have been advanced into the subsurface to their final depth.

5.3 Well Construction and Installation

After the augers have attained the final or completion depth, the drillers should check the depth with a weighted tape measure. Assemble the well materials above ground and verify conformance with specifications. The drillers will install the well screen and casing into the

borehole and verify the specified screen depth is achieved. As the drillers install the sand (filter) pack, the augers may be slowly withdrawn. Frequent measurements with the weighted tape measure must be taken to verify that the sand is always above the bottom of the augers. When the filter pack has reached the specified height above the screen, bentonite will be installed to the specified height and hydrated with two to five gallons of water. The augers are typically withdrawn from the borehole after bentonite hydration. Record the volume of filter pack and bentonite installed. The remaining annular space may be backfilled with bentonite, grout, or native materials per the project specifications.

5.4 Surface Completion

The driller should cut excess casing material off such that the top of casing is approximately three inches bgs. The surface completion design will depend on the well location (e.g. in a driveway, in a landscaped area, etc.), existing adjacent surface finish, and client preference. In high traffic areas, a typical design consists of an 18-inch by 18-inch by 4-inch (minimum) concrete pad surrounding a protective, gasketed steel monitoring well cover (road box). In low traffic paved areas, the road box may be set within the hole created by the lead auger. In areas where traffic is not an issue, the well may be protected using a stick-up well box. Consult the project Work Plan for details regarding the site-specific requirements. Regardless of the surface completion detail, the finished well cover and concrete pad immediately surrounding the well cover shall be slightly higher in elevation than the ground surface.

5.5 Well Development

Conventional ground water monitoring wells are typically developed using a bailer, a surge block, a submersible pump, or a combination of these tools. Well development will be conducted in accordance with Gannett Fleming SOP No. MI-S-13 titled "Standard Operating Procedure (SOP) for Monitoring Well Development."

6.0 REFERENCES

American Society for Testing and Materials, 1999, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils. ASTM D 1586-99.

Driscoll, Fletcher G., 1986. Groundwater and Wells. Johnson Division, St. Paul, Minnesota.

7.0 ATTACHMENTS

None.

GANNETT FLEMING STANDARD OPERATING PROCEDURE (SOP)
MONITORING WELL DEVELOPMENT

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TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 4
5.0 PROCEDURES 4
5.1 Overview 4
5.2 Methods 4
6.0 REFERENCES 6
7.0 ATTACHMENTS 6

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for developing monitoring wells. Well development is necessary to stabilize and increase the permeability of the sand filter pack that is installed around the monitoring well screen and to restore the permeability of the surrounding formation that may have been reduced by drilling operations. Wells are typically developed until fine material and water introduced to the subsurface as part of the drilling process is removed.

Monitoring wells share similarities with supply wells that are installed to produce water for human or agricultural purposes but also have significant differences. A properly-installed monitoring well must be able to supply a sample of ground water that is representative of the ground water at that location in an aquifer. Care must be taken to ensure that the drilling/well installation, and development processes minimally impact physicochemical conditions in the aquifer. As a result, many well development methods that are available for use on water supply wells, such as air lift or pressure surging and high velocity jetting, should not be used to develop a monitoring well since these techniques can significantly alter the redox chemistry of the aquifer.

The selection of the well development method is made by the rig geologist in consultation with other technical team members and is based on the drilling methods, well construction and installation details, and the characteristics of the formation in which the well is screened. The primary methods of well development are summarized below. Other techniques are available and may be applied on a site-specific basis following consultation with the project technical and management team members.

2.0 SCOPE

The well development procedures described herein are applicable for use with existing or new monitoring wells.

3.0 GLOSSARY

Key definitions are explained in the Methods section.

4.0 RESPONSIBILITIES

Hydrogeologist- Is responsible for evaluating the geologic conditions encountered during the drilling as conveyed by the rig geologist. The hydrogeologist will have the final input in regard to which development method is preferable.

Rig Geologist- Is responsible for producing an accurate, concise and sufficiently descriptive boring log. In addition, the geologist must oversee the development and take thorough field notes, including water quality measurements as necessary.

5.0 PROCEDURES

5.1 Overview

The procedures described below are the most commonly employed well development methods in the industry. They are meant to provide the reader with a brief overview of the technology. A more detailed discussion may be found in Driscoll (1986).

5.2 Methods

Overpumping and Backwashing – Wells may be developed by alternately drawing the water level down (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and sand pack serves to remove fines from the formation immediately adjacent to the well screen that may have been mobilized by the drilling process, as well as preventing bridging (wedging) of sand grains installed surrounding the well screen. Backwashing is typically accomplished by several methods including pouring water into the well and then bailing or starting and stopping a pump intermittently to change water levels in the well. Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen or introduce large quantity of air to the formation in the screened interval.

Surging with a Surge Plunger – A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is used to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack.

There are two basic types of surge plungers–solid and valved. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

Bailing – Bailing can be an effective development tool, combining the effects of pumping and surging. A bailer can agitate water in the well, dislodge fine materials, and remove water and solids from the well. The bailer may be allowed to fall freely through the borehole until is strikes the surface of the water, creating a surge of water into the formation. The bailer, when withdrawn rapidly, creates drawdown that induces particles to flow back into the well. To remove solids, the bailer should be dropped to the bottom of the well and agitated with short strokes to suspend solids that may have accumulated. Solids may be removed by retrieving the bailer from the bottom of the well after the solids have been disturbed and suspended.

Stabilization – At a minimum, well development will continue until the turbidity has been visibly reduced and the thickness of accumulated solids at the bottom of the well has been reduced to either less than at the start of development, or less than 0.5 foot. A record of well development activities, including the method used, quantity of water added (if applicable) and water removed must be made in the project log book.

Depending on the project scope, and as described in the site-specific project Work Plan and/or Field Sampling Plan (FSP), the wells may then be allowed to settle for approximately 15 minutes and the stability of selected ground water indicator parameters monitored. Typically a temporary pump will be installed in the well and the pump discharge and drawdown will be established at levels that are expected during production (or sampling by the low flow/low stress method). The discharge water will be measured at five-minute intervals for one or more of the following indicator parameters: pH, specific conductivity, temperature, and/or turbidity. Development will be considered complete when the following criteria, as determined by the project hydrogeologist and rig geologist, are met:

pH:	within 0.2 units for three consecutive measurements; and/or
Specific conductivity:	within 10 % for three consecutive measurements; and/or
Temperature:	within 1° Celsius for three consecutive measurements; and/or
Turbidity:	within 10 % for three consecutive measurements.

If one or more of the relevant criteria are not met, development will continue, up to a predetermined time limit to be determined by the project manager. If criteria are still not met at that point, the project manager will review the data and the development methods, and decide whether additional pumping is needed.

6.0 REFERENCES

Driscoll, Fletcher G., 1986. Groundwater and Wells. Johnson Division, St. Paul, Minnesota.

7.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE (SOP)
INVESTIGATION DERIVED WASTE

GANNETT FLEMING OF MICHIGAN, INC.
WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 3
5.0 PROCEDURES 3
5.1 On-Site Disposal 3
5.2 Off-Site Disposal 4
6.0 REFERENCES 5
7.0 ATTACHMENTS 5

1.0 PURPOSE

The purpose of this procedure is to provide the proper methods for disposing of investigation derived waste (IDW). All IDW disposal activities will adhere to all applicable Federal, State and local guidelines and will be agreed upon by Gannett Fleming of Michigan, Inc. (Gannett Fleming) and the client prior to the initiation of field activities.

2.0 SCOPE

This Standard Operating Procedure (SOP) provides accepted procedures for disposing of IDW.

3.0 GLOSSARY

IDW – Waste materials generated during investigation activities at a site, including excess soil generated during boring activities that is not used for sample analysis, monitoring well development water, monitoring well purge water, disposable sampling equipment, and used health and safety supplies.

4.0 RESPONSIBILITIES

Project Manager – Is responsible for ensuring appropriate procedures are established and followed and for reviewing the procedures used by the field crew, and for correctly determining the hazard classification of the IDW.

Field Operations Leader – Is responsible for assuring that all IDW is disposed of properly.

Field Technical Staff – Are responsible for following the procedures listed in this SOP and for confirming any site-specific variations from the SOP prior to conducting fieldwork.

5.0 PROCEDURES

5.1 Soil and Ground Water Remains On-Site

If on-site placement of IDW is appropriate and agreed upon by Gannett Fleming and the client, the following disposal steps may be followed as applicable:

- Excess soil generated during drilling activities will be returned to the borehole from which it came;

- After appropriate samples from a monitoring well have been collected, purge water generated from that ground water monitoring well can be returned to the monitoring well from which it came;
- Drilling cuttings generated from monitoring well installation will be containerized and disposed of off-site following the off-site disposal procedures listed in Section 5.2, unless prior arrangements based on chemical testing of the soil cuttings have been made with the client;
- Monitoring well development water will be containerized and properly disposed of off-site following the off-site disposal procedures listed in Section 5.2, unless prior arrangements based on analytical results have been made with the client;
- Decontamination water will be allowed to run off onto the ground surface upgradient of any impacted monitoring wells;
- Disposable sampling equipment will be disposed of in an appropriate manner; and
- Used health and safety supplies will be disposed of in an appropriate manner.

5.2 Soil and Ground Water Disposed Off Site

If off-site disposal is appropriate and agreed upon by Gannett Fleming and the client, the following steps will be followed as applicable:

- Excess soil (including drilling cuttings, excess soil from sampling activities, and field screening samples) generated from drilling will be containerized in properly labeled Department of Transportation (DOT) – approved 55-gallon drums or another approved container (e.g., a roll-off box);
- Water generated from monitoring well development or purging prior to sampling will be containerized in properly labeled DOT-approved 55-gallon drums or another approved container (e.g., polytank);
- Decontamination water will be containerized in properly labeled DOT-approved 55-gallon drums;
- Used health and safety supplies and disposable sampling equipment will be containerized with a solid waste stream (i.e., drill cuttings);

- Each waste stream (i.e., soil drill cuttings, monitoring well development water, etc.) will be analyzed for waste characterization based on soil and ground water analytical results obtained from samples collected at the site;
- Based on the waste characterization results, an appropriate disposal facility (hazardous or non-hazardous waste facility) will be selected;
- Each waste stream will be transported with proper manifesting documentation to the selected waste facility.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

GANNETT FLEMING STANDARD OPERATING PROCEDURE (SOP) INSTALLATION OF TEMPORARY GROUND WATER MONITORING WELLS

GANNETT FLEMING OF MICHIGAN, INC. WIXOM, MICHIGAN

Office Location:
Gannett Fleming of Michigan, Inc.
30503 Beck Road
Wixom, Michigan 48393
(248) 960-5840

TABLE OF CONTENTS

1.0 PURPOSE 3
2.0 SCOPE 3
3.0 GLOSSARY 3
4.0 RESPONSIBILITIES 3
5.0 PROCEDURES 4
5.1 Pre-Mobilization Activities 4
5.2 Borehole Installation 5
5.3 Temporary Monitoring Well Construction and Installation 5
5.4 Surface Completion 6
5.5 Temporary Ground Water Monitoring Well Development 6
5.6 Temporary Ground Water Monitoring Well Removal 6
6.0 REFERENCES 6
7.0 ATTACHMENTS 6

1.0 PURPOSE

The purpose of this procedure is to describe the installation and construction of temporary ground water monitoring wells (temporary monitoring wells) using direct-push technology or hollow-stem augers (HSA) to create the borehole.

2.0 SCOPE

This procedure gives technical guidance on the installation and construction of temporary ground water monitoring wells using direct-push or HSA technologies. The procedural description is general since the actual well construction details, including the screen and casing material, length of screen, screen depth, sampling requirements, etc., will be project-specific due to differences in site geology and the contaminants present.

Temporary ground water monitoring wells are used to collect ground water samples at locations where permanent wells can not be installed or as part of an initial or limited site assessment. Advantages of using temporary ground water monitoring wells include savings of both time and material costs for installation, and also cost savings during future ground water sampling events by minimizing the total number of permanent monitoring wells that are installed during a site investigation. However, temporary ground water monitoring wells differ from permanent monitoring wells both in their construction and in the quality of well development. Ground water samples collected from temporary ground water monitoring wells generally contain significant quantities of fine-grained sediment that can bias some ground water tests. Data obtained from temporary ground water monitoring well samples must be evaluated with respect to these differences.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Field Operations Leader – Is responsible for ensuring that field personnel have been trained in the use of this procedure.

Field Geologist – Is responsible for borehole drilling activities and documenting observations made during drilling in a project logbook. The Field Geologist will generate a detailed boring log for each test borehole that shall include a description of the temporary ground water monitoring well construction materials and pertinent drilling and testing information.

5.0 PROCEDURES

These procedures provide a general overview of the different components involved in the successful installation of a temporary ground water monitoring well. The procedures include pre-mobilization activities, borehole installation and soil logging, temporary ground water monitoring well construction and installation, surface completion, and temporary ground water monitoring well development.

5.1 Pre-Mobilization Activities

The pre-mobilization activities are typically summarized in the project Work Plan. The Work Plan should provide detailed information on drilling requirements, methods, and objectives. The Work Plan should provide the driller with the following information regarding the temporary wells:

- Known geologic characteristics;
- Anticipated total depth of each borehole;
- Temporary monitoring well construction materials (e.g. PVC, stainless steel, etc.);
- Screen slot size;
- Anticipated length of screen and casing;
- Existing surface at each temporary monitoring well location (e.g. concrete, asphalt, grass);
- Preferred auger or macrocore size (outside and inside diameter);
- Soil and ground water sampling requirements;
- Surface completion requirements; and,
- Well development specifications.

There may be other considerations to discuss with the driller prior to mobilization, including soil cuttings and development water handling and disposal requirements, access limitations to well locations, staging areas, etc. Prior to mobilization, confirm that the appropriate access and construction permits have been obtained and utility mark outs (e.g., MISS DIG, JULIE) have been completed. **It is critical that complete utility investigation and mark out be completed prior to mobilization.**

5.2 Borehole Installation

Before drilling can commence in areas adjacent to subsurface utilities or where little information regarding utility locations is available, borehole clearance procedures must be performed with a hand auger. Project-specific exceptions to this requirement can occur if sufficient information regarding the locations of the utilities is available. If required, advance a hand auger to a minimum depth of five feet below ground surface (bgs) and record any observations in the project log book. Augering/macrocore advancement may commence after completing the clearance procedure. The temporary ground water monitoring well will be installed inside of the auger/macrocore boring as described in the following section after the borehole has been advanced to the target depth.

5.3 Temporary Monitoring Well Construction and Installation

After the augers/macrocores have attained the target depth, the drillers should check the depth with a weighted tape measure. The drillers should assemble the temporary ground water monitoring well materials above ground and verify conformance with specifications. The drillers will install the well screen and casing into the borehole and verify that the specified screen depth is achieved. The augers/macrocores may then be slowly withdrawn until the bottom is above the temporary well screen. For shallow temporary wells (depth depending on soil types encountered at the site), the augers/macrocores may be removed entirely from the ground. For deeper temporary wells, the augers/macrocores should be withdrawn only above the screen to allow for easier well removal. Unless project-specific conditions require a sand pack and grout, natural collapse will be used to seal the screen. If the project-specific requirements call for a sand pack and grouting, refer to Gannett Fleming SOP No. MI-S-12 "Installation of Conventional Ground Water Monitoring Wells".

5.4 Surface Completion

The temporary ground water monitoring well riser should extend far enough above the ground surface to allow for a sufficient length to grab or attached equipment to easily remove the casing and screen from the ground.

5.5 Temporary Ground Water Monitoring Well Development

Temporary ground water monitoring wells should be developed following the procedures described in Gannett Fleming SOP MI-S-13 "Monitoring Well Development." All well development and purge water must be handled according to the procedures outlined in Gannett Fleming SOP MI-S-14 "Investigation Derived Waste."

5.6 Temporary Ground Water Monitoring Well Removal

Once the temporary ground water monitoring well is no longer required, the casing and screen shall be removed from the ground. Depending on the project-specific requirements, the borehole may be filled with soil cuttings, bentonite, grout, or a combination of these materials. The top of the borehole shall be patched to match the surrounding material.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

APPENDIX G

FORMS

Gannett Fleming

LOG OF BORING

(Page 1 of 2)

Project No.:
Site Name
City, State

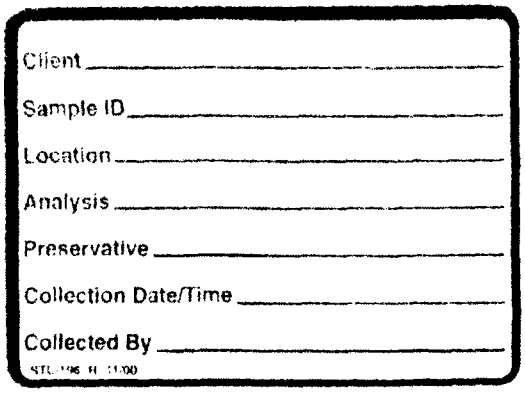
Geologist	:	Well Installed	:
Drilling Date	:	Depth of Boring	:
Drilling Company	:	Well Material	:
Drilling Method	:	Well Diameter	:
Size/Type of Bit	:	Slot Size/Length	:

Depth in Feet	Samples	Sampling Interval	% Recovery	DESCRIPTION	Blow Counts	Field Screening Results	Moisture	Well: Elev.:
0								
5								
10								
15								
20								
25								
30								

Legend:
Trace 1-10%
Little 10-20%
Some 20-35%
And 35-50%

NA Not Applicable

12-10-2004 ...isfer\Nicole\Quicklog\Fieldlog.bor


Client
Sample ID
Location
Analysis
Preservative
Collection Date/Time
Collected By

MDEQ ENVIRONMENTAL LABORATORY SAMPLE SCHEDULING FORM

Instructions on page 2

DEQ Information

Site Code #:	(If none specified, Laboratory will assign permanent site code)				
Site Name:	AY:	INDEX:	PCA:	Proj:	Ph:
Program or Section Name:	Circle one:	1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal		
DEQ Project Manager Name:		E-Mail Address: @mi.gov			
Division:	District / Office:		Telephone Number: ( ) - ext:		

Report Mailing Address:	Attention:	Invoice Address:	Attention:
	Street:		Street:
	P.O. Box:		P.O. Box:
	City, State, Zip:		City, State, Zip:

Designated Overflow Laboratory:	**Accept HT Code?** ☐ Yes ☐ No

Contractor / LOE Information

Firm Name:	Telephone Number: ( ) - ext:
Contractor E-Mail Address for final reports: 1. 2.	Contact Person:

Sample Collection Information

Anticipated Delivery Week: **Anticipated Delivery Date:**	**Sample Hazard (if known):** None

Requested Test and Sample Number Information

Matrix	Test(s) Name (see next page for available tests)	# of Samples	Matrix	Test(s) Name (see next page for available tests)	# of Samples
(EXAMPLE) Water	(EXAMPLE) pH, VOC, BOD, MI10 Metals, PCB	(EXAMPLE) 12	(EXAMPLE) Sediment	(EXAMPLE) MI10 Metals, PCB, KJEL N, Tot. P	(EXAMPLE) 7
Matrix			Matrix		
Matrix			Matrix		
Matrix			Matrix		
Matrix			Matrix		

ADDITIONAL INFORMATION:

NOTE: A hard copy report will be sent ONLY to the MDEQ Project Manager. All other copies will be e-mailed to the e-mail addresses entered above.

SAVE THIS FILE AND E-MAIL COMPLETED FORM TO DULIBANR@michigan.gov AND COPY TO FELDPAUB@michigan.gov

(For assistance call (517) 335-9800)

INSTUCTIONS:

1. **SITE CODE ID**: A site code ID is required. Each division/program may create a unique ID up to 8 alpha/numeric characters in length. It must be unique! i.e....RRD001BC (for RRD, site 001, Bay City). The client information provided will be assigned to each site code in the database. The laboratory will assign a site code if not provided on the sample request paperwork.
2. **DEQ INFORMATION:** If you are an LOE filling out this form, you must obtain the information from the MDEQ Project Manager. They will provide the Site Code ID, AY, INDEX, PCA, Proj. & Ph codes.
3. **INVOICE ADDRESS:** This is required. If all invoices are to be sent to your division Administrative staff, enter Admin. Staff name, Division Initials, & Constitution Hall (i.e. Karen Kalinowski, WD, CH. We will complete the invoice address information.

Highlighted tests must be scheduled on Sample Scheduling Form

WATER MATRIX – AVAILABLE TESTS

ORGANIC	GENERAL CHEMISTRY	INORGANIC
VOA VOLATILES (624/8260) -Full List -BTEX/MTBE only **ON** PESTICIDES/PCBS 608/8081/8082) -Pesticides & PCBs -Pesticides only -PCBs only ****** NPDES ONLY****** -Scan 3 (NPDES Only) **BNA** BASE NEUTRAL & ACIDS (625/8270) -BNAcids -PNAs only -BNs only SPECIAL REQUESTS Library Search Volatiles Semivolatiles Other (Specify)	**DO** -Diss Oxygen **GN** -NO2, o-Phos -Residue SS -BOD Tot 5 day -BOD Carb 5 day **CA** -Chlorophyll **GA** -COD -TOC -NO3 + NO2, NH3 -KJEL N, Tot P **GB** -Total CN -Amenable CN **GG** -Phenolics **OG** -Oil & Grease	**MA** -Total Metals **MAD** - Diss-Field Filtered **ICP-MS (200.8/6020)** Cd Cr Cu Ni Pb Zn As Ba Se Ag Co Mn Sb Sr Tl Al Be Mo Ti V **ICP (200.7/6010)** B Fe Li **Flame AA (200/7000 Series)** Ca Mg Na K Hardness **Cold Vapor AA (245.1/7470/7471)** Hg **MN** pH, Conductance Cl, SO_4, Total Alk HCO_3 / CO_3 Cr^{+6} -Low Level Hg

SEDIMENT MATRIX – AVAILABLE TESTS

VOA VOLATILES *(MeOH/8260) -Full List -BTEX/MTBE only **OS PESTICIDES/PCBS (8081/8082)** - Pesticides & PCBs -Pesticides only -PCBs only **BNA BASE NEUTRAL & ACIDS (8270)** - BNAs -PNAs only -BNs only	**SPECIAL REQUESTS** Library Search (Qualitative) Volatiles Semivolatiles Fingerprint **GS GENERAL CHEMISTRY** - COD -KJEL N, Tot. P -Phenolics -Total CN - % Total Solids	**ICP (6010)** Cd Cr Cu Ni Pb Zn Ba Co Mn Fe Li Al Be Mo Sr Ti V Pb (both fine & coarse) **Graphite Furnace AA** As Ag Se Tl **Flame AA (7000 Series)** Ca Mg Na K **Cold Vapor AA** Hg -% Total Solids

Oil / PRODUCT

OL VOLATILES (8260) -Volatile Full List -BTEX/MTBE only PESTICIDES/PCBS (8081/8082) -Pesticides & PCBs -Pesticides only - PCBs only	**BASE NEUTRAL & ACIDS (8270)** -BNAs -PNAs only -BNs only ****SPECIAL REQUESTS**** Library Search (Qualitative) Volatiles Semivolatiles **HW** -Flashpoint -Solubility	**MO (METALS-OIL)** **ICP (6010)** Cd Cr Cu Ni Pb Zn Ba Co Mn Fe Li Al Be Mo Ti V **Cold Vapor AA** Hg – Mercury **Hydride AA (7061)** As - Arsenic -% Cl -BTU -% Sulfur -% Ash -% Moisture

MDEQ ENVIRONMENTAL LABORATORY

Sample Bottle and Preservative Request Form

Contact : Barry Baker (bakerbg@michigan.gov)
Phone (517)335-9686
Fax (517)335-9551

Requested by: *Phone Number:*	*Date(s) Scheduled at MDEQ Laboratory*	TODAY'S DATE
E-mail		
Division/District or Company name	*Site or Project*	PICK-UP DATE
	PLEASE ALLOW AT LEAST 2 WEEKS FOR PREPARATION	

	Bottle Code	Parameter Group	Plastic Containers: 500 mL White	250 mL White	Avail. CN Kits[5]	250 mL Brown	Glass Containers: 40 mL Septum Vial	MeOH Kit[1]	1000 mL Amber	250 mL (8oz) Wide	250 mL Narrow	250 mL SC CAP	Preservatives	Check if Needed
WATER	DO	Dissolved Oxygen											DO KIT[3]	
	GN	Gen Chem/Neutral Ortho-phos. Nitrite, BOD, Silica, Residues												
	GA	Gen Chem/Acidic COD, TOC, Ammonia, Kjel N, Tot Phos , Nitrate + Nitrite											H2SO4	
	GG	Gen Chem/ Phenolics-Glass											H2SO4	
	GCN	Available CN											AVAIL.CN KIT[5]	
	GB	Gen Chem/Basic Total & Amenable Cyanide											10 N NaOH	
	S	Sulfide											1 M ZnAC 10 N NaOH	
	CA	Chlorophyll a											1% MgCO3	
	MA	Metals/Total Acidic Cd,Cr,Cu,Pb,Zn,As,Ba,Se,Ag,Hg, Ni,Co,Mn,Sb,Sr,Tl,Al,Be,Mo,Ti,V, B,Fe,Li,Ca,Mg,Na,K,											1:1 HNO3	
	MAD	Metals/Acidic Dissolved Parameter List Same as MA, Field Filtered											1:1 HNO3	
	MD	Metals/Dissolved Parameter List Same as MA, Lab Filtered												
	MN	Minerals/Neutral pH, Conduct., Cr+6, Chloride, Sulfate, Alk., Carbonate, Bicarbonate												
	OG	Oil and Grease	**OG samples require 2 x 250mL jars per sample**										H2SO4	
	VOA	Volatiles 8260/624	**VOA requires 3 vials[4]**										1:1 HCL	
	VOA	Trip blanks	**# of Trip blanks needed**											
	ON	PCB/Pesticides 608/8081/8082	**ON samples require 2 ambers[2]**											
	BNA	BNA/PNA/BN/Acids 8270/625	**BNA samples require 2 ambers[2]**											
SOIL	MS	Metals List Same as MA w/out B, Sb												
	GS	Gen Chem/ TP, Kjel-N,Phenolics, COD, Total & Avail Cyanide												
	VOA	Volatiles MeOH/8260[1]											MeOH	
	VOA	Trip Blanks	**# of trip blanks needed**											
	OS/BNA	PCB/Pesticides/BNA/PNA/BN 8270/8081/8082												
OIL	MO	Metals/Oil Liq & Solid Waste List Same as MA w/out Se,Ag,Sb,Sr,Tl,B												
	OL	Volatiles/PCB/Pesticides/BNA/BN 8260/8270/8081/8082												
	HW	Flash Point/ Solubility												
	MX	Metals/TCLP/SPLP/ASTM for MI-10												
	OX	TCLP/SPLP Volatiles 8260												

Other Requested Supplies (labels, coolers, etc.):

Please include field QC in the bottle count

TOTAL REQUESTED												

PREPARED BY: _____

Refer to back of form for collection and preservation information.

[1]MeOH Kit includes 1-tared vial, 1-10mL MeOH tube, 1-capped syringe, & 1-syringe label.

[2]See note #14 on reverse side.

[3]DO Kit: DO-1 & DO-2 reagent, must request H_2SO_4 (unless you already have it)

[4]EDB (8011) requires a 4th vial.

[5]Available Cyanide Kit: $PbCO_3$, NaOH, filter/plunger apparatus, and vials.

Do not pre-preserve bottles

August, 2005

COLLECTION AND PRESERVATION OF WATER, SEDIMENT, AND OIL SAMPLES

	BOTTLE CODE	PARAMETER GROUP	NOTES	BOTTLE TYPE	SIZE/COMMENTS	COOL TO 4 C° X = YES	PRESERVATIVE	AMOUNT	MAXIMUM HOLDING TIME
	DO	DISSOLVED OXYGEN	1	GLASS	250 mL GLASS STOPPER	X	FIX ON SITE (WINKLER)		8 HR
	GN	GEN CHM/NEUTRAL	2,3	PLASTIC	500 mL	X			2, 7, or 28 DAYS
	GA	GEN CHM/ACIDIC	3,4	PLASTIC	500 mL	X	H2SO4 TO pH < 2	10 DROPS/ 500 mL	28 DAYS
	GG	GEN CHM/PHENOLICS	5	GLASS	250 mL SCREW CAP	X	H2SO4 TO pH<2	5 DROPS/ 250 mL	28 DAYS
	GB	GEN CHM/BASIC	3,6,7,8	PLASTIC	250 mL OR 500 mL	X	10N NaOH TO pH=12	10 DROPS/ 250 mL	14 DAYS (24 HR)
W	GCN	GEN CHM/BASIC AVAIL. CYANIDE	19	PLASTIC	50 mL VIAL	X	PbCO3 FILTER 10N NaOH TO pH=12	2 DROPS/ 50 mL	14 DAYS
A	S	SULFIDE	1	PLASTIC	250 mL	X	2N ZnAC. 10N NaOH TO pH>9	10 DROPS 2 DROPS/ 250 mL	7 DAYS
T	CA	CHLOROPHYLL A	9	PLASTIC	250 mL	X	1% MgCO3	5 DROPS/ 250 mL	2 DAYS
E	MA	METALS/TOTAL ACIDIC	10	PLASTIC	500 mL		1:1 HNO3 TO pH<2	5 mL/ 500 mL	28 DAYS, 6 MO
R	MAD	METALS/ACIDIC FIELD FILTERED	10,11	PLASTIC	500 mL		FILTER ON SITE THEN ADD 1:1 HNO3 TO pH<2	5 mL/ 500mL	28 DAYS, 6 MO
	MD	METALS/LAB FILTERED	11	PLASTIC	500 mL	X	LAB FILT. & PRES.		WIN 24 HRS.
	MN	MINERAL/NEUTRAL	12	PLASTIC	500 mL	X			WIN 24 HRS, 2 DAYS, 14 & 28 DAYS
	OG	OIL & GREASE		GLASS	2x250mL W.M.	X	H2SO4 to pH<2	10 DROPS/250mL	28 DAYS
	VOA	VOLATILES 8260/624	13	GLASS	2-40mL SEPTUM VIALS	X	1:1 HCl TO pH<2	5 DROPS/VIAL	14 DAYS
	ON	PCB/PESTICIDES 608/8081/8082	14,17,18	GLASS	2-1000mL AMBER	X			7 DAYS
	BNA	BNA/PNA/BN/ACIDS 625/8270	14,18	GLASS	2-1000mL AMBER	X			7 DAYS
S	MS	METALS		GLASS	250 mL W.M.	X			
O	GS	GEN CHEM		GLASS	250mL W.M.	X			
I	VOA	VOLATILES MeOH/8260	16	GLASS	MeOH Kit	X	METHANOL	10g/10mL MeOH	14 DAYS
L	OS/BNA	PCB/PESTICIDES/BNA/PNA/BN 8270/8081/8082		GLASS	250mL W.M.	X			14 DAYS
O	MO	METALS		GLASS	250 mL W.M.	X			
I	OL	VOLATILES/PCB/PESTICIDES/BNA/BN	15	GLASS	250 mL W.M.	X			
L	HW	FLASH POINT		GLASS	250mL W.M.	X			
	MX	METALS/TCLP/SPLP/ASTM for MI10		GLASS	250mL W.M.	X			
	OX	TCLP/SPLP VOLATILES 8260		GLASS	250 mL SEPTUM JARS	X			14 DAYS

NOTES:

1 EXTRA CARE SHOULD BE TAKEN DURING COLLECTION SO THAT THE SAMPLE IS NOT AERATED BEFORE PRESERVATION

2 GN, GEN CHM/NEUTRAL, INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES: SETTLEABLE RESIDUE, NITRITE, ORTHOPHOSPHATE, BOD, AND TURBIDITY (2 DAYS); TOTAL, FILTERABLE, NONFILTERABLE AND VOLATILE RESIDUES (7 DAYS); SILICATES (28 DAYS).

3 ADD SUFFIX "D" TO BOTTLE CODE WHEN SAMPLE IS FIELD FILTERED.

4 EXCESS ACID PRESERVATIVE WILL CAUSE INTERFERENCE...COUNT DROPS CAREFULLY, CHECK pH, ADD MORE ACID IF NECESSARY (pH=2). GA INCLUDES CHEMICAL OXYGEN DEMAND (COD), TOTAL ORGANIC CARBON (TOC), NITRATE PLUS NITRITE, AMMONIA, KJELDAHL NITROGEN, AND TOTAL PHOSPHORUS.

5 CHLORINATED SAMPLES FOR PHENOLS SHOULD BE COLLECTED IN A SEPARATE BOTTLE AND DECHLORINATED WITH 141N FAS (FERROUS AMMONIUM SULFATE, USUALLY ONE DROP) BEFORE PRESERVATION (USE BOTTLE CODE GP).

6 GB INCLUDES TOTAL CYANIDE, AND CYANIDE AMMENABLE TO CHLORINATION (FREE). HOLDING TIME IS 24 HOURS IF SULFIDES ARE PRESENT.

7 CHLORINATED SAMPLES FOR CYANIDES MUST BE DECHLORINATED WITH ASCORBIC ACID (0.6 G/L) IMMEDIATELY AFTER COLLECTION AND THEN PRESERVED WITH NaOH.

8 THE PROPER CONTAINER DEPENDS ON PARAMETERS REQUESTED. 250 ML FOR TOTAL ONLY, 500 ML FOR AMENABLE

9 IF SAMPLE IS FILTERED ON SITE AND THE MEMBRANE FILTER ADDED TO 90% ACETONE (SUPPLIED BY THE LAB) AND REFRIGERATED, HOLDING TIME IS ONE MONTH. STORE FILTERED SAMPLE IN THE DARK AND ON ICE.

10 RECOMMENDED MAXIMUM HOLDING TIME FOR MERCURY, SODIUM, POTASSIUM, MAGNESIUM, CALCIUM (28 DAYS), OTHER METALS (6 MONTHS)

11 IF FIELD FILTRATION IS NOT AVAILABLE, SEND UNFILTERED SAMPLE TO THE LAB AS SOON AS POSSIBLE (WITHIN 24 HOURS). DO NOT ADD ACID TO DISSOLVED METAL IF UNFILTERED.

12 MN, MINERALS/NEUTRAL INCLUDES THE FOLLOWING PARAMETERS WITH THEIR HOLDING TIMES: pH (ANALYSES SHOULD BE PERFORMED IMMEDIATELY ON SITE), HEXAVALENT CHROMIUM (24 HOURS), ALKALINITIES (CO3, HCO3, TOTAL ALK) (14 DAYS); SPECIFIC CONDUCTANCE, CHLORIDE, SULFATE (28 DAYS).

13 FILL BOTTLE COMPLETELY (NO AIR BUBBLES) AND MAKE SURE TEFLON SIDE OF SEPTUM FACES SAMPLES. DUPLICATE VIALS REQUIRED

14 IF BOTH ON AND BNA ARE COLLECTED,COLLECT A MAXIMUM OF 3 AMBERS PER SAMPLE IDENTIFICATION

15 INCLUDES PETROLEUM HYDROCARBONS, SPILL IDENTIFICATION.

16 WEIGH OUT 10 GRAMS OF SOIL AND ADD TO A 40mL TARED VIAL. OPEN THE 10 mL METHANOL TUBE AND ADD TO THE VIAL. FILL, CAP, AND LABEL THE SYRINGE WITH SOIL SAMPLE.

17 LOW LEVEL PCB BY SPECIAL REQUEST ONLY. COLLECT 3 AMBERS PER SAMPLE.

18 COLLECT 3 AMBERS PER SAMPLE PER PARAMETER GROUP FOR QA/QC FOR ONE SAMPLE IN TWENTY.

19 WITHIN 15 MINUTES OF COLLECTION POUR APPROX. 50 ML OF SAMPLE INTO PBCO3 VIAL MIX. FILTER USING FILTER/PLUNGER APPARATUS. DECANT LIQUID ABOVE FILTER/PLUNGER INTO A NEW TUBE; PRESERVE WITH 10N NAOH TO pH 12.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB WORK ORDER #

MATRIX=WATER

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:		
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded	
		2. CMI (Non RRD)	6. RRD-LUST - Federal	
		3. NPDES	7. RRD-SUPERFUND- Federal	
		4. OTHER-list here -		

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO yes, which parameters?

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY:	INDEX:	PCA:
			PROJECT:		PH:

OVERFLOW LAB (Required for Funded RRD & CMI samples)

1ST CHOICE: | 2ND CHOICE

COLLECTED BY: | PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:

1.)

2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (8260)

Full List	1 2 3 4 5 6 7 8 9 10
BTEX/MTBE/TMB only	1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (8081/8082)

Pesticides & PCBs	1 2 3 4 5 6 7 8 9 10
Pesticides only	1 2 3 4 5 6 7 8 9 10
PCBs only	1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)

BNAs	1 2 3 4 5 6 7 8 9 10
PNAs only	1 2 3 4 5 6 7 8 9 10
BNs only	1 2 3 4 5 6 7 8 9 10
ACIDs only	1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)

Volatiles	1 2 3 4 5 6 7 8 9 10
Semivolatiles	1 2 3 4 5 6 7 8 9 10
FingerPrint	1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxygen	1 2 3 4 5 6 7 8 9 10
GN NO_3, o-Phos	1 2 3 4 5 6 7 8 9 10
Residue SS	1 2 3 4 5 6 7 8 9 10
Residue TDS	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
BOD Tot 5 day	1 2 3 4 5 6 7 8 9 10
BOD Carb 5 day	1 2 3 4 5 6 7 8 9 10
Turbidity	1 2 3 4 5 6 7 8 9 10
CA Chlorophyll	1 2 3 4 5 6 7 8 9 10
GA COD	1 2 3 4 5 6 7 8 9 10
TOC	1 2 3 4 5 6 7 8 9 10
NO3 + NO2, NH3	1 2 3 4 5 6 7 8 9 10
KJEL N, Tot P	1 2 3 4 5 6 7 8 9 10
S Sulfide	1 2 3 4 5 6 7 8 9 10
GP Phenolics	1 2 3 4 5 6 7 8 9 10
GB Total CN	1 2 3 4 5 6 7 8 9 10
Amenable CN	1 2 3 4 5 6 7 8 9 10
GCN Available CN	1 2 3 4 5 6 7 8 9 10
OG Oil & Grease	1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals	1 2 3 4 5 6 7 8 9 10
MAD Diss-Field Filtered	1 2 3 4 5 6 7 8 9 10
MD Diss-Lab Filtered	1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No.

MICH TEN METALS (As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn)	1 2 3 4 5 6 7 8 9 10
ICP-MS (200.8/6020)	
Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
As Ba Se Ag	1 2 3 4 5 6 7 8 9 10
Co Mn Sb Sr Tl	1 2 3 4 5 6 7 8 9 10
Al Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
ICP (200.7/6010)	
B Fe Li	1 2 3 4 5 6 7 8 9 10
Flame AA (200/7000 Series)	
Ca Mg Na K	1 2 3 4 5 6 7 8 9 10
Hardness	1 2 3 4 5 6 7 8 9 10
Cold Vapor AA (245.1/7470/7471)	
Hg	1 2 3 4 5 6 7 8 9 10
MN pH, Conductance	1 2 3 4 5 6 7 8 9 10
Cl, SO_4, Total Alk	1 2 3 4 5 6 7 8 9 10
HCO_3, CO_3	1 2 3 4 5 6 7 8 9 10
Cr^{+6}	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

Revised November 24,2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

****NPDES ONLY****

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=WASTEWATER

SITE CODE NUMBER	SITE NAME	CIRCLE ONE: 1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded
		2. CMI (Non RRD)	6. RRD-LUST - Federal
		3. NPDES	7. RRD-SUPERFUND- Federal
		4. OTHER-list here -	

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY. INDEX. PCA
			PROJECT: PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE:	2ND CHOICE:	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (624)
- -VOC - Full List 1 2 3 4 5 6 7 8 9 10
- -BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (608)
- -Scan 3 1 2 3 4 5 6 7 8 9 10
- -PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (625)
- -BNAs 1 2 3 4 5 6 7 8 9 10
- -PNAs only 1 2 3 4 5 6 7 8 9 10
- -BNs only 1 2 3 4 5 6 7 8 9 10
- -ACIDs only 1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)
- -Volatiles 1 2 3 4 5 6 7 8 9 10
- -Semivolatiles 1 2 3 4 5 6 7 8 9 10
- -FingerPrnt 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxygen 1 2 3 4 5 6 7 8 9 10

GN NO_3,o-Phos 1 2 3 4 5 6 7 8 9 10
- Residue SS 1 2 3 4 5 6 7 8 9 10
- Residue TDS 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10
- BOD Tot 5 day 1 2 3 4 5 6 7 8 9 10
- BOD Carb 5 day 1 2 3 4 5 6 7 8 9 10
- Turbidity 1 2 3 4 5 6 7 8 9 10

CA Chlorophyll 1 2 3 4 5 6 7 8 9 10

GA COD 1 2 3 4 5 6 7 8 9 10
- TOC 1 2 3 4 5 6 7 8 9 10
- NO3 NO2,NH3 1 2 3 4 5 6 7 8 9 10
- KL N,Tot P 1 2 3 4 5 6 7 8 9 10

S Sulfide 1 2 3 4 5 6 7 8 9 10

GP Phenolics 1 2 3 4 5 6 7 8 9 10

GB Total CN 1 2 3 4 5 6 7 8 9 10
- Amenable CN 1 2 3 4 5 6 7 8 9 10

GCN Available CN 1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals 1 2 3 4 5 6 7 8 9 10
MAD Diss-Field Filtered 1 2 3 4 5 6 7 8 9 10
MD Diss-Lab Filtered 1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No.

ICP-MS (200.8/6020)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- As Ba Se Ag 1 2 3 4 5 6 7 8 9 10
- Co Mn Sb Sr Tl 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Ti V 1 2 3 4 5 6 7 8 9 10

ICP (200.7/6010)
- B Fe Li 1 2 3 4 5 6 7 8 9 10

Flame AA (200/7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10
- Hardness 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- Hg 1 2 3 4 5 6 7 8 9 10

MN pH,Conductance 1 2 3 4 5 6 7 8 9 10
- Cl, SO_4, Total Alk 1 2 3 4 5 6 7 8 9 10
- HCO_3, CO_3 1 2 3 4 5 6 7 8 9 10
- Cr^6 1 2 3 4 5 6 7 8 9 10

OG Oil & Grease 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

W-BacT

MATRIX=WATER

LAB WORK ORDER #					
SITE CODE NUMBER	SITE NAME	CIRCLE ONE: 1. NO SITE FUNDING 2. 3. NPDES CMI (Non RRD) 4. OTHER-list here -			
DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY:	INDEX:	PCA:
			PROJECT:		PH:
OVERFLOW LAB (Required for Funded RRD & CMI samples) 1ST CHOICE:	2ND CHOICE		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO: 1.)		
COLLECTED BY:		PHONE:	2.)		

****** SAFETY INFORMATION REQUIRED ******
SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

GENERAL CHEMISTRY

CA Chlorophyll	1 2 3 4 5 6 7 8 9 10	
DO Diss Oxygen	1 2 3 4 5 6 7 8 9 10	
GN NO_3, o-Phos	1 2 3 4 5 6 7 8 9 10	
Residue SS	1 2 3 4 5 6 7 8 9 10	
Residue TDS	1 2 3 4 5 6 7 8 9 10	
BOD Tot 5 day	1 2 3 4 5 6 7 8 9 10	
BOD Carb 5 day	1 2 3 4 5 6 7 8 9 10	
Turbidity	1 2 3 4 5 6 7 8 9 10	
GA COD	1 2 3 4 5 6 7 8 9 10	
TOC	1 2 3 4 5 6 7 8 9 10	
NO3 + NO2, NH3	1 2 3 4 5 6 7 8 9 10	
KJEL N, Tot P	1 2 3 4 5 6 7 8 9 10	

INORGANIC

↓↓↓Circle Metal and Corresponding Sample No. ↓↓↓

MA Total Metals	1 2 3 4 5 6 7 8 9 10
ICP-MS (200.8/6020)	
Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
As Ba Se Ag	1 2 3 4 5 6 7 8 9 10
Co Mn Sb Sr Tl	1 2 3 4 5 6 7 8 9 10
Al Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
ICP (200.7/6010)	
B Fe Li	1 2 3 4 5 6 7 8 9 10
Flame AA (200/7000 Series)	
Ca Mg Na K	1 2 3 4 5 6 7 8 9 10
Hardness	1 2 3 4 5 6 7 8 9 10
Cold Vapor AA (245.1/7470/7471)	
Hg	1 2 3 4 5 6 7 8 9 10

MN pH, Conductance	1 2 3 4 5 6 7 8 9 10
Cl, SO_4, Total Alk	1 2 3 4 5 6 7 8 9 10
HCO_3 CO_3	1 2 3 4 5 6 7 8 9 10
Cr^{+6}	1 2 3 4 5 6 7 8 9 10

MICROBIOLOGICAL TESTS

NPEC E coli	1 2 3 4 5 6 7 8 9 10

▶ NOTE 6 Hour Hold Time!!

OTHER TESTS: LIST HERE

_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	Date / Time	RECEIVED BY / ORGANIZATION	Date / Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time
Print Name & Organization	Date	Print Name & Organization	Date
Signature — If mailed, outer container sealed YES NO (circle one)	Time	Signature — If mailed, outer container sealed YES NO (circle one)	Time

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=LL HG Water

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:		
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded	
		2. CMI (Non RRD)	6. RRD-LUST - Federal	
		3. NPDES	7. RRD-SUPERFUND- Federal	
		4. OTHER-list here -		

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY.	INDEX:	PCA.
			PROJECT:		PH:

OVERFLOW LAB (Required for RRD & CMI samples)

1ST CHOICE. | 2ND CHOICE.

COLLECTED BY: PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:

1.)

2.)

****** SAFETY INFORMATION REQUIRED ******
SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES (8260)
- Full List 1 2 3 4 5 6 7 8 9 10
- BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

ON PESTICIDES/PCBS (8081/8082)
- Pesticides & PCBs 1 2 3 4 5 6 7 8 9 10
- Pesticides only 1 2 3 4 5 6 7 8 9 10
- PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)
- BNAs 1 2 3 4 5 6 7 8 9 10
- PNAs only 1 2 3 4 5 6 7 8 9 10
- BNs only 1 2 3 4 5 6 7 8 9 10
- ACIDs only 1 2 3 4 5 6 7 8 9 10

SPECIAL REQUESTS

Library Search (Qualitative)
- Volatiles 1 2 3 4 5 6 7 8 9 10
- Semivolatiles 1 2 3 4 5 6 7 8 9 10
- FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

DO Diss Oxgen 1 2 3 4 5 6 7 8 9 10

GN $NO_{2,3}$-Phos 1 2 3 4 5 6 7 8 9 10
- Residue SS 1 2 3 4 5 6 7 8 9 10
- Residue TDS 1 2 3 4 5 6 7 8 9 10
- 1 2 3 4 5 6 7 8 9 10
- BOD Tot 5 day 1 2 3 4 5 6 7 8 9 10
- BOD Carb 5 day 1 2 3 4 5 6 7 8 9 10
- Turbidity 1 2 3 4 5 6 7 8 9 10

CA Chlorophyll 1 2 3 4 5 6 7 8 9 10

GA COD 1 2 3 4 5 6 7 8 9 10
- TOC 1 2 3 4 5 6 7 8 9 10
- NO3 NO2,NH3 1 2 3 4 5 6 7 8 9 10
- KL N,Tot P 1 2 3 4 5 6 7 8 9 10

S Sulfide 1 2 3 4 5 6 7 8 9 10

GP Phenolics 1 2 3 4 5 6 7 8 9 10

GB Total CN 1 2 3 4 5 6 7 8 9 10
- Amenable CN 1 2 3 4 5 6 7 8 9 10

GCN Available CN 1 2 3 4 5 6 7 8 9 10

INORGANIC

MA Total Metals 1 2 3 4 5 6 7 8 9 10

MAD Diss-Field Filtered 1 2 3 4 5 6 7 8 9 10

MD Diss-Lab Filtered 1 2 3 4 5 6 7 8 9 10

Circle Requested Metal and Corresponding Sample No

ICP-MS (200.8/6020)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- As Ba Se Ag 1 2 3 4 5 6 7 8 9 10
- Co Mn Sb Sr Tl 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Ti V 1 2 3 4 5 6 7 8 9 10

ICP (200.7/6010)
- B Fe Li 1 2 3 4 5 6 7 8 9 10

Flame AA (200/7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10
- Hardness 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- Hg

LL Hg Low Level Mercury (1631)
- Total/Acid Added 1 2 3 4 5 6 7 8 9 10
- Total/ No Acid 1 2 3 4 5 6 7 8 9 10
- Diss/Acid Added 1 2 3 4 5 6 7 8 9 10
- Diss/No Acid Added 1 2 3 4 5 6 7 8 9 10

MN pH,Conductance 1 2 3 4 5 6 7 8 9 10
- Cl, SO_4, Total Alk 1 2 3 4 5 6 7 8 9 10
- HCO_3, CO_3 1 2 3 4 5 6 7 8 9 10
- Ca^+ 1 2 3 4 5 6 7 8 9 10

OG Oil & Grease 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody	RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1 Are samples expected to contain cyanide (CN)? YES NO
If yes, at what level? _____

2 Are samples expected to be flamable? YES NO

3 Are samples acidic prior to preservation (pH < 2)? YES NO

4 Are samples caustic prior to preservation (pH > 12)? YES NO

5 Are samples expected to be a Biohazard? YES NO

6 Are samples expected to be reactive with water or acid? YES NO

7 Are samples expected to be radioactive? YES NO

8 Are samples expected to contain dioxin? YES NO

9 Are samples expected to be explosive? YES NO

10 List additional suspected hazard information.

_____

_____

_____

PRESERVATIVE TRACKING NUMBERS

BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)	BOTTLE CODE	PRESER-VATIVE	PRESERVATIVE TRACKING NUMBER (FL NUMBER)
VOA	HCl	FL -	S	ZnAC	FL -
DO	DO-1	FL -	S	NaOH	FL -
DO	DO-2	FL -	CA	$MgCO_3$	FL -
DO	H_2SO_4	FL -	MA/MAD	HNO_3	FL -
GA/GG	H_2SO_4	FL -	OG	H_2SO_4	FL -
GB	NaOH	FL -	GCN	NaOH	FL -

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Goldenrod

LAB ORDER #

MATRIX=SEDIMENT/SOIL/SOLIDS

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:		
		1. NO SITE FUNDING	5. RRD-CLEANUP - State Funded	
		2. CMI (Non RRD)	6. RRD-LUST - Federal	
		3. NPDES	7. RRD-SUPERFUND- Federal	
		4. OTHER-list here -		

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY: INDEX: PCA:
			PROJECT: PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE:	2ND CHOICE:	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

VOA VOLATILES *(MeOH/8260)
- VOC - Full List 1 2 3 4 5 6 7 8 9 10
- BTEX/MTBE/TMB only 1 2 3 4 5 6 7 8 9 10

OS PESTICIDES/PCBS (8081/8082)
- Pesticides & PCBs 1 2 3 4 5 6 7 8 9 10
- Pesticides only 1 2 3 4 5 6 7 8 9 10
- PCBs only 1 2 3 4 5 6 7 8 9 10

BNA BASE NEUTRAL & ACIDS (8270)
- BNAs 1 2 3 4 5 6 7 8 9 10
- PNAs only 1 2 3 4 5 6 7 8 9 10
- BNs only 1 2 3 4 5 6 7 8 9 10

***MeOH Preservative Tracking Number** **FL -**

ORGANIC SPECIAL REQUESTS

Library Search (Qualitative)
- Volatiles 1 2 3 4 5 6 7 8 9 10
- Semivolatiles 1 2 3 4 5 6 7 8 9 10
- FingerPrint 1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

GS
- COD 1 2 3 4 5 6 7 8 9 10
- TKN,Tot. P 1 2 3 4 5 6 7 8 9 10
- Phenolics 1 2 3 4 5 6 7 8 9 10
- Total CN 1 2 3 4 5 6 7 8 9 10
- % Total Solids 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10
- _ 1 2 3 4 5 6 7 8 9 10 Hg

INORGANIC

Circle Requested Metal and Corresponding Sample No.

MICH TEN METALS 1 2 3 4 5 6 7 8 9 10
(As,Ba,Cd,Cr,Cu,Pb,Hg,Se,Ag,Zn)

ICP (6010)
- Cd Cr Cu Ni Pb Zn 1 2 3 4 5 6 7 8 9 10
- Ba Co Mn Fe Li 1 2 3 4 5 6 7 8 9 10
- Al Be Mo Sr Ti V 1 2 3 4 5 6 7 8 9 10
- Pb (both fine & coarse) 1 2 3 4 5 6 7 8 9 10

Graphite Furnace AA (7000 Series)
- As Ag Se Tl 1 2 3 4 5 6 7 8 9 10

Flame AA (7000 Series)
- Ca Mg Na K 1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (245.1/7470/7471)
- 1 2 3 4 5 6 7 8 9 10

% Total Solids 1 2 3 4 5 6 7 8 9 10
_ 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Yellow

LAB ORDER #

MATRIX=ORGANIC/OIL/COAL

SITE CODE NUMBER	SITE NAME	CIRCLE ONE:	1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES 4. OTHER-list here -	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO If yes, which parameters?
			@mi.gov		

PRIMARY CONTACT PERSON	CONTRACT FIRM NAME (if applicable)	PHONE	AY: INDEX: PROJECT:	PCA: PH:

OVERFLOW LAB (Required for RRD & CMI samples)		E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1ST CHOICE:	2ND CHOICE	1.)
COLLECTED BY:	PHONE:	2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

OL VOLATILES (8260)

Volatile Full List	1 2 3 4 5 6 7 8 9 10
BTEX/MTBE/TMB only	1 2 3 4 5 6 7 8 9 10

PESTICIDES/PCBS (8081/8082)

Pesticides & PCBs	1 2 3 4 5 6 7 8 9 10
Pesticides only	1 2 3 4 5 6 7 8 9 10
PCBs only	1 2 3 4 5 6 7 8 9 10

BASE NEUTRAL & ACIDS (8270)

BNAs	1 2 3 4 5 6 7 8 9 10
PNAs only	1 2 3 4 5 6 7 8 9 10
BNs only	1 2 3 4 5 6 7 8 9 10

******ORGANIC SPECIAL REQUESTS******

Library Search (Qualitative)

Volatiles	1 2 3 4 5 6 7 8 9 10
Semivolatiles	1 2 3 4 5 6 7 8 9 10
FingerPrint	1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

HW

Flashpoint	1 2 3 4 5 6 7 8 9 10
Solubility	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

INORGANIC

MO

Circle Requested Metal and Corresponding Sample No.

ICP (6010)

Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Ba Co Mn Fe Li	1 2 3 4 5 6 7 8 9 10
Al Be Mo Ti V	1 2 3 4 5 6 7 8 9 10

Cold Vapor AA (7470/7471)

Hg - Mercury	1 2 3 4 5 6 7 8 9 10

Hydride AA (7061)

As - Arsenic	1 2 3 4 5 6 7 8 9 10

Fuel Analyses

% Cl	1 2 3 4 5 6 7 8 9 10
BTU	1 2 3 4 5 6 7 8 9 10
% Sulfur	1 2 3 4 5 6 7 8 9 10
% Ash	1 2 3 4 5 6 7 8 9 10
% Moisture	1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO
10	List additional suspected hazard information.		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Blue

LAB ORDER #

MATRIX=ASTM LEACH / TCLP / SPLP

SITE CODE NUMBER | **SITE NAME** | **CIRCLE ONE:** 1. NO SITE FUNDING; 2. CMI (Non RRD); 3. NPDES; 4. OTHER-list here -; 5. RRD-CLEANUP - State Funded; 6. RRD-LUST - Federal; 7. RRD-SUPERFUND- Federal

DIVISION | **DISTRICT/OFFICE** | **MDEQ PROJECT MANAGER** | **E-MAIL ADDRESS** @mi.gov | **PHONE** | ACCEPT HT CODES? YES / NO If yes, which parameters?

PRIMARY CONTACT PERSON | **CONTRACT FIRM NAME (if applicable)** | **PHONE** | AY | INDEX: | PCA
PROJECT: | **PH:**

OVERFLOW LAB **(Required for RRD & CMI samples)**
1ST CHOICE | 2ND CHOICE

COLLECTED BY: | **PHONE:**

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:
1.)
2.)

****** SAFETY INFORMATION REQUIRED ******
SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
5	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

ORGANIC

OX

TCLP Volatiles	1 2 3 4 5 6 7 8 9 10
SPLP Volatiles	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

GENERAL CHEMISTRY

GS

ASTM Leach (Neutral Leach)	1 2 3 4 5 6 7 8 9 10
Ortho P, NO_2	1 2 3 4 5 6 7 8 9 10
COD	1 2 3 4 5 6 7 8 9 10
TOC	1 2 3 4 5 6 7 8 9 10
NO_3+NO_2, NH_3	1 2 3 4 5 6 7 8 9 10
Kjel N, Tot. P	1 2 3 4 5 6 7 8 9 10
Phenolics	1 2 3 4 5 6 7 8 9 10
Cyanide	1 2 3 4 5 6 7 8 9 10
% Total Solids	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

INORGANIC

MS

ASTM Leach (Neutral Leach)	
Cl SO4 Alk.	1 2 3 4 5 6 7 8 9 10
Cr^{+6}	1 2 3 4 5 6 7 8 9 10
Ca Mg Na K	1 2 3 4 5 6 7 8 9 10
Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Fe Co Li Mn	1 2 3 4 5 6 7 8 9 10
Al Ba Be Mo Ti V	1 2 3 4 5 6 7 8 9 10
As Ag Se Sb Tl	1 2 3 4 5 6 7 8 9 10
Hg	1 2 3 4 5 6 7 8 9 10
% Total Solids	1 2 3 4 5 6 7 8 9 10

MX

TCLP Metals	1 2 3 4 5 6 7 8 9 10
SPLP Metals	1 2 3 4 5 6 7 8 9 10
ICP (6010)	
Ba Cd Cr Cu Ni Pb Zn	1 2 3 4 5 6 7 8 9 10
Graphite Furnace AA (7000 Series)	
As Ag Se	1 2 3 4 5 6 7 8 9 10
Cold Vapor AA (7470/7471)	
Hg	1 2 3 4 5 6 7 8 9 10
_____	1 2 3 4 5 6 7 8 9 10

Circle Requested Parameter and Corresponding Sample No.

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION
(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO
10	List additional suspected hazard information.		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY

Pink

ENVIRONMENTAL LABORATORY

ANALYSIS REQUEST SHEET

MATRIX=AIR CANISTER VOLATILES

AB ORDER #

SITE CODE NUMBEI	SITE NAME	:IRCLE ONE:	1. NO SITE 2. CMI (Non 3. NPDES 4. OTHER-list	5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION	DISTRICT/OFFICE	MDEQ PROJECT MANAGER	E-MAIL ADDRESS	PHONE	ACCEPT HT CODES? YES / NO
			(@mi.gov		

PRIMARY CONTACT PERSON	PHONE	AY:	INDEX:	PCA:

OVERFLOW LAB (Required for RRD & CMI samples)		PROJECT:	PH:
1ST CHOICE	2ND CHOICE:	E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:	
COLLECTED BY:	PHONE:		

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		CANISTER NUMBER	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				

****INFORMATION BELOW FOR FIELD STAFF ONLY****

GENERAL INFORMATION

AIRS NO.:	SAMPLER NO:

SAMPLING INFORMATION

Canister Pressure

1st CANISTER:	2nd CANISTER:
START:	START:
STOP:	STOP:

Timer Settings

C1 (PUMP)		C2 (VALVE)	
START:	DAY:	START:	DAY:
STOP:	DAY:	STOP:	DAY:

VERIFIED: **COMMENTS:**

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

See Safety Section "Back of Form"

Revised November 24, 2004

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

White

LAB ORDER #

MATRIX=ALDEHYDE CARTRIDGE

E CODE NUMBER	**SITE NAME**	**CIRCLE ONE:**	**1. NO SITE FUNDING**	**5. RRD-CLEANUP - State Funded**
			2. CMI (Non RRD)	**6. RRD-LUST - Federal**
			3. NPDES	**7. RRD-SUPERFUND- Federal**
			4. OTHER-list here -	

DIVISION	**DISTRICT/OFFICE**	**MDEQ PROJECT MANAGER**	**E-MAIL ADDRESS**	**PHONE**	ACCEPT HT CODES? YES / NO
			@michigan.gov		

PRIMARY CONTACT PERSON	**CONTRACT FIRM NAME (if applicable)**	**PHONE**	AY.	INDEX:	PCA:
			PROJECT:		**PH:**

OVERFLOW LAB (**Required for RRD & CMI samples**)		**E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:**
1ST CHOICE:	2ND CHOICE:	**1.)**
COLLECTED BY:	**PHONE:**	**2.)**

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		FIELD ID OR DESCRIPTION	SAMPLE COLLECTION DATE	CARTRIDGE LOT NUMBER	**INTAKE BLACK BALL** ROTAMETER FLOW *PRE* VALUE *POST*		SAMPLE INFORMATION
01	AA						
02	AA						
03	AA						
04	AA						
05	AA						
06	AA						

SAMPLER #: _____

ROTAMETER #: _____

CARTRIDGE LOT #: _____

AVERAGE

Pressure (mm Hg): _____

Temperature (Degrees Centigrade): _____

Total Elapsed Time (Minutes): _____

If AVERAGES are filled in you do *not* have to fill in Pre and Post Sampling Info

PRE-SAMPLING INFO

DATE/TIME INSTALLED: _____

BAROMETRIC PRESSURE (mm Hg): _____

TEMPERATURE (Degrees Centigrade): _____

ELAPSED TIME (Minutes): _____

POST-SAMPLING INFO

DATE/TIME REMOVED: _____

BAROMETRIC PRESSURE (mm Hg): _____

TEMPERATURE (Degrees Centigrade): _____

ELAPSED TIME (Minutes): _____

CARTRIDGE LABELING INSTRUCTIONS:

1. Label foil pouch with sample date, site name/ID, your initials, and the sample origin and include the following:

PRIMARY CARTRIDGE (PORT #1) - #1

PRIMARY CARTRIDGE (PORT #1) BACKUP - #1-B

COLLOCATED CARTRIDGE (PORT #2) - #2

COLLOCATED CARTRIDGE (PORT #2) BACKUP - #2-B

FIELD BLANK - FB

2. Do not write on the actual cartridge.

3. List units used for barometric pressure as mm Hg.

4. List units of temperature as degrees C.

5. Temperature should reflect outside ambient conditions.

6. Use black ball in rotameter to measure flow through cartridge.

FOR CO-LOCATED RUN, MEASURE FLOW OF EACH CARTRIDGE

*IF THE SAMPLE IS COLLECTED IN THE VAN DENOTE THIS ON LABEL.

Chain-of-Custody	RELEASED BY - ORGANIZATION	RECEIVED BY - ORGANIZATION	DATE	TIME
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		
	Print Name & Organization	Print Name & Organization		
	Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

Green

LAB ORDER #

MATRIX=SURFACE COATINGS & INKS

CODE NUMBER | SITE NAME | CIRCLE ONE: 1. NO SITE FUNDING 2. CMI (Non RRD) 3. NPDES 4. OTHER-list here - 5. RRD-CLEANUP - State Funded 6. RRD-LUST - Federal 7. RRD-SUPERFUND- Federal

DIVISION | DISTRICT/OFFICE | MDEQ PROJECT MANAGER | E-MAIL ADDRESS (@michigan.gov) | PHONE | ACCEPT HT CODES? YES / NO

PRIMARY CONTACT PERSON | CONTRACT FIRM NAME (if applicable) | PHONE

AY: INDEX: PCA:

PROJECT: PH:

OVERFLOW LAB (Required for RRD & CMI samples)

1ST CHOICE: 2ND CHOICE:

COLLECTED BY: PHONE:

E-MAIL ADDRESSES TO SEND ADDITIONAL REPORTS TO:

1.)

2.)

****** SAFETY INFORMATION REQUIRED ******

SEE BACK OF FORM

LAB USE ONLY		SAMPLE DESCRIPTION	SAMPLE COLLECTED DATE MM/DD/YY	SAMPLE COLLECTED TIME MILITARY	COMMENTS
1	AA				
2	AA				
3	AA				
4	AA				
	AA				
6	AA				
7	AA				
8	AA				
9	AA				
10	AA				

INORGANIC

VOC (lb/gal) 1 2 3 4 5 6 7 8 9 10

Density (lb/gal) 1 2 3 4 5 6 7 8 9 10

Chain-of-Custody

RELEASED BY / ORGANIZATION	RECEIVED BY / ORGANIZATION	DATE	TIME
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		
Print Name & Organization	Print Name & Organization		
Signature	Signature		

DEQ

MICHIGAN DEPT. OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL LABORATORY
ANALYSIS REQUEST SHEET

SAFETY INFORMATION

(MUST BE COMPLETED PRIOR TO SAMPLE SUBMITTAL)

1	Are samples expected to contain cyanide (CN)? If yes, at what level? _____	YES	NO
2	Are samples expected to be flammable?	YES	NO
3	Are samples expected to be acidic (pH < 2)?	YES	NO
4	Are samples expected to be caustic (pH > 12)?	YES	NO
5	Are samples expected to be a Biohazard?	YES	NO
6	Are samples expected to be reactive with water or acid?	YES	NO
7	Are samples expected to be radioactive?	YES	NO
8	Are samples expected to contain dioxin?	YES	NO
9	Are samples expected to be explosive?	YES	NO

10 List additional suspected hazard information.

CLIENT CHAIN OF CUSTODY **SAMPLER'S SIGNATURE** _____ **Quote**

From (1): Contact:
Phone:
Fax:
Project (1): P.O.# (1): _____

Please provide any special reporting instructions.

Analysis Wanted (2):

Total Number of Containers:

Turn Around Time (In Calendar Days):

Sample ID (3)	Date / Time	Preservation (4)	Matrix	Sample Amt.						Remarks

Relinquished By/Sign.	Date/Time	Received By/Sign.	Relinquished By/Sign.	Date/Time	Received By/Sign.

Received for Laboratory By/Signature	Date/Time	Send Samples to: **Eno River Labs, LLC** **Attn: Sample Management Group** **2445 S. Alston Ave.** **Durham, NC 27713 USA** **Phone: (919) 281-4040 • Fax: (919) 281-4070**

Directions (1) Provide and/or correct client and project information.
(2) Verify analysis, check approriate boxes for each sample.
(3) Please be sure that this matches the ID on the sample container.
(4) Please indicate the preservation used for each sample.

QUALITY ASSURANCE PROJECT PLAN
SHIAWASSEE RIVER PROJECT
HOWELL, MICHIGAN

FIELD AUDIT CHECKLIST

SITE NAME: _____

GANNETT FLEMING PROJECT NO: _____

MDEQ-RRD PROJECT NO: _____

DATE OF FIELD AUDIT: _____

Item	Description of Field Audit Activities	QA Manager Initials
1	Review of field sampling records	
2	Review of field measurement procedures	
3	Examination of the application of sample identifications following the specified protocol	
4	Review of field instrument calibration records and procedures	
5	Recalibration of field instruments to verify calibration to the manufacturer's specifications	
6	Review of the sample handling and packaging procedures	
7	Review of the COC procedures	

CLIENT CHAIN OF CUSTODY **SAMPLER'S SIGNATURE** _____ **Quote 0400000388**

From (1): Michigan Dept. of Env. Quality
Constitution Hall;Atrium North
525 West Allegan
Lansing, MI 48933

Contact: Al Taylor
Phone: 517-335-4799
Fax: 517-373-4797

Project (1): SOLE SOURCE CONTRACT

P.O.# (1): _____

(DNR03 /UN)

Please provide any special reporting instructions.

Analysis Wanted (2):

1613B:T-O	8290:T-O	WHO PCBs		

Total Number of Containers:

Turn Around Time (In Calendar Days):

Sample ID (3)	Date / Time	Preservation (4)	Matrix	Sample Amt.						Remarks

Relinquished By/Sign.	Date/Time	Received By/Sign.	Relinquished By/Sign.	Date/Time	Received By/Sign.

Received for Laboratory By/Signature	Date/Time	Send Samples to: Eno River Labs, LLC Attn: Sample Management Group 2445 S. Alston Ave. Durham, NC 27713 USA Phone: (919) 281-4040 • Fax: (919) 281-4070

Directions:
(1) Provide and/or correct client and project information.
(2) Verify analysis, check approriate boxes for each sample.
(3) Please be sure that this matches the ID on the sample container.
(4) Please indicate the preservation used for each sample.

CUSTODY SEAL

SHIP TO ENO RIVER LABS.

NAME: _____

SIGNATURE: _____

DATE: _____

TO BE PLACED ACROSS BOTTLE CAP AFTER SAMPLING