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June 9, 2014

Ms. Leanne Moore
Project Manager
United States Fish and Wildlife Service
4503 West DeYoung, Suite 102
Marion, IL 62959

Subject: Modifications to the SAP – EE/CA for Area 7 Pesticide Area at AUS OU
Revision: 4 Status: Final

Dear Ms. Moore:

TRC Environmental Corporation (TRC), on behalf of Great Lakes Synergy Corporation, has enclosed the Revision 4 final versions of the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP), in accordance with the AOC signed July 26, 2012, for the Engineering Evaluation/Cost Analysis (EE/CA) for the Area 7 Pesticide Area of the AUS OU at Crab Orchard National Wildlife Refuge NPL site. According to your transmittal letter, dated May 30, 2014, Revision 3 of the Health and Safety Plan (HASP) was approved.

The revised documents reflect modifications provided by FWS in the May 30, 2014 letter, with the following exceptions/comments:

First, as noted in an e-mail to you on June 2nd, the transmittal letter was received after 5 pm on Friday, May 30th, which translates to a received date of Monday, June 2nd.

Second, you stated, "….TRC has represented to FWS that submitting the documents by June 9 will not affect the enforceable schedule established in the SAP, which requires GLS to conduct fish sampling during the first week of August 2014." As I noted in an e-mail to you on June 3rd, this is an incorrect representation. August 4, 2014 represents the first time we both agreed the fish window was open to begin sampling. As the QAPP currently states "….pre-mobilization site visit and land-based activities will be conducted prior to fish, SW, and sediment sampling. Schedule to be determined based on field conditions and contractor availability." In addition, GLS cannot commit to a schedule based on their submittal date, but rather on FWS' approval date. If final approvals are received from FWS by June 16 with no further modifications, then GLS can commit to being prepared to sample within the 2014 fish window. However, conditions (such as water levels) may still interfere, as you know. GLS is submitting electronic versions of these documents today, June 9th, with hard copies and CDs to follow.

We appreciated the opportunity to work with you on our questions to specific comments during the revision process. We look forward to hearing from you and are glad to answer any questions that may arise during your review.

Sincerely,
TRC Environmental Corporation

Tom Stolzenburg

Tom Stolzenburg, Ph.D.
Project Coordinator

Alyssa Sellwood

Alyssa Sellwood, P.E.
Project Manager

Enclosures: Final Quality Assurance Project Plan – Revision 4
Final Field Sampling and Analysis Plan – Revision 4
Final Health and Safety Plan – Revision 3

cc: Michael Coffey & Jill Evers – FWS
Melissa Papasavvas – USDOI
Mary Hagerty & Jeff Aust – URS
Nan Gowda – USEPA
Paul Lake – Illinois EPA
Nancy Dehmlow – GLS
Jessica Esser – ECCS
Samy Shahryar – ALS
Meredith Westover, John Rice, Peggy Popp, & Gretchen Rahn – TRC

Quality Assurance Project Plan

Area 7 Pesticide Area of the Additional and Uncharacterized Sites Operable Unit

Crab Orchard National Wildlife Refuge NPL Site
Marion, Illinois (Williamson County)

Revision 4 - Final

June 2014

Quality Assurance Project Plan

Area 7 Pesticide Area of the Additional and Uncharacterized Sites Operable Unit

Crab Orchard National Wildlife Refuge NPL Site
Marion, Illinois (Williamson County)

Revision 4 - Final
June 2014

Prepared By
TRC Environmental Corporation
Madison, Wisconsin

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Acronyms and Abbreviations

µg/L	micrograms per liter
mg/L	milligrams per liter
mL/min	milliliters per minute
AOC	Administrative Settlement Agreement and Order on Consent
AUS OU	Additional and Uncharacterized Sites Operable Unit
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CRA	Conestoga-Rovers and Associates
Crab Orchard	The Crab Orchard National Wildlife Refuge
DI	deionized
DO	dissolved oxygen
DOI	Department of the Interior
DQI	data quality indicators
DQO	Data Quality Objective
ECCS	Environmental Chemistry Consulting Services, Inc.
ECD	electron capture detector
EDD	electronic data deliverable
EE/CA	Engineering Evaluation and Cost Assessment
E_H	redox potential
FSP	Field Sampling Plan
FWS	United States Fish and Wildlife Service
GC	gas chromatography
GC/MS	gas chromatograph/mass spectrometer
GD-OTS	General Dynamics Ordinance and Tactical Systems, Inc.
GIS	geographic information system
GPS	global positioning system
GLS	Great Lakes Synergy Corporation

HASP	Health and Safety Plan
HSR	Health and Safety Representative
IC	ion chromatograph
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interface check samples
ICV	initial calibration verification
IDW	investigation-derived waste
IEPA	Illinois Environmental Protection Agency
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDL	Method Detection Limit
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
MSD	matrix spike duplicate
NPL	National Priorities List
NTU	nephelometric turbidity unit
ORP	oxidation reduction potential
OSC	on-site coordinator
OU	operable unit
PA/SI	Preliminary Site Assessment/Site Inspection
PAH	polycyclic aromatic hydrocarbons
PFD	personal flotation device
pH	negative logarithm (base 10) of hydrogen ion activity
PID	photoionization detector
PM	Project Manager
PRGs	preliminary remediation goals
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
Refuge	The Crab Orchard National Wildlife Refuge
RI/FS	Remedial Investigation/Feasibility Study
RF	response factor

RL	Reporting Limit
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RT	retention time
SAP	Sampling and Analysis Plan
SIM	selective ion monitoring
Site	The Warehouses, the surrounding area, and any area where hazardous substances have been released, or have otherwise come to be located
SOP	Standard Operating Procedure
SOW	scope of work
SPCC	system performance check compound
SVOC	semivolatile organic compounds
SW-846	Test Methods for Evaluating Solid Waste, 1996
TAL	Target Analyte List
TBD	to be determined
TRC	TRC Environmental Corporation
UFP	Uniform Federal Policy
URS	URS, Inc.
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
Warehouses	four buildings within Area 7 (IN-1-3, IN-1-4, IN-1-5, and IN-1-6)

Section 1
Introduction

1.1 Background

The Crab Orchard National Wildlife Refuge ("Crab Orchard" or the "Refuge"), located near Marion, Illinois, includes a site on the National Priorities List ("NPL") subject to the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. § 9601, et seq. ("CERCLA"). The NPL site is divided into seven operable units by which the investigation and cleanup of the site is organized. Area 7 is part of the Additional and Uncharacterized Sites Operable Unit ("AUS OU") of the NPL site. Four buildings within Area 7, (IN-1-3, IN-1-4, IN-1-5, and IN-1-6 [the "Warehouses"]), were previously leased by Great Lakes Synergy Corporation ("GLS") for the storage of pesticides (Figure 1). The U.S. Fish and Wildlife Service (FWS) investigated the Warehouses and surrounding area as part of the Preliminary Assessment/Site Inspection (PA/SI) for the AUS OU (URS, 2003). Additional sampling was done after the PA/SI (URS, 2002), and as part of Phase I of the Remedial Investigation (RI) for the AUS OU, in 2006-2007. Investigations included wipe sampling from building interiors and soil, groundwater, surface water, and sediment samples from areas around the buildings. A drainageway leading from the Warehouses toward an embayment of Crab Orchard Lake was investigated, but samples were not obtained from the Lake. FWS determined that the soil adjacent to the Warehouses, as well as the interior of the buildings and materials inside the Warehouses are impacted by the release and/or substantial threat of release of pesticides and related hazardous substances. Pesticides have also been detected in water and sediment samples collected from the drainageway. A preliminary baseline human health risk assessment ("HHRA") has found that the Site could pose unacceptable risks to human receptors (FWS, 2007a) and a preliminary baseline ecological risk assessment ("BERA") has found that the Site could pose unacceptable risks to ecological receptors (FWS, 2007b). The United States Fish and Wildlife Service ("FWS"), as the lead agency for the AUS OU, has determined that a removal action is appropriate for pesticide concentrations detected in soil at the site. The United States Environmental Protection Agency ("USEPA") and Illinois Environmental Protection Agency ("IEPA") are support agencies for the AUS OU.

On July 26, 2012, GLS entered into an Administrative Settlement Agreement and Order on Consent ("AOC") with FWS to perform an Engineering Evaluation and Cost Assessment ("EE/CA") investigation in support of a non-time critical removal action. FWS has prepared a Work Plan for the EE/CA investigation (FWS, 2012). The Work Plan outlines the general procedures and detailed directions for GLS's implementation of the EE/CA investigation. The Work Plan generally defines

two phases of investigation. Phase I includes the collection of surface water, sediment, and fish tissue samples for the baseline risk assessments. Phase II includes sampling to delineate the extent of contamination. The scope of each investigation phase is defined in Section 2.

1.2 Previous QAPP Documents

The USEPA requires that all environmental monitoring and measurement efforts mandated or supported by USEPA participate in a centrally managed quality assurance program. Any party generating data under this program has the responsibility to implement minimum procedures to ensure that precision, accuracy, completeness, and representativeness of the data are known and documented. To ensure that this responsibility is met uniformly, a written Quality Assurance Project Plan ("QAPP") must be prepared for each project.

The Preliminary Site Assessment/Site Inspection (PA/SI) and post-PA/SI sampling was performed by URS, Inc. (URS), in 2000 and 2001 in accordance with a generic AUS OU QAPP (FWS, 2000). Conestoga-Rovers and Associates ("CRA") and ENTRIX, Inc. ("ENTRIX"), on behalf of General Dynamics Ordinance and Tactical Systems, Inc. (GD-OTS), prepared a new Sampling and Analysis Plan ('SAP"), consisting of the Field Sampling Plan ("FSP") and generic QAPP, in April 2006 (CRA/ENTRIX, 2006). This new SAP was developed to support proposed actions at the AUS OU under the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (NewFields, 2006). Three addenda to the 2006 AUS OU QAPP document have been previously requested and approved. The first addendum authorized the addition of organophosphorus pesticides and herbicides to the analytical program (ENTRIX, 2006); the second addendum authorized the addition of white phosphorous to the analytical program (ENTRIX, 2007); and the third authorized changes to the laboratory data deliverables and data validation level (ENTRIX, 2008). A complete revision of the generic AUS OU QAPP, incorporating each of these additions, was prepared in February, 2009 (NewFields/ENTRIX, 2009).

1.3 Development of the QAPP

This QAPP has been prepared as a "project-specific" QAPP as defined by, and in accordance with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), Manual V1, March 2005 (USEPA, 2005a), and the Uniform Federal Policy for Quality Assurance Project Plans, Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities V1, March 2005 (USEPA, 2005b). This QAPP has been prepared to address GLS's investigation of the pesticide contamination at Area 7 of the AUS OU, and is a companion to the Field Sampling Plan (TRC, 2014).

All quality assurance and quality control (QA/QC) procedures performed under this QAPP will be in accordance with applicable professional technical standards, USEPA requirements, other pertinent government regulations and guidelines, and the specific project goals and requirements.

This QAPP presents the objectives, organization, functional activities, and specific QA and QC activities associated with implementing the projects that are described in Section 2. This QAPP also describes the specific protocols that will be followed for sampling of various environmental media, sample handling and storage, chain-of-custody, and laboratory analysis.

1.4 Applicability

This QAPP is applicable for work to be performed by Great Lakes Synergy Corporation (GLS) and its representatives associated with Area 7 of the AUS OU. The work activities will include tasks conducted by GLS under the AOC, as may be amended or modified. This QAPP is intended to support Phase I of the EE/CA field investigation, as well as any subsequent sampling programs associated with the EE/CA investigation (e.g., Phase II) with only minor revisions or attachments. This QAPP also includes matrices and analytes anticipated for the Phase II work, such that the laboratory selected for chemical analysis can be reviewed and approved for the full scope of chemical analysis anticipated for the completion of the EE/CA investigation. This QAPP will be modified in the future as other sampling programs or projects are identified or defined, *e.g.*, additional worksheets, such as Problem Definition-DQOs (Worksheet #10-1), will be inserted to describe the project sampling objectives and sampling program. This QAPP may also be updated to address additional investigations or remedial actions that may be required under the AOC.

Section 2
Scope of Planned Activities

This section provides a summary of the scope of specific projects and activities at Area 7 of the AUS OU that require, or may require, collection and analysis of environmental data and samples. Some of the projects and activities are in the final planning stage, awaiting FWS's approval of project-specific sampling plans that have been submitted for review and approval (e.g., EE/CA Phase I). Future investigation activities that will require sampling and analysis have been identified, but project- or task-specific sampling plans for these activities have not yet been prepared. A summary of these planned and future projects and activities for pesticide contamination at Area 7 of the AUS OU is provided below.

2.1 EE/CA Investigation – Phase I

The general objectives of the EE/CA investigation are:

- To identify and characterize the nature and extent of contamination and any threat to public health, welfare, or the environment caused by the release or threatened release of hazardous substances at or from the site.
- To develop and evaluate removal action alternatives to prevent, mitigate, or otherwise respond to or remedy any release or threatened release of hazardous substances.

The Work Plan (FWS, 2012) generally defines two phases of investigation. Phase I of the EE/CA investigation will focus on the collection of the sediment, surface water, and fish tissue samples necessary to complete the baseline human health and ecological risk assessments. The sampling and analytical program summary, including numbers of samples for various media, analyses, and brief descriptions of each sample type, is included in Attachment 1. Analysis is focused on the contaminants that have been identified at the site. In cases where statistical analysis will be done, a minimum of eight samples is indicated. Details are presented in Section 2 of the FSP. These data will be used to refine the preliminary remediation goals (PRGs) for the site, prior to performing additional characterization and delineation of soil impacts adjacent to the Warehouses. Additional investigative tasks specified in the Work Plan (FWS, 2012) that are not contingent upon the final risk assessments will be performed during the Phase I investigation wherever possible. These tasks include monitoring well installation, groundwater sampling, wipe sampling of the building interiors, initial reconnaissance of four Warehouse buildings (IN-1-3 through IN-1-6) and contents, and a topographic survey.

Details for the implementation of the Phase I investigation are provided in QAPP Worksheets 10-1 and 11-1. Sampling locations are shown in Figures 2 through 4.

2.2 EE/CA Investigation – Phase II

Phase II of the EE/CA investigation will focus on characterization and delineation of pesticides, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) at the site. The scope and details of the Phase II investigation are to be defined following the completion of the Phase I investigation, and the subsequent revision of the baseline risk assessments. It is expected that the details of the Phase II investigation will be presented in a revision to the FSP and QAPP.

Section 3
Document Overview

This project-specific QAPP has been developed in accordance with the Uniform Federal Policy (UFP) QAPP guidance (USEPA, 2005a), and is composed of a series of 37 worksheets, along with a series of attachments. The worksheets provide information on project management, project objectives, measurement and data acquisition, project assessment and oversight, and data review. The attachments include a summary of the sampling and analytical program, laboratory QC limits, current screening levels, laboratory SOPs, and a proposed project schedule. In accordance with USEPA guidance, cross-referencing is utilized where applicable, in order to streamline the document, including references to planning documents that are companion documents to this project-specific QAPP.

Section 4
References

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USEPA. 2005b. Uniform federal policy for quality assurance project plans. Part 2B, quality assurance/quality control compendium: minimum QA/QC activities (Version 1). Pub. Nos., EPA: EPA-505-B-04-900B, DoD: DTIC ADA 426957. March 2005.

USEPA. 2008. U.S. EPA contract laboratory program. National functional guidelines for organic data review. EPA 540-R-08-01. June 2008.

List of Worksheets

WORKSHEET	DATE OF LAST REVISION	TITLE
QAPP Worksheet #1	February 2014	Title and Approval Page
QAPP Worksheet #2	February 2014	Identifying Information
QAPP Worksheet #3	June 2014	Distribution List
QAPP Worksheet #4-1	February 2014	Project Personnel Sign-Off Sheet (TRC)
QAPP Worksheet #4-2	February 2014	Project Personnel Sign-Off Sheet (Environmental Chemistry Consulting Services)
QAPP Worksheet #4-3	February 2014	Project Personnel Sign-Off Sheet (ALS Environmental)
QAPP Worksheet #4-4	February 2014	Project Personnel Sign-Off Sheet (Necropsy/Histopathology Lab)
QAPP Worksheet #5	February 2014	Project Organizational Chart
QAPP Worksheet #6	February 2014	Communication Pathways
QAPP Worksheet #7	February 2014	Personnel Responsibilities and Qualifications
QAPP Worksheet #8	February 2014	Special Personnel Training Requirements
QAPP Worksheet #9-1	February 2014	Project Scoping Session Participants Sheet
QAPP Worksheet #10-1	February 2014	Problem Definition – DQOs (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #11-1	February 2014	Project Quality Objectives/Systematic Planning Process Statements (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #12-1	February 2014	Measurement Performance Criteria (Organochlorine Pesticides – Water)
QAPP Worksheet #12-2	February 2014	Measurement Performance Criteria (Organochlorine Pesticides – Soil/Sediment)
QAPP Worksheet #12-3	February 2014	Measurement Performance Criteria (Organochlorine Pesticides – Fish Tissue)
QAPP Worksheet #12-4	February 2014	Measurement Performance Criteria (Organochlorine Pesticides – Wipe Samples)
QAPP Worksheet #12-5	February 2014	Measurement Performance Criteria (Volatile Organic Compounds – Water)
QAPP Worksheet #12-6	February 2014	Measurement Performance Criteria (Volatile Organic Compounds – Soil/Sediment)
QAPP Worksheet #12-7	February 2014	Measurement Performance Criteria (Polycyclic Aromatic Hydrocarbons – Soil/Sediment)
QAPP Worksheet #12-8	February 2014	Measurement Performance Criteria (Total Organic Carbon – Soil/Sediment)
QAPP Worksheet #12-9	February 2014	Measurement Performance Criteria (Fish Tissue – Lipids)
QAPP Worksheet #13	February 2014	Secondary Data Criteria and Limitations
QAPP Worksheet #14	February 2014	Summary of Project Tasks

WORKSHEET	DATE OF LAST REVISION	TITLE
QAPP Worksheet #15-1	February 2014	Reference Limits and Evaluation (Pesticides – Groundwater)
QAPP Worksheet #15-2	February 2014	Reference Limits and Evaluation (Pesticides – Surface Water)
QAPP Worksheet #15-3	February 2014	Reference Limits and Evaluation (Pesticides – Surface Soil)
QAPP Worksheet #15-4	February 2014	Reference Limits and Evaluation (Pesticides – Subsurface Soil)
QAPP Worksheet #15-5	February 2014	Reference Limits and Evaluation (Pesticides – Sediment)
QAPP Worksheet #15-6	February 2014	Reference Limits and Evaluation (Pesticides – Fish Tissue)
QAPP Worksheet #15-7	February 2014	Reference Limits and Evaluation (Pesticides – Wipe Samples)
QAPP Worksheet #15-8	February 2014	Reference Limits and Evaluation (Volatile Organic Compounds – Groundwater)
QAPP Worksheet #15-9	February 2014	Reference Limits and Evaluation (Volatile Organic Compounds – Surface Soil)
QAPP Worksheet #15-10	February 2014	Reference Limits and Evaluation (Volatile Organic Compounds – Subsurface Soil)
QAPP Worksheet #15-11	February 2014	Reference Limits and Evaluation (Polycyclic Aromatic Hydrocarbons – Surface Soil)
QAPP Worksheet #15-12	February 2014	Reference Limits and Evaluation (Polycyclic Aromatic Hydrocarbons – Subsurface Soil)
QAPP Worksheet #15-13	February 2014	Reference Limits and Evaluation (Total Organic Carbon – Sediment)
QAPP Worksheet #15-14	February 2014	Reference Limits and Evaluation (Lipids – Fish Tissue)
QAPP Worksheet #16-1	February 2014	Project Schedule/Timeline (Engineering Evaluation/Cost Analysis)
QAPP Worksheet #17-1	February 2014	Sampling Design and Rationale (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #18-1	February 2014	Sampling Locations and Methods/SOP Requirements (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #19	February 2014	Analytical SOP Requirements
QAPP Worksheet #20	February 2014	Field Quality Control Sample Summary
QAPP Worksheet #21	June 2014	Project Sampling SOP Reference
QAPP Worksheet #22	February 2014	Field Equipment Calibration, Maintenance, Testing, and Inspection
QAPP Worksheet #23	February 2014	Analytical SOP References
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QAPP Worksheet #26	February 2014	Sample Handling System (ECCS, ALS, Necropsy/Histopathology Lab)
QAPP Worksheet #27	February 2014	Sample Custody Requirements
QAPP Worksheet #28-1	February 2014	QC Samples – Organochlorine Pesticides (Water)
QAPP Worksheet #28-2	February 2014	QC Samples – Organochlorine Pesticides (Soil/Sediment)

WORKSHEET	DATE OF LAST REVISION	TITLE
QAPP Worksheet #28-3	February 2014	QC Samples – Organochlorine Pesticides (Fish Tissue)
QAPP Worksheet #28-4	February 2014	QC Samples – Organochlorine Pesticides (Wipe Samples)
QAPP Worksheet #28-5	February 2014	QC Samples – Volatile Organic Compounds (Water)
QAPP Worksheet #28-6	February 2014	QC Samples – Volatile Organic Compounds (Soil/Sediment)
QAPP Worksheet #28-7	February 2014	QC Samples – Polycyclic Aromatic Hydrocarbons (Soil/Sediment)
QAPP Worksheet #28-8	February 2014	QC Samples – Total Organic Carbon (Soil/Sediment)
QAPP Worksheet #28-9	February 2014	QC Samples – Lipids (Fish Tissue)
QAPP Worksheet #29	February 2014	Project Documents and Records
QAPP Worksheet #30	February 2014	Analytical Services
QAPP Worksheet #31-1	February 2014	Planned Project Assessments (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #32-1	February 2014	Assessment Findings and Corrective Action Responses (Engineering Evaluation/Cost Analysis – Phase I Investigation)
QAPP Worksheet #33	February 2014	QA Management Reports
QAPP Worksheet #34	February 2014	Verification (Step I) Process
QAPP Worksheet #35	February 2014	Validation (Steps IIa and IIb) Process
QAPP Worksheet #36	February 2014	Validation (Steps IIa and IIb) Summary
QAPP Worksheet #37	February 2014	Usability Assessment

QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name:	Pesticide Contamination at Area 7 of the Additional and Uncharacterized Sites Operable Unit (AUS OU), Crab Orchard National Wildlife Refuge NPL Site.
Site Location:	Area 7 consists of 26 buildings, surrounding lawns, and interconnecting roadways. It is located approximately 1.5 miles east of the intersection of Highway 148 and Ogden Road, and 0.5 miles north of Ogden Road. The pesticide contamination at Area 7 includes four buildings (IN-1-3 through IN-1-6; The "Warehouses"), the soil adjacent to The Warehouses, and all areas where pesticides and related hazardous substances have come to be located.
Document Title:	Quality Assurance Project Plan
Lead Organization:	U.S. Fish and Wildlife Service
Preparer's Name and Organizational Affiliation:	Meredith Westover, TRC Environmental Corp.
Preparer's Contact Information:	708 Heartland Trail, Suite 3000, Madison, WI 53717, 608.826.3667 mwestover@trcsolutions.com
Preparation Date:	Revision 4 - Final June 2014
Investigative Organization's Project Coordinator:	Signature: Thomas Stolzenburg Thomas Stolzenburg, TRC Environmental Corp.
Investigative Organization's Project QA Manager:	Signature: Bruce Iverson, TRC Environmental Corp.

QAPP Worksheet #1 (continued)
Title and Approval Page

Laboratory QA Manager:	Signature: Michael Linskens Michael Linskens, Environmental Chemistry Consulting Services Signature: Suzanne LeMay Suzanne LeMay, ALS Environmental Signature:
Lead Organization's Project Manager:	Signature: Leanne Moore, U.S. Fish and Wildlife Service
Support Organization's Project Manager:	Signature: Nan Gowda, USEPA Region 5 Signature: Paul Lake, Illinois EPA
Regulatory Agency's QAPP Reviewer:	Signature: Jeff Aust, URS Signature: Warren Layne, Ph.D., USEPA

Document Control Number: CONWR-001

QAPP Worksheet #2
Identifying Information

Site Name/Project Name:	Pesticide Contamination at Area 7 of the Additional and Uncharacterized Sites Operable Unit (AUS OU), Crab Orchard National Wildlife Refuge NPL Site.
Site Location:	Area 7 consists of 26 buildings, surrounding lawns, and interconnecting roadways. It is located approximately 1.5 miles east of the intersection of Highway 148 and Ogden Road, and 0.5 miles north of Ogden Road. The pesticide contamination at Area 7 includes four buildings (IN-1-3 through IN-1-6; The "Warehouses"), the soil adjacent to The Warehouses, and all areas where pesticides and related hazardous substances have come to be located.
Site Number/Code:	USEPA ID: IL8143609487
Operable Unit:	Additional and Uncharacterized Sites Operable Unit
Contractor's Name:	TRC Environmental Corp (TRC)
Contractor's Number:	608.826.3600
Contract Title:	NA
Work Assignment Number:	NA
Identify guidance used to prepare QAPP:	Uniform Federal Policy for Quality Assurance Project Plans, Manual VI (USEPA, 2005a)
Identify regulatory program:	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Identify approval entity:	U.S. Fish and Wildlife Service
Indicate whether the QAPP is a generic or a project-specific QAPP:	This project-specific QAPP has been prepared to cover the analytical tasks associated with the EE/CA for the Pesticide Contamination at Area 7, as defined in the Work Plan (FWS, 2012).
List dates of scoping sessions that were held:	See Worksheet #9-1.

QAPP Worksheet #2 (continued)
Identifying Information

List dates and titles of QAPP documents written for previous site work, if applicable:	
Quality Assurance Project Plan, organization partners (stakeholders), and connection with lead organization:	FWS. 2000. Draft final Quality Assurance Project Plan, Site Inspection, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois (Williamson County). March 2000. Conestoga-Rovers and Associates/ENTRIX, Inc. 2006. Quality Assurance Project Plan, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Williamson County, Illinois. April 2006. ENTRIX, Inc. 2006. Quality Assurance Project Plan Addendum (Organophosphorus Pesticides, Herbicides), Additional and Uncharacterized Sites Operable Unit, Crab Orchard NWR, Marion, Illinois – Williamson County. September 2006. ENTRIX, Inc. 2007. Quality Assurance Project Plan Addendum II (White Phosphorus), Additional and Uncharacterized Sites Operable Unit, Crab Orchard NWR, Marion, Illinois – Williamson County. January 2007. NewFields Companies, L.L.C./ENTRIX, Inc. 2008. Quality Assurance Project Plan Addendum (Data Validation). November 2008. NewFields Companies, L.L.C./ENTRIX, Inc. 2009. Quality Assurance Project Plan, Additional and Uncharacterized Sites Operable Unit, Crab Orchard NWR, Williamson County, Illinois. February 2009. (Final).
List data users:	Great Lakes Synergy Corporation (GLS); TRC Environmental Corporation (TRC); U.S. Fish and Wildlife Service (FWS); Illinois Environmental Protection Agency (IEPA); USEPA Region 5 (USEPA)
Lead Organization's Program Manager:	Leanne Moore, FWS

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Project Management and Objectives		
2.1 Title and Approval Page	▪ Title and Approval Page	Worksheet #1, Title and Approval Page
2.2 Document Format and Table of Contents	▪ Table of Contents ▪ QAPP Identifying Information	The Table of Contents is provided following the QAPP cover page. Worksheet #2, Identifying Information
2.2.1 Document Control Format		
2.2.2 Document Control Numbering System		
2.2.3 Table of Contents		
2.2.4 QAPP Identifying Information		
2.3 Distribution List and Project Personnel Sign-Off Sheet	▪ Distribution List ▪ Project Personnel Sign-Off Sheet	Worksheet #3, Distribution List; and Worksheets #4-1 through 4-4, Project Personnel Sign-Off Sheet
2.3.1 Distribution List		
2.3.2 Project Personnel Sign-Off Sheet		
2.4 Project Organization	▪ Project Organizational Chart ▪ Communication Pathways ▪ Personnel Responsibilities and Qualifications Table ▪ Special Personnel Training Requirements Table	Worksheet #5, Project Organization Chart; Worksheet #6, Communication Pathways; Worksheet #7, Personnel Responsibilities and Qualifications; and Worksheet #8, Special Personnel Training Requirements
2.4.1 Project Organization Chart		
2.4.2 Communication Pathways		
2.4.3 Personnel Responsibilities and Qualifications		
2.4.4 Special Training Requirements and Certification		

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Project Management and Objectives (continued)		
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	▪ Project Planning Session ▪ Documentation (including Data Needs tables) ▪ Project Scoping Session Participants Sheet ▪ Problem Definition, Site History, and Background ▪ Site Maps (historical and current)	Worksheet #9, Project Scoping Session Participants Sheet; and Worksheet #10-1, Problem Definition-DQOs Site history and more detail concerning the project DQOs can be found in the companion documents to this QAPP.
2.6 Project Quality Objectives and measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement performance Criteria	▪ Site-Specific Project Quality Objectives (PQOs) ▪ Measurement Performance Criteria Table	Worksheet #11-1, Project Quality Objectives/Systematic Planning Process Statements; Worksheets #12-1 through #12-9, Measurement Performance Criteria
2.7 Secondary Data Evaluation	▪ Sources of Secondary Data and Information ▪ Secondary Data Criteria and Limitations Table	Worksheet #13, Secondary Data Criteria and Limitations
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	▪ Summary of Project Tasks ▪ Reference Limits and Evaluation Table ▪ Project Schedule/Timeline Table	Worksheet #14, Summary of Project Tasks; Worksheets #15-1 through #15-14, Reference Limits and Evaluation; and Worksheet #16-1, Project Schedules/Timelines

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Measurement/Data Acquisition		
3.1 Sampling Tasks	▪ Sampling Design and Rationale ▪ Sample Location Map ▪ Sampling Locations and Methods/ SOP Requirements Table ▪ Analytical Methods/SOP Requirements Table ▪ Field Quality Control Sample Summary Table ▪ Sampling SOPs ▪ Project Sampling SOP References Table ▪ Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Worksheet #17-1, Sampling Design and Rationale; Worksheet #18-1, Sampling Locations and Methods/SOP Requirements; Worksheet #19, Analytical SOP Requirements (sample containers, preservation, and holding times); Worksheet #20, Field Quality Control Sample Summary Worksheet #21, Project Sampling SOP Reference; and Worksheet #22, Field Equipment Calibration, Maintenance, Testing, and Inspection The laboratory SOPs can be found in Attachment 4. More details concerning the sampling design and rationale and the field sampling procedures can be found in the companion documents to this QAPP.
3.1.1 Sampling Process Design and Rationale		
3.1.2 Sampling Procedures and Requirements		
3.1.2.1 Sampling Collection Procedures		
3.1.2.2 Sample Containers, Volume, and Preservation		
3.1.2.3 Equipment/Sample Container Cleaning and Decontamination Procedures		
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures		
3.1.2.5 Supply Inspection and Acceptance Procedures		
3.1.2.6 Field Documentation Procedures		

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Measurement/Data Acquisition (continued)		
3.2 Analytical Tasks	▪ Analytical SOPs ▪ Analytical SOP References Table ▪ Analytical Instrument Calibration Table ▪ Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Worksheet #23, Analytical SOP References; Worksheet #24, Analytical Instrument Calibration; and Worksheet #25, Analytical Instrument and Equipment Maintenance, Testing, and Inspection The laboratory SOPs can be found in Attachment 4.
3.2.1 Analytical SOPs		
3.2.2 Analytical Instrument Calibration Procedures		
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures		
3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures	▪ Sample Collection Documentation Handling, Tracking, and Custody SOPs ▪ Sample Container Identification ▪ Sample Handling Flow Diagram ▪ Example Chain-of-Custody Record and Seal	Worksheet #27, Sample Custody Requirements More details concerning the field sampling procedures can be found in the companion documents to this QAPP. Example COC forms can be found in Attachment 4.
3.3.1 Sample Collection Documentation		
3.3.2 Sample Handling and Tracking System		
3.3.3 Sample Custody		
3.4 Quality Control Samples	▪ QC Samples Table ▪ Screening/Confirmatory Analysis Decision Tree	Worksheets #28-1 through #28-9, Present QC sample information for project analysis
3.4.1 Sampling Quality Control Samples		
3.4.2 Analytical Quality Control Samples		

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Measurement/Data Acquisition (continued)		
3.5 Data Management Tasks	▪ Project Documents and Records Table ▪ Analytical Services Table ▪ Data Management SOPs	Worksheet #29, Project Documents and Records, and Worksheet #30, Analytical Services
3.5.1 Project Documentation and Records		
3.5.2 Data Package Deliverables		
3.5.3 Data Reporting Formats		
3.5.4 Data Handling and Management		
3.5.5 Data Tracking and Control		
4.1 Assessments and Response Actions	▪ Assessments and Response Actions ▪ Planned Project Assessments Table ▪ Audit Checklists ▪ Assessment Findings and Corrective Action Responses Table	Worksheet #31-1, Planned Project Assessments, and Worksheet #32-1, Assessment Findings and Corrective Action Responses
4.1.1 Planned Assessments		
4.1.2 Assessment Findings and Corrective Action Responses		
4.2 QA Management Reports	▪ QA Management Reports Table	Worksheet #33, QA Management Reports
4.3 Final Project Report		

QAPP Worksheet #2 (continued)
Identifying Information

REQUIRED QAPP ELEMENT(S) AND CORRESPONDING QAPP SECTION(S) (U.S. EPA, 2005a)	REQUIRED INFORMATION	CROSSWALK TO RELATED INFORMATION AND DOCUMENTS
Data Review		
5.1 Overview		
5.2 Data Review Steps	▪ Verification (Step I) Process Table ▪ Validation (Steps IIa and IIb) Process Table ▪ Validation (Steps IIa and IIb) Summary Table ▪ Usability Assessment	Worksheet #34, Verification (Step 1) Process; Worksheet #35, Validation (Step I) Process; Worksheet #36, Validation (Steps IIa and IIb) Summary; and Worksheet #37, Usability Assessment.
5.2.1 Step I: Verification		
5.2.2 Step II: Validation		
5.2.2.1 Step IIa Validation Activities		
5.2.2.2 Step IIb Validation Activities		
5.2.3 Step III: Usability Assessment		
5.2.3.1 Data Limitations and Actions from Usability Assessment		
5.2.3.2 Activities		
5.3 Streamlining Data Review	▪ None	NA
5.3.1 Data Review Steps To Be Streamlined		
5.3.2 Criteria for Streamlining Data Review		
5.3.3 Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3
Distribution List

QAPP RECIPIENTS	TITLE	ORGANIZATION	TELEPHONE NUMBER	E-MAIL ADDRESS	DOCUMENT CONTROL NUMBER
Leanne Moore	Project Coordinator	FWS	618.998.5907	Leanne_Moore@fws.gov	CONWR-001
Michael Coffey	Remedial Activities Coordinator/Program Manager	FWS	618.998.5961	Michael_Coffey@fws.gov	CONWR-001
Jill Evers	Administrative Officer	FWS	618.998.5969	Jill_Evers@fws.gov	CONWR-001
Melissa D. Papasavvas	Solicitor	DOI	202.208.3070	Melissa.Papasavvas@sol.doi.gov	CONWR-001
Mary Hagerty	Project Manager	URS Corporation	314.743.4107	Mary.Hagerty@URS.com	CONWR-001
Jeff Aust	Project Chemist	URS Corporation	402.952.2516	Jeff.Aust@URS.com	CONWR-001
Nan Gowda	Project Manager	USEPA Region 5	312.353.9236	gowda.nanjunda@epamail.epa.gov	CONWR-001
Paul Lake	Project Manager	Illinois EPA	217.785.7728	paul.lake@illinois.gov	CONWR-001
Nancy Dehmlow	Respondent	Great Lakes Synergy Corporation	847.437.0200	nancy.dehmlow@synergy55.com	CONWR-001
Tom Stolzenburg	Project Coordinator	TRC	608.826.3661	tstolzenburg@trcsolutions.com	CONWR-001

QAPP Worksheet #3 (continued)
Distribution List

QAPP RECIPIENTS	TITLE	ORGANIZATION	TELEPHONE NUMBER	E-MAIL ADDRESS	DOCUMENT CONTROL NUMBER
Alyssa Sellwood	Project Manager	TRC	608.826.3658	asellwood@trcsolutions.com	CONWR-001
Meredith Westover	Senior Hydrogeologist Data QA Manager	TRC	608.826.3667	mwestover@trcsolutions.com	CONWR-001
John Rice	Senior Engineer	TRC	608.826.3655	jrice@trcsolutions.com	CONWR-001
Field Staff	Staff Scientists	TRC	608.826.3600	Various	CONWR-001
Peggy Popp	Database Manager	TRC	608.826.3652	ppopp@trcsolutions.com	CONWR-001
Gretchen Rahn	Data Validator	TRC	608.393.4166	grahn@trcsolutions.com	CONWR-001
Jessica Esser	Project Manager	ECCS	608.221.8700	jce@eccsmobilelab.com	CONWR-001
Samy Shahryar	Project Manager	ALS	360.577.7222	shar.samy@alsglobal.com	CONWR-001
To be determined	Project Manager	Necropsy/ Histopathology Lab, to be determined	To be determined	To be determined	CONWR-001

QAPP Worksheet #4-1
Project Personnel Sign-Off Sheet (TRC)

PROJECT PERSONNEL	TITLE	TELEPHONE NUMBER	SIGNATURE	DATE QAPP READ
Tom Stolzenburg	Project Coordinator (on behalf of GLS)	608.826.3661		
Alyssa Sellwood	Project Manager	608.826.3658		
Bruce Iverson	QA Manager	608.826.3644		
John Rice	Senior Engineer	608.826.3655		
Meredith Westover	Senior Hydrogeologist Data QA Manager On-Site Coordinator Health and Safety Representative	608.826.3667		
Peggy Popp	Database Manager	608.826.3652		
Gretchen Rahn	Data Validator	608.393.4166		

QAPP Worksheet #4-2
Project Personnel Sign-Off Sheet (Environmental Chemistry Consulting Services)

PROJECT PERSONNEL	TITLE	TELEPHONE NUMBER	SIGNATURE	DATE QAPP READ
Karl Olm	Laboratory Manager	608-221-8700		
Jessica Esser	Project Manager	608-221-8700		
Michael Linskens	QA Manager	608-221-8700		
Richard Johnson	Pesticides Supervisor	608-221-8700		
Chris Sauer	Volatiles Supervisor	608-221-8700		
Chris Sauer	Semi-Volatiles Supervisor	608-221-8700		

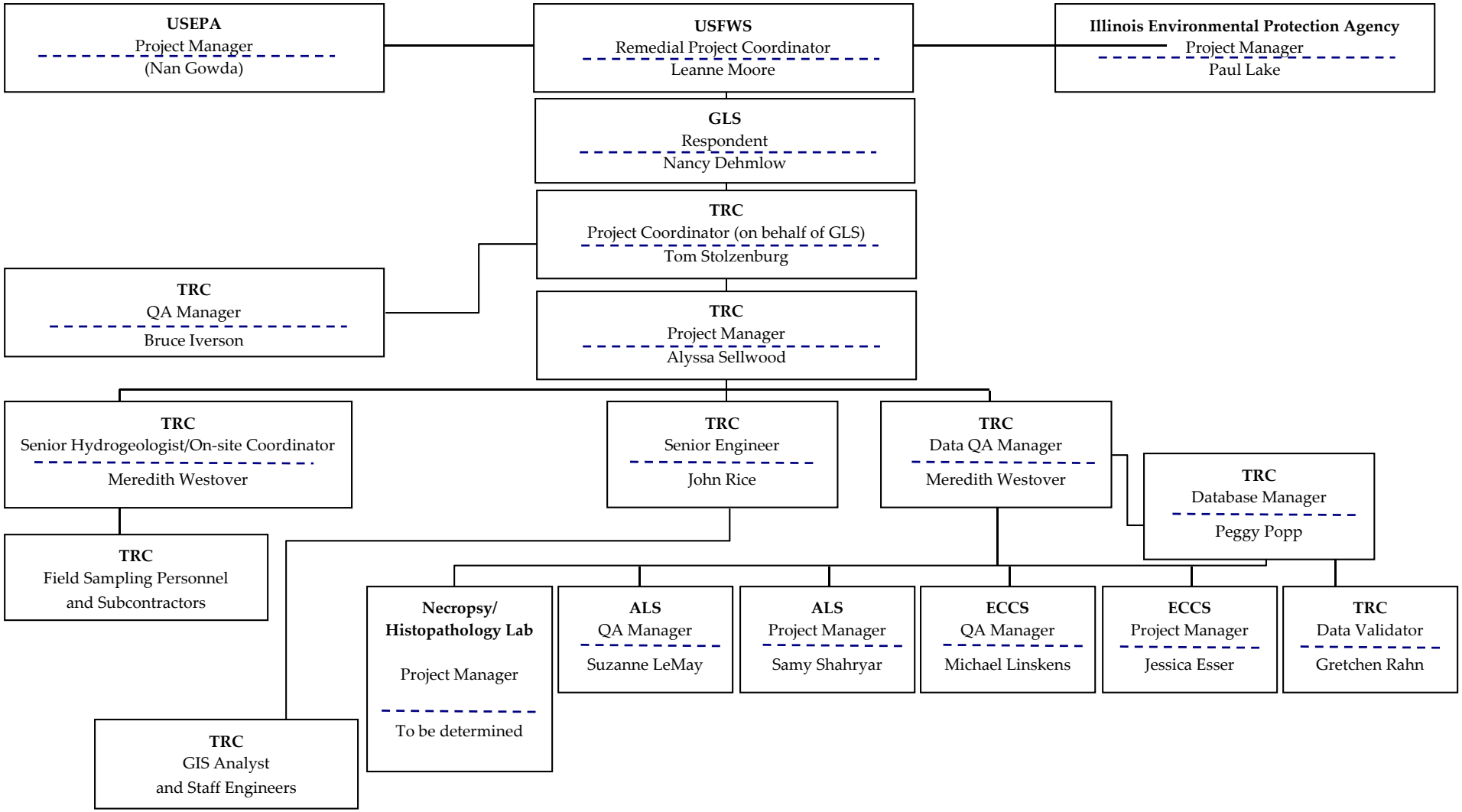
QAPP Worksheet #4-3
Project Personnel Sign-Off Sheet (ALS Environmental)

PROJECT PERSONNEL	TITLE	TELEPHONE NUMBER	SIGNATURE	DATE QAPP READ
Jeffery Grindstaff	Laboratory Director	360.577.7222		
Samy Shahryar	Project Manager	360.577.7222		
Suzanne LeMay	QA Manager	360.577.7222		
Jon James	Semivolatile Organics Department Manager	360.577.7222		
Elissa Erickson	Supervisor – Semivolatile Organics Extractions	360.577.7222		
Loren Portwood	Pesticides Supervisor	360.577.7222		

QAPP Worksheet #4-4
Project Personnel Sign-Off Sheet (Necropsy/Histopathology Lab)

PROJECT PERSONNEL	TITLE	TELEPHONE NUMBER	SIGNATURE	DATE QAPP READ
To be determined	Project Manager	To be determined		

QAPP Worksheet #5
Project Organizational Chart



QAPP Worksheet #6
Communication Pathways

COMMUNICATION DRIVERS	RESPONSIBLE ENTITY	NAME	TELEPHONE NUMBER	PROCEDURE (timing, pathways, etc.)
Normal day-to-day project communications	TRC Project Coordinator	Thomas Stolzenburg, TRC	608.826.3661	Normal day-to-day project communications between GLS and other parties, including the FWS RPM, will be managed by the TRC Project Coordinator.
Manage project technical work	TRC Project Manager	Alyssa Sellwood, TRC	608.826.3658	Performance of technical work and production of technical documents will be managed by the TRC Project Manager.
Coordinate field program	On-site Coordinator (OSC) and Health and Safety Officer	Meredith Westover, TRC	608.826.3667	The OSC will provide the TRC Project Manager and TRC Project Coordinator with an update of field sampling activities, including related questions or problems, by telephone or e-mail at the end of each field work day. The OSC will also report any QA/QC problems related to field measurements to the TRC Project Manager and Data QA Manager by telephone or e-mail by the end of the same business day.
Provide daily progress reports - field sampling	On-site Coordinator (OSC) and Health and Safety Officer	Meredith Westover, TRC	608.826.3667	The OSC will provide the TRC Project Manager with written daily progress reports, including field records, sampling logs, Chain-of-Custody Records, and any other pertinent information by e-mail or fax within 2 business days.
Notify the Project Manager and the Data QA Manager of any QAPP deviations in the field	On-site Coordinator (OSC) and Health and Safety Officer	Meredith Westover, TRC	608.826.3667	The OSC will immediately notify the TRC Project Manager and the TRC Data QA Manager of any deviations from the QAPP or other approved planning documents (e.g. FSP, HSP, or EE/CA workplan), including the reasons, by telephone or e-mail.

QAPP Worksheet #6 (continued)
Communication Pathways

COMMUNICATION DRIVERS	RESPONSIBLE ENTITY	NAME	TELEPHONE NUMBER	PROCEDURE (timing, pathways, etc.)
Notify the FWS and USEPA of any QAPP deviations	TRC Project Coordinator	Thomas Stolzenburg, TRC	608.826.3661	The TRC Project Coordinator will immediately report all substantial deviations from the QAPP or associated planning documents (e.g. FSP, HSP, or EE/CA Workplan) or data quality problems to the FWS and USEPA by e-mail.
Reporting lab data quality issues	Laboratory Project Manager	Jessica Esser, ECCS	608.221.8700	The Laboratory Project Manager will notify the TRC Data QA Manager of any QA/QC issues within 1 business day.
	Laboratory Project Manager	Samy Shahryar, ALS	360.577.7222	
	Laboratory Project Manager	Necropsy/ Histopathology Lab To be determined	To be determined	
	TRC Data QA Manager	Meredith Westover, TRC	608.826.3667	The TRC Data QA Manager reports significant laboratory QA/QC issues that the laboratory cannot, or will not routinely correct to the TRC Project Manager and the TRC Project Coordinator.
Field and analytical corrective actions	TRC Data QA Manager	Meredith Westover, TRC	608.826.3667	The TRC Data QA Manager will recommend the need for corrective action for analytical issues, in conjunction with the TRC Project Coordinator, the TRC Project Manager, the On-site Coordinator, and the FWS RPM and Laboratory Project Manager, as appropriate.
	TRC Project Manager	Alyssa Sellwood, TRC	608.826.3658	The TRC Project Manager has the authority to authorize TRC staff, subcontractors, and the Laboratory Project Manager to implement corrective actions provided for in the QAPP and associated planning documents.

QAPP Worksheet #6 (continued)
Communication Pathways

COMMUNICATION DRIVERS	RESPONSIBLE ENTITY	NAME	TELEPHONE NUMBER	PROCEDURE (timing, pathways, etc.)
Field and analytical corrective actions (continued)	TRC Project Coordinator TRC Project Manager TRC Data QA Manager	Thomas Stolzenburg, TRC Alyssa Sellwood, TRC Meredith Westover, TRC	608.826.3661 608.826.3658 608.826.3667	When necessary, the TRC Project Coordinator, TRC Project Manager, and TRC Data QA Manager, in consultation with FWS staff, USEPA staff, and TRC specialists, will develop corrective actions for field procedures, which may include changes to the QAPP or associated planning documents. TRC must record the proposed changes in writing and submit them to FWS and USEPA for approval. When necessary, the TRC Project Coordinator, TRC Project Manager, and TRC Data QA Manager, in consultation with FWS staff, USEPA staff, Laboratory staff, and TRC specialists, will develop corrective actions for laboratory analytical procedures, which may include changes to the QAPP or associated planning documents. TRC must record the proposed changes in writing and submit them to FWS and USEPA for approval.
Release of final analytical data	TRC Data QA Manager	Meredith Westover, TRC	608.826.3667	No final analytical data can be released until validation is complete and the Data QA Manager has approved the release.
	Laboratory QA Manager	Michael Linskens, ECCS	608.221.8700	The Laboratory QA Manager will communicate directly to FWS and USEPA by incorporating the case narrative in the laboratory reports.
	Laboratory QA Manager	Samy Shahryar, ALS	360.577.7222	
	Laboratory QA Manager	Necropsy/ Histopathology Lab To be determined	To be determined	
	Data Validator	Gretchen Rahn	608.393.4166	The TRC Data Validator will communicate directly to FWS and USEPA by incorporating data validation reports in the EE/CA reports.
QAPP amendments	TRC Data QA Manager	Meredith Westover, TRC	608.826.3667	The QAPP will be reviewed every 5 years, or as new scope items are defined. Any major changes to the QAPP must be approved by the TRC Data QA Manager, the TRC Project Manager, the TRC Project Coordinator, FWS, and the USEPA before the changes can be implemented.

QAPP Worksheet #7
Personnel Responsibilities and Qualifications

NAME	PROJECT ROLE	ORGANIZATIONAL AFFILIATION	EDUCATION AND EXPERIENCE QUALIFICATIONS
Jessica Esser	Laboratory Project Manager	ECCS	B.S., Biology/Chemistry, Edgewood College, 2001 over 11 years experience
Michael Linskens	Laboratory QA Manager	ECCS	M.S. Water Science, University of Wisconsin – Stevens Point, 1980 B.S., Water Chemistry, University of Wisconsin – Stevens Point, 1978 over 35 years experience
Samy Shahryar	Laboratory Project Manager	ALS	Ph.D., Atmospheric Science, Desert Research Institute/University of Nevada-Reno, 2009 M.S., Applied Geography, University of Colorado-Colorado Springs, 2004 B.S., Chemistry, University of Montana, 1998 over 12 years experience
Suzanne LeMay	Laboratory QA Manager	ALS	G.S., Geology, University of Oregon-Eugene, 1981 over 27 years experience
To be determined	Necropsy/Histopathology Laboratory Project Manager	To be determined	To be determined
Thomas Stolzenburg, Ph.D.	Project Coordinator	TRC	Ph.D., Civil and Environmental Engineering, Water Chemistry Program, University of Wisconsin - Madison, 1979 B.S., Resource Management and Biology, UW-Stevens Point, 1974 Over 30 years experience
Alyssa Sellwood	Project Manager	TRC	M.S., Geological Engineering, University of Wisconsin - Madison, 2002 B.S., Geological Engineering/Geology and Geophysics, University of Wisconsin - Madison, 2000 over 10 years experience

QAPP Worksheet #7 (continued)
Personnel Responsibilities and Qualifications

NAME	PROJECT ROLE	ORGANIZATIONAL AFFILIATION	EDUCATION AND EXPERIENCE QUALIFICATIONS
John Rice	Senior Engineer	TRC	M.S., Civil and Environmental Engineering, University of Wisconsin - Madison, 1984 B.S., Civil and Environmental Engineering, University of Wisconsin - Madison, 1982 Over 26 years experience
Meredith Westover	Senior Hydrogeologist Data QA Manager On-Site Coordinator Health and Safety Representative	TRC	M.S., Geology, University of Wisconsin, Madison, 1994 B.S., Geology, University of California, Davis, 1992 over 17 years experience
Peggy Popp	Database Manager	TRC	B.S., Biochemistry, Beloit College, 1982 over 25 years experience
Gretchen Rahn	Data Validator	TRC	B.S., Microbiology, University of Wisconsin - La Crosse, 1997 over 8 years experience

QAPP Worksheet #7 (continued)
Personnel Responsibilities and Qualifications

TRC

Project Coordinator

- Serve as primary point-of-contact for TRC.

Project Manager

- Establish and communicate project milestones and schedules.
- Coordinate and review TRC work products.
- Direct TRC team members.

QA Manager

- Provide overall quality assurance, including a review of TRC's performance on the project.
- Review project progress and TRC work products for compliance with project objectives and requirements.

On-site Coordinator and Health and Safety Representative

- Coordinate field staff who will be measuring and recording field parameters, collecting samples, and documenting activities, to ensure compliance with the QAPP and associated planning documents.
- Order sample bottles from the laboratory.
- Prepare reports pertaining to relevant field activities.
- Maintain field and laboratory files, including project documentation, sample logs, and calculations; and provide complete copies to the TRC Project Manager.
- Provide on-site health and safety orientation to all TRC staff and subcontractors, and monitor site activities for compliance with the project Health and Safety Plan.
- Conduct field audits as necessary.

QAPP Worksheet #7 (continued)
Personnel Responsibilities and Qualifications

Senior Engineer

- Provide technical input during the planning, design, and implementation stages of the project.
- Review the technical aspects of TRC's submittals.
- Provide senior technical support to the On-site Coordinator for questions or problems that may arise during field work.

Data QA Manager

- Serve as the primary point-of-contact with the laboratory on matters involving data deliverables.
- Coordinate field QA/QC procedures with the On-site Coordinator (*e.g.*, calibrations for field analytical measurements and field audits, as necessary), and review pertinent field records for compliance with the QAPP.
- Review laboratory QA/QC procedures and documentation, as provided in data deliverables.
- Review data for compliance with the Data Quality Objectives (DQOs) for the project.
- Oversee data validation activities and preparation of QA/QC reports by the data validator.

Database Manager

- Establish and maintain a project database.
- Import electronic data deliverables (EDDs) provided by the laboratory into the project database.
- Perform a QA/QC check of imported data versus the hard copy data.
- Transcribe field and non-EDD laboratory data into the project database, as necessary.
- Tabulate data for end users.

QAPP Worksheet #7 (continued)
Personnel Responsibilities and Qualifications

ANALYTICAL LABORATORY

Laboratory QA Manager

- Verify that the laboratory meets the QA/QC standards specified in the QAPP.
- Supervise in-house chain-of-custody.
- Perform laboratory audits, in accordance with the QAPP.

Laboratory Project Manager

- Serve as the primary point-of-contact for the laboratory.
- Oversee preparation of analytical reports.

QAPP Worksheet #8
Special Personnel Training Requirements

PROJECT FUNCTION	SPECIALIZED TRAINING - TITLE OR DESCRIPTION OF COURSE	TRAINING PROVIDER	TRAINING DATE	PERSONNEL/ GROUPS RECEIVING TRAINING	PERSONNEL TITLES/ ORGANIZATIONAL AFFILIATION	LOCATION OF TRAINING RECORDS/ CERTIFICATES
Field activities	▪ 40-hour HAZWOPER and 8-hour HAZWOPER refresher ▪ Degree in geology, soil science, engineering, or related field	▪ Certified HAZWOPER training professionals ▪ Accredited college, university, or equivalent	▪ 8-hour refresher within previous year ▪ Various	Field personnel	TRC personnel	TRC project offices
Analytical chemistry	▪ Environmental Chemistry Consulting Services is registered in Illinois under NELAC(1)	N/A	N/A	N/A	Environmental Chemistry Consulting Services (ECCS) 2525 Advance Road Madison, WI 53718 Jessica Esser 608.221.8700	Laboratory office
Analytical chemistry	▪ ALS is registered under NELAC(1)	N/A	N/A	N/A	ALS Environmental 1317 S. 13th Avenue Kelso, WA 98626 Samy Shahryar 360.577.7222	Laboratory office
Necropsy/ Histopathology	▪ To be determined	NA	NA	NA	To be determined	Laboratory office

Notes:
(1) National Environmental Laboratory Accreditation Conference

QAPP Worksheet #9-1
Project Scoping Session Participants Sheet

Extensive environmental investigations have been performed at Area 7 of the AUS OU in accordance with FWS-approved QAPPs and other planning and design documents over the last decade. Additional projects involving collection of environmental data are in various stages of planning, preparation, and approval by FWS.

This QAPP has been prepared as a "Project Specific" QAPP in accordance with USEPA's current (2005) QAPP guidance. The scope of this QAPP includes project-specific or task-specific details associated with the EE/CA investigations for pesticide contamination at Area 7, as outlined in the Work Plan (FWS, 2012). Therefore, because the scope, format, and required contents for this update of the QAPP are well defined, a QAPP/project scoping meeting at FWS's office has not been held or scheduled. However, a conference call with representatives of FWS could be arranged, if requested, to provide further information regarding the site or past and planned data collection and remediation activities, or to respond to questions regarding this QAPP.

QAPP Worksheet #10-1
Problem Definition - DQOs
(EE/CA – Phase I Investigation)

Step 1: State the problem.

A preliminary baseline human health risk assessment ("HHRA") has found that the pesticide contamination at Area 7 of the AUS OU (the Site) could pose unacceptable risks to human receptors (FWS, 2007a); and a preliminary baseline ecological risk assessment ("BERA") has found that the Site could pose unacceptable risks to ecological receptors (FWS, 2007b). FWS has determined that a removal action is appropriate for the Site, and has developed a Work Plan to complete an Engineering Evaluation/Cost Analysis (EE/CA) in support of a non-time-critical removal action (FWS, 2012). Additional soil, surface water, sediment, fish tissue, and groundwater data are needed to define the site remediation goals, prior to defining the extent of impacts at the site. In addition, existing Building IN-1-3 has not been evaluated for usability.

Step 2: Identify the goal of the study.

The objectives of Phase I of the EE/CA investigation are as follows:

- to collect the surface water, sediment, and fish tissue samples necessary to refine the baseline ecological and human health risk assessments.
- to refine the extent of groundwater contamination associated with pesticide contamination at Area 7 of the AUS OU.
- to evaluate the interior of building IN-1-3 for suitability for use.
- to characterize the nature and extent of contamination, including contaminant fate and transport at the Site.

Step 3: Identify information inputs.

Information inputs include the following:

- Analysis of surface water samples collected from the embayment, from Crab Orchard Lake near the embayment, and from Crab Orchard Creek.
- Visual observation and description of sediment cores and samples collected from the embayment, from Crab Orchard Lake near the embayment, and from Crab Orchard Creek.
- Analysis of sediment samples collected from the embayment, from Crab Orchard Lake near the embayment, and from Crab Orchard Creek.
- Morphological assessment, necropsy, and analysis of two game fish and two forage fish species from within the embayment, and from Crab Orchard Lake near the embayment.
- Visual observation and description of soil samples collected during the installation of three new groundwater monitoring wells.
- Evaluation of the aquifer permeability by performing single well response tests from the three new groundwater monitoring wells.
- Evaluation of static water level data from existing permanent Area 7 monitoring wells W01, W02, W03, W15, W17, and new permanent wells W21, W22, and W23.
- Analysis of groundwater samples collected from the three new permanent groundwater monitoring wells (W21, W22, and W23) and five previously existing permanent monitoring wells (W01, W02, W03, W15, and W17).
- Visual observation of building interiors, building conditions, and building contents.
- Analysis of wipe samples from Building IN-1-3.
- Conduct a site topographic survey.

QAPP Worksheet #10-1 (continued)
Problem Definition - DQOs
(EE/CA – Phase I Investigation)

Step 4: Define the boundaries of the sampling.

The boundaries of the sampling for the Phase I EE/CA investigation are the embayment, Crab Orchard Creek, Crab Orchard Lake near the embayment (as defined by the sediment, surface water, and fish sampling locations), the Warehouse buildings (IN-1-3 through IN-1-6), the existing and proposed monitoring well network, and the drainage basin between the Warehouses and Crab Orchard Lake. Figures 2 through 5 show the proposed sampling locations, monitoring well locations, and extent of drainage basin.

Step 5: Develop the analytical approach.

- Surface Water – The analytical approach for surface water sampling is described in detail in Section 4 of the Work Plan (FWS, 2012), and summarized in Section 2 of the FSP (TRC, 2014). Surface water data will be evaluated in revisions to the HHRA (FWS, 2007a) and the BERA (FWS, 2007b) following the Phase I investigation. The results will also be evaluated in an EE/CA Investigation Report following completion of the EE/CA investigation.
- Sediment – The analytical approach for sediment sampling is described in detail in Section 4 of the Work Plan (FWS, 2012), and summarized in Section 2 of the FSP (TRC, 2014). Sediment data will be evaluated in revisions to the HHRA (FWS, 2007a) and the BERA (FWS, 2007b) following the Phase I investigation. The results will also be evaluated in an EE/CA Investigation Report following completion of the EE/CA investigation.
- Fish Tissue – The analytical approach for fish tissue sampling is described in detail in Section 4 of the Work Plan (FWS, 2012), and summarized in Section 2 of the FSP (TRC, 2014). Fish tissue data will be evaluated in revisions to the HHRA (FWS, 2007a) and the BERA (FWS, 2007b) following the Phase I investigation. The results will also be evaluated in an EE/CA Investigation Report following completion of the EE/CA investigation.
- Groundwater – The analytical approach for groundwater sampling is described in detail in Section 4 of the Work Plan (FWS, 2012), and summarized in Section 2 of the FSP (TRC, 2014). Groundwater data will be evaluated in an EE/CA Investigation Report following completion of the EE/CA investigation.
- Building Interior Wipe Samples – The analytical approach for wipe sampling is described in detail in Section 4 of the Work Plan (FWS, 2012), and summarized in Section 2 of the FSP (TRC, 2014). Wipe sample data will be evaluated in an EE/CA Investigation Report following completion of the EE/CA investigation.

Step 6: Specify performance or acceptance criteria.

Data collected under this monitoring program must be of sufficient quality for a comparison to appropriate screening levels, preliminary remediation goals, and historical data. The consequences of a false acceptance or rejection error is quite low, since no large decision would rest on any one sample, and questionable results can be confirmed with additional samples. However, USEPA approved methods will be followed for sample analysis. The acceptance criteria for these activities is having collected sufficient data and observations to meet the objectives in Step 2 above. In addition, the collected data must meet the appropriate analytical QA/QC requirements to be considered valid (e.g. Worksheets 12, 15, 19-28, 31-37).

Step 7: Develop the plan for obtaining the data.

Specific procedures for sampling, chain of custody, instrument calibration, analysis, reporting, and internal quality control are described in the FSP (TRC, 2014) and other worksheets of this QAPP.

QAPP Worksheet #11-1
Project Quality Objectives/Systematic Planning Process Statements
(EE/CA – Phase I Investigation)

Who will use the data?

GLS, TRC, FWS, USEPA, Illinois EPA.

What will the data be used for?

The data will be used to characterize the nature and extent of contamination, including contaminant fate and transport at the Site.

- **Surface Water Samples:**
  The surface water quality samples will be used to finalize the HHRA and BERA (FWS, 2007a and 2007b); and to refine the site preliminary remediation goals (PRGs).
- **Sediment Samples:**
  The sediment samples will be used to finalize the HHRA and BERA (FWS, 2007a and 2007b); to refine the site PRGs; and to delineate the extent of pesticide impacts in sediment.
- **Fish Tissue Samples:**
  The fish tissue samples will be used to finalize the HHRA and BERA (FWS, 2007a and 2007b); and to refine the site PRGs.
- **Groundwater Samples:**
  The groundwater samples will be used to further delineate the extent of pesticide and volatile organic compound (VOC) constituents in groundwater; and to monitor the change in constituent concentrations over time. Site groundwater elevation data and single well response test data will be used to evaluate groundwater flow conditions at the site.
- **Building Interior Wipe Samples:**
  Wipe samples from the interior of Warehouse building IN-1-3 will be used to determine if the building is suitable for human occupancy.

What types of data are needed (target analytes, analytical groups, field-screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

Target analyte lists (TAL), and sampling and analytical protocols are defined later in this document; sampling protocol is described in detail in the FSP (TRC, 2014).

- **Surface Water Samples:**
  Discrete surface water samples will be collected from each of the 26 approximate sampling locations shown on Figure 2, and analyzed according to the program in Attachment 1. One of the surface water samples will be at the mouth of the drainage leading from Area 7. Surface water samples will be collected using a jar sampling method. In the event that a sampling location cannot be sampled using the jar method, the sample will be collected using a peristaltic pump outfitted with PTFE (or PTFE-lined polyethylene) tubing and a vacuum transfer container placed between the pump intake and the pump head. Sampling methodology is described in detail in the FSP (TRC, 2014). After the analytical sample is collected, a grab sample will be collected for a field turbidity measurement, and a flow-through cell equipped with probes to measure pH, temperature, specific conductance, dissolved oxygen, and redox potential will be used to collect field water quality measurements. Each of the samples will be analyzed at an off-site fixed base laboratory under standard laboratory turnaround times. The analytical methods are as follows: Pesticides TAL (SW-846 Method 8081A).

QAPP Worksheet #11-1 (continued)
Project Quality Objectives/Systematic Planning Process Statements
(EE/CA – Phase I Investigation)

What types of data are needed (target analytes, analytical groups, field-screening, on-site analytical or off-site laboratory techniques, sampling techniques)? (continued)

- **Sediment Samples:**

  Discrete sediment samples will be collected from each of the 26 approximate sampling locations shown on Figure 2 (if sediment is present and reasonably/safely accessible), and analyzed according to the program summarized in Attachment 1. The sediment sampling locations are intended to be coincident with the surface water sampling locations. Sediment samples will be collected with a coring device wherever possible. Samples may be collected using a stainless steel scoop, or with a ponar dredge, depending on site conditions, and the required sampling depth. The material from each sample interval will be thoroughly mixed to ensure homogeneity, and placed in laboratory sample containers. The samples will be analyzed at an off-site, fixed-base laboratory under standard laboratory turnaround times. The analytical methods are as follows: Pesticides TAL (SW-846 Method 8081A); Total Organic Carbon (TOC) (Walkley Black).

- **Fish Tissue Samples:**

  Fish tissue samples will be collected for forage fish and game fish in the two fishing areas delineated on Figure 3. Fish will be collected from deep water locations (water depth of approximately 6-feet or more) and from near shore locations for forage fish using electrofishing, gill netting, or seining. Fish samples will be analyzed in accordance with the program in Attachment 1. Necropsies for internal and external morphology collection of organ tissues for pathology and processing of fillets for chemical analysis will either take place in the field or in an off-site fixed-base laboratory. All game fish samples and two forage fish samples will undergo a necropsy and morphological assessment; selected samples will be subject to a histopathology. Fillets of the game fish samples and whole body samples of the forage fish samples will be analyzed at an off-site fixed-based laboratory under standard laboratory turnaround times. The analytical methods are as follows: Pesticides TAL (SW-846 Method 8081B); percent lipids.

- **Groundwater Samples:**

  Static water levels will be collected at the existing permanent monitoring wells at the Area 7 pesticide area (W01, W02, W03, W15, and W17) and new permanent wells (W21, W22, and W23). Discrete groundwater samples will be collected from each permanent well (3 new, and 5 existing) according to the program and schedule in Attachment 1. Well locations are shown on Figure 4. Groundwater samples will be collected using a low-flow purging and sampling technique, and a flow-through cell equipped with probes to measure pH, temperature, specific conductance, dissolved oxygen, and redox potential will be used to collect field measurements. Field measurements will be used during purging to determine when the well has been purged adequately to produce a representative groundwater sample. Each of the samples will be analyzed by an off-site, fixed-base laboratory under standard laboratory turnaround times. The analytical methods are as follows: VOCs TAL (SW-846 Method 8260B); Pesticides TAL (SW-846 Method 8081A).

- **Building Interior Wipe Samples:**

  Discrete wipe samples will be collected from the interior of building IN-1-3, at locations to be determined by FWS. Two samples will be collected from the floor, three samples will be collected from the metal walls, and three will be collected from the wood frame. The field sampling team will select sampling sites being mindful of the ASTM D6661-10 standard requiring smooth and non-porous surfaces. Each wipe sample will be collected using a 3-inch by 3-inch sterile gauze pad moistened with 80/20 iso-octane/acetone in accordance with ASTM Standard 6661-10. Each of the samples will be analyzed by an off-site, fixed-base laboratory, and will be performed under standard laboratory turnaround times. The analytical methods are as follows: Pesticides TAL (SW-846 Method 8081A)

QAPP Worksheet #11-1 (continued)
Project Quality Objectives/Systematic Planning Process Statements
(EE/CA – Phase I Investigation)

How "good" do the data need to be in order to support the environmental decision?

Field measurements of pH, temperature, specific conductance, redox potential, dissolved oxygen, and turbidity will be collected with meters calibrated in accordance with the manufacturer's requirements, and as specified in Worksheet 22. Data of this level of quality are sufficient to determine the representativeness of the groundwater samples collected, and for providing information for basic field level decisions.

Samples for pesticides, VOCs, TOC, and lipid analysis will be collected and analyzed in accordance with the performance standards of the EPA standards listed above. EPA methods provide sufficient data quality for finalizing the baseline risk assessments, making decisions regarding the groundwater plume extent, and making decisions regarding the usability of Warehouse building IN-1-3. In addition, the collected data must meet the appropriate analytical QA/QC requirements to be considered valid (e.g., Worksheets 12, 15, 19-28, 31-37).

Laboratory method detection limits (MDLs) must be low enough to meet the Remediation Goals (RGs) for the site. QAPP Worksheet #15 highlights all cases where a screening level or preliminary RG is below the laboratory MDL. Screening levels are not final cleanup levels, and are provided for reference only during the development of final RGs. Only one compound (1,2-dibromo 3-chloropropane) has an MDL (0.25 µg/L) that does not get down to the PRG (0.2 µg/L) for Class I groundwater. The 0.05 µg/L difference between the MDL and RG for groundwater will not affect our evaluation of this compound.

Note that wipe samples collected from the interior of Warehouse Building IN-1-3 will likely be from surfaces that do not fully comply with the ASTM Standard (ASTM D6661-10) for wipe sampling (smooth and non-porous surfaces). The discussion of these results will take non-compliant surfaces into account.

Verifiable data are necessary to determine Action Memorandum compliance.

How many data are needed (number of samples for each analytical group, matrix, and concentration)?

Surface water and sediment samples will be collected once from each of 26 proposed locations (where surface water is present) from within the embayment, Crab Orchard Lake near the embayment, and from Crab Orchard Creek, and analyzed according to the program summarized in Attachment 1. This frequency and number of samples is sufficient to finalize the baseline risk assessments for the site, and to provide initial delineation of constituents within the sediment and surface water.

Eight fish tissue samples will be collected from each of two game fish species (e.g., bass and catfish), and two forage fish species (e.g. bluegill, common carp, minnows, etc.) from within the embayment; and eight fish tissue samples will be collected from each of the species listed above from Crab Orchard Lake near the embayment. Each of the tissue samples will be analyzed in accordance with Attachment 1. The eight samples for each species at each location provides a statistically significant population for evaluating human health and ecological risk.

Groundwater samples will be collected from each of the new and five existing permanent monitoring wells on a one-time basis, and analyzed according to the analytical program in Attachment 1. This frequency and number of samples is sufficient to make decisions regarding the extent of pesticide and VOC constituents in groundwater, and will be available to compare to historical groundwater data. Depending on the results of the groundwater sampling conducted during Phase 1, investigation of the vertical extent of groundwater contamination may be warranted for Phase II.

Wipe samples will be collected from eight locations inside Warehouse building IN-1-3 on a one-time basis, and analyzed according to the analytical program in Attachment 1. This frequency and number of samples is sufficient to make decisions regarding the building's suitability for use.

QAPP Worksheet #11-1 (continued)
Project Quality Objectives/Systematic Planning Process Statements
(EE/CA – Phase I Investigation)

Where, when, and how should the data be collected/generated?

- **Surface Water Samples:**
  Surface water samples will be collected on a one-time basis at the locations shown on Figure 2, and analyzed in accordance with the analytical program included in Attachment 1. Details of the sample collection methodology are included in the FSP (TRC, 2014).
- **Sediment Samples:**
  Sediment samples will be collected on a one-time basis at the locations shown on Figure 2, and analyzed in accordance with the analytical program included in Attachment 1. Details of the sample collection methodology are included in the FSP (TRC, 2014).
- **Fish Tissue Samples:**
  Fish tissue samples will be collected on a one-time basis from the areas shown on Figure 3, and analyzed in accordance with the analytical program included in Attachment 1. Details of the sample collection methodology are included in the FSP (TRC, 2014).
- **Groundwater Samples:**
  Groundwater samples will be collected on a one-time basis at the locations shown on Figure 4, and analyzed in accordance with the analytical program included in Attachment 1. Details of the sample collection methodology are included in the FSP (TRC, 2014).
- **Building Interior Wipe Samples:**
  Building interior wipe samples from Warehouse building IN-1-3 will be collected on a one-time basis at locations to be determined by FWS, and analyzed in accordance with the analytical program included in Attachment 1. Details of the sample collection methodology are included in the FSP (TRC, 2014).

Who will collect and generate the data?

TRC will collect the samples; Environmental Chemistry Consulting Services (ECCS) and authorized subcontractors will analyze the sediment, surface water, groundwater, and wipe samples and issue data reports; a laboratory (to be determined) will perform the necropsy and preserve organ samples for potential histopathology; ALS will perform chemical analysis on the fish tissue samples and issue reports; and TRC will validate the data.

QAPP Worksheet #11-1 (continued)
Project Quality Objectives/Systematic Planning Process Statements
(EE/CA – Phase I Investigation)

How will the data be reported? All of the compositional analyses will be available within three weeks of receipt at the laboratory. Level IV reports, where required (Worksheet 14), will be available within five weeks of receipt at the laboratory. Laboratory and field analytical data will be incorporated into the project database. Data transmittals will be generated as specified in Worksheet 16-1, and a final EE/CA report will be generated as specified in Worksheet 16-1. All laboratory and field analytical data, survey data, and photographs will be provided to FWS in an electronic format (in a format specified by FWS). Field documentation will be included in an appendix to the EE/CA report.
How will the data be archived? Validated data will be archived in an appropriate computer database to ensure that information is readily available, searchable, and compatible with a GIS system. EDDs of site data will be generated and submitted to FWS and USEPA as specified in Worksheet 16-1.

QAPP Worksheet #12-1
Measurement Performance Criteria (Organochlorine Pesticides - Water)

Matrix: Aqueous
Analytical Group: Organochlorine Pesticides by 8081A
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-07 SOP-0025-003	Preparation: ECCS-PRE-002	Precision-overall	RPD < 35%	Field duplicate	S&A
	Analysis: ECCS-LAM-003	Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD and LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-2
Measurement Performance Criteria (Organochlorine Pesticides – Soil/Sediment)

Matrix: Solid (Soil/Sediment)
Analytical Group: Organochlorine Pesticides by 8081A
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-03 SOP-04 SOP-0025-002	Preparation: ECCS-PRE-002 Analysis: ECCS-LAM-003	Precision-overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD and LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-3
Measurement Performance Criteria (Organochlorine Pesticides – Fish Tissue)

Matrix: Fish Tissue
Analytical Group: Organochlorine Pesticides by 8081B
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-10	Preparation: ALS-MET-TISP ALS-EXT-3541	Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
	Analysis: ALS-SOC-8081	Accuracy/Bias	< RL	Method blank	A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 40%	MS/MSD and LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-4
Measurement Performance Criteria (Organochlorine Pesticides – Wipe Samples)

Matrix: Wipe Samples
Analytical Group: Organochlorine Pesticides by 8081A
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
ECCS-01	Preparation: ECCS-PRE-007	Precision-overall	RPD < 50%	Field duplicate	S&A
	Analysis: ECCS-LAM-003	Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD and LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-5
Measurement Performance Criteria (Volatile Organic Compounds - Water)

Matrix: Aqueous
Analytical Group: VOCs by 8260B
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-07	Preparation: ECCS-LAM-004 Analysis: ECCS-LAM-004	Precision-overall	RPD < 35%	Field duplicate	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD and LCS/LCSD[3]	A
		Accuracy/Bias	-50% to +200%	Internal standards	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-6
Measurement Performance Criteria (Volatile Organic Compounds – Soil/Sediment)

Matrix: Solid (Soil/Sediment)
Analytical Group: VOCs by 8260B
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-03 SOP-04 SOP-0025-002	Preparation: ECCS-LAM-004 Analysis: ECCS-LAM-004	Precision-overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD and LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD and LCS/LCSD[3]	A
		Accuracy/Bias	-50% to +200%	Internal standards	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-7
Measurement Performance Criteria (Polycyclic Aromatic Hydrocarbons – Soil/Sediment)

Matrix: Solid (Soil/Sediment)
Analytical Group: PAHs by 8270D GC/MS SIM
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-03 SOP-04 SOP-0025-002	Preparation: ECCS-PRE-003 Analysis: ECCS-LAM-030	Precision-overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	Surrogate	A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD or LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD or LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-8
Measurement Performance Criteria (Total Organic Carbon – Soil/Sediment)

Matrix: Solid (Soil/Sediment)
Analytical Group: Total Organic Carbon by Walkley-Black
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-03 SOP-04 SOP-0025-002	Preparation: PACE-01 Analysis: PACE-01	Precision-overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias contamination	< RL	Blanks (field, equipment, method-specific)	S&A
		Accuracy/Bias	%Rec, laboratory generated limits[4]	MS/MSD or LCS/LCSD[3]	A
		Precision	%RPD < 20%	MS/MSD or LCS/LCSD[3]	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #12-9
Measurement Performance Criteria (Fish Tissue – Lipids)

Matrix: Fish Tissue
Analytical Group: Percent lipids
Concentration Level: All

SAMPLING PROCEDURE[1]	ANALYTICAL METHOD/SOP[2]	DATA QUALITY INDICATORS (DQIs)	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	QC SAMPLE ASSESSES ERROR FOR SAMPLING(S), ANALYTICAL(A), OR BOTH (S&A)
SOP-10	Preparation: ALS-MET-TISP ALS-EXT-LIPID	Accuracy/Bias	< abs. value of 0.5 mg	Method blank	A
	Analysis: ALS-EXT-LIPID	Precision	%RPD < 20%	Duplicate	A

Footnotes:
(1) Reference number from QAPP Worksheet #21.
(2) Reference number from QAPP Worksheet #23.
(3) MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD is supplied.
(4) See Attachment 2.

QAPP Worksheet #13
Secondary Data Criteria and Limitations

SECONDARY DATA	DATA SOURCE (originating organization, report title, and date)	DATA GENERATOR(S) (originating organization, data types, data generation/collection dates)	HOW DATA WILL BE USED	LIMITATIONS ON DATA USE
Preliminary Assessment/Site Inspection (PA/SI) (Historical Data)	FWS. 2003. Final Post Preliminary Assessment/Site Inspection Report.	URS; Sample dates between April and May 2000; soil and sediment samples	▪ Used to identify areas of elevated pesticide concentrations in soil and sediment ▪ Used as reference points for designing the pesticide delineation investigation	None[1]
Post PA/SI Investigation (Historical Data)	FWS. 2003. Final Post Preliminary Assessment/Site Inspection Report.	URS; Sample dates in March 2001 and May 2001; soil, sediment, and surface water samples	▪ Used to identify areas of elevated pesticide concentrations in soil and sediment ▪ Used as reference points for designing the pesticide delineation investigation	None[1]
Remedial Investigation (RI) (Historical Data)	NewFields. December 2011. Draft Remedial Investigation Report.	NewFields, on behalf of GD-OTS; Sample dates include October and December 2006, January through March 2007, and October through December 2007; data include soil, surface water, sediment, and groundwater data.	▪ Soil boring logs used to assess physical nature of subsurface soil. ▪ Groundwater data used to evaluate trends in water chemistry over time. ▪ Soil and sediment data may be used for delineation of extent of constituents in site soil and sediment, and to demonstrate compliance with site PRGs.	None[1]

[1] Data were collected and analyzed In accordance with USEPA-approved planning documents (see Worksheet #2 for dates of approved planning documents).

QAPP Worksheet #14
Summary of Project Tasks

SAMPLING AND ANALYSIS TASKS	
EE/CA Phase I Investigation	
Sampling tasks:	▪ Collect surface water and sediment samples in the embayment, Crab Orchard Lake near the embayment, and Crab Orchard Creek, as specified in the Work Plan (FWS, 2012) and FSP (TRC, 2014) ▪ Collect fish tissue samples from the embayment and from Crab Orchard Lake near the embayment, as specified in the Work Plan (FWS, 2012) and FSP (TRC, 2014). ▪ Install three new groundwater monitoring wells as specified in the Work Plan (FWS, 2012) and FSP (TRC, 2014). — visually describe and log soil borings — perform single well response tests on each new monitoring well ▪ Collect groundwater level measurements from all existing Area 7 pesticide wells (W01, W02, W03, W15, and W17) and new permanent monitoring wells (W21, W22, and W23). Collect groundwater samples from the three new (W21, W22, and W23), and 5 previously existing (W01, W02, W03, W15, and W17) permanent groundwater monitoring wells, as specified in the Work Plan (FWS, 2012) and FSP (TRC, 2014). ▪ Collect wipe samples from the inside of Warehouse building IN-1-3 as specified in the Work Plan (FWS, 2012) and FSP (TRC, 2014)
Analysis tasks:	▪ All analytical samples of soil, sediment, surface water, groundwater, and wipes will be submitted to ECCS in Madison, Wisconsin, for analysis in accordance with the analytical program (Attachment 1). Specific analyses are as follows: — Pesticides by SW846 Method 8081A – all matrices. — Volatile organic compounds (VOCs) by SW846 Method 8260B – groundwater. — Total Organic Carbon (TOC) by Walkley Black – sediment. TOC analysis will be performed by ECCS subcontractor Pace Analytical (Madison, Wisconsin). ▪ Analytical samples of all game and two forage fish will be either processed in the field, or submitted to a necropsy/histopathology laboratory (to be determined) for morphological assessment, necropsy, and potential histopathology. Forage fish samples for chemical analysis will be submitted directly to ALS in Kelso, Washington, from the Site; and the entity performing the necropsy (to be determined) will prepare game fish tissue and send to ALS for pesticide (SW846 Method 8081B) and lipid analysis in accordance with the analytical program (Attachment 1). ▪ All analyses will be performed within standard turnaround times.
Quality control tasks:	The samples will be collected and processed, and the laboratory waste will be disposed, as described in the laboratory SOPs. QC samples will be collected as described in Worksheet #20.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Secondary data:	See Worksheet 13.
Data management tasks:	▪ **Field data reduction** - Raw data from field measurements and sample collection activities will be recorded as specified in the FSP (TRC, 2014). If the data are to be used in the project reports, they will be reduced or summarized, and the method of reduction will be documented in the report. No calculation will be involved in field data reduction. The On-site Coordinator or designee will proofread all forms and notebooks to determine if transcription errors have been made by the field crew. ▪ **Laboratory data reduction** – ECCS, ALS, necropsy/histopathology laboratory (to be determined), and approved subcontracting labs will perform in-house analytical data reduction under the direction of the Laboratory QA Manager. The Laboratory QA Manager will be responsible for assessing data quality and advising of any data that were rated "preliminary" or "unacceptable" or of other notations that would caution the data user of possible unreliability. Data reduction, by the laboratory, will be conducted as follows: — The analysts who produced the laboratory data will first conduct a systematic review (Level 1 Review). — An experienced peer, supervisor, or designee will examine the data (the Level 2 Review) to ensure that the Level 1 review has been completed correctly and thoroughly. Following the Level 2 review, the data will be turned over to the Laboratory Project Manager for a third-level review. — The Laboratory Project Manager will review the data for completeness and attainment of quality control criteria as outlined in the USEPA methods and for overall reasonableness. — The Laboratory Project Manager will verify the accuracy and completeness of the final reports. — The Laboratory QA Manager and the supervisor of the pertinent analytical section, in conjunction with the TRC Data QA Manager and TRC Project Manager, will decide whether any sample reanalysis is required. — Data reduction procedures are included in the USEPA-approved methods and associated laboratory SOPs. ▪ **Field data reporting** - Field data reporting will consist of field notebooks and logs, photographs, boring logs, calibration and measurement records, and Chain–of-Custody (COC) documentation, including field quality control samples that will be collected to assess the quality of the analytical data and to evaluate sampling and analytical reproducibility. Field records will be reviewed by the TRC Project Manager for consistency with the planned activities, and any concerns will be discussed with the TRC On-Site Coordinator. Field performance and field system audits will also be performed, as discussed below and in Worksheets #31 and 32. All field analytical data will be incorporated into the project database, and will be provided to FWS in a format specified by FWS.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Data management tasks: (continued)	▪ **Laboratory data reporting** - The analytical laboratories will prepare and retain full analytical and QC documentation. Such retained documentation need not be on hard (paper) copy, but may be in other storage media (*e.g.*, computer diskette or magnetic tape). As needed, ECCS, ALS, and the necropsy/histopathology laboratory (to be determined) will supply a hard copy of the retained information. Analytical data packages will be prepared in accordance with the November 2008 QAPP addendum, approved by FWS (FWS, 2008), requiring 10 percent of the data generated (based on the number of samples) to be reviewed at a Level IV review. The analytical laboratories will provide the following information in each analytical data package submitted (Level II data packages): — Dated cover sheets, signed by the Analytical Project Manager, listing a laboratory batch number; the analyses performed; the number of samples and respective matrices; and the project name and number — Tabulated results of inorganic and organic compounds identified and quantified, including sample preparation and analysis dates, and cross-references of laboratory and field sample identification numbers — Tabulation of Method Detection Limits, as appropriate — Laboratory copies of the Chain of Custody forms — Analytical results for surrogate recoveries (as appropriate), QC sample spikes and sample spike duplicates; standard procedural blanks; and laboratory control samples, as appropriate for the specified analyses Laboratory reports for a minimum of 10 percent of the samples collected will include the following additional information (Level IV data packages): — **Case narrative -** date of issuance; laboratory analysis performed; any deviations from required analytical methods; laboratory sample lot numbers; numbers of samples and respective matrices; QC procedures used and references to the acceptance criteria; laboratory report table of contents; project name and number; condition of samples upon receipt; dates of extraction, preparation, and analysis; discussion of whether or not sample holding times were met; discussion of technical problems or other observations that may have created analytical difficulties; discussion of any laboratory QC checks that failed to meet project criteria; signature of the laboratory Project Manager, and copies of the COC Records — **Raw data** - system printouts (or legible photocopies) identifying the date of analyses, the mass spectra tuning data, the name of the analyst, the parameters determined, the initial and continuing calibration, the calibration verification summary, the method blanks, the sample and any dilutions, sample duplicates and spikes, chromatograms, GC/MS spectra, computer printouts, internal standard area and RT summary, cleanup information, control samples, ICP outputs, and inter-element correction data

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Data management tasks: (continued)	Soil, sediment, and fish tissue sample analytical data generated by the laboratory will be reported in micrograms per kilogram (µg/kg) or milligrams per kilogram (mg/kg) on a dry-weight basis. Groundwater and surface water data will be reported in micrograms per liter (µg/L) or milligrams per liter (mg/L). Wipe sample analytical results will be reported at a total micrograms (µg) or total milligrams (mg) per wipe. Results between the laboratory Method Detection Limit (MDL) and the Reporting Limit (RL) will be reported, and flagged as estimated values. Data retained in the project database may be converted to units other than those reported by the laboratories. Sample results will not be corrected for contamination found in laboratory blanks. However, sample results may be qualified as not detected based on laboratory, field, and/or trip blank contamination. Analytical data for this project will be reported in both an electronic data deliverable (EDD) and an analytical data package. The EDD will be generated by the analytical laboratory and will be used by TRC to facilitate loading the analytical data into the project database. The Laboratory QA Manager will perform a final review of the report summaries and case narratives to determine if the report meets project requirements. The task of reporting laboratory data to the FWS and USEPA will begin after the data review activity has been concluded. The validated analytical data will be provided to the FWS in an electronic format specified by FWS, and in accordance with the project schedule (Worksheet #16). ▪ **Data Validation Reporting -** A report will be prepared containing a QA/QC section summarizing the quality of the data. The data validation report prepared under the direction of TRC Data QA Manager will address the assessment of data precision, accuracy, completeness, and comparability; the results of performance audits, if any; the results of system audits; any reported non-conformances; any significant QA/QC problems and recommended solutions; the results of corrective actions since the last report; and approved revisions to the QA/QC processes. The report will indicate whether the QA objectives were met and whether the data can be used for the intended purposes based on an evaluation of compliance with control limits, the results of audits, and compliance with the procedures specified in the QAPP and the FSP.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Documentation and records:	Records will be maintained to provide documentation of the entire data generation process, including field sampling and laboratory analysis. ▪ **Field documentation -** Field personnel will develop and retain comprehensive records of field activities, including field sampling, field analysis, and sample Chain-of-Custody, to allow a reconstruction of field events and sample handing during data review and interpretation. ▪ **Laboratory project files –** Each analytical laboratory will maintain a file for pertinent project information, including Chain-of-Custody Records; other custody documents (air bills, etc.); work orders; Sample Receipt Acknowledgment Forms, if any; instrument detection limit and control limit tabulations; all raw analytical data on bench sheets; laboratory data; and project communication records. Such retained documentation need not be on hard (paper) copy, but may be in other storage media (*e.g.*, computer diskette or magnetic tape). As needed, the analytical laboratory will supply a hard copy of the retained information. ▪ **Laboratory notebooks -** Logbooks, bench sheets, instrument notebooks, and instrument printouts will be retained as part of the permanent laboratory record, including the associated quality controls. Each page in the laboratory logbooks and bench sheets will be signed and dated by the analyst, and errors will be crossed out in indelible ink. System printouts of raw inorganic and organic data will include dates of analyses; analyst's name; parameters determined; calibration curve; calibration verifications; method blanks; sample number and dilutions performed; and sample duplicates, spikes, and control samples. Internal laboratory QC sample results will be indicated on the analytical bench sheets and will include sample spikes, sample duplicates, initial and continuous calibration verification of standards and blanks, standard procedural blanks, laboratory control samples, ICP serial dilutions, and ICP interference check samples. ▪ **Computer and hard copy storage -** Other than records and documents provided to FWS prior to or during the conduct of work, all non-identical records and documents relating to the performance of work will be maintained by TRC and the laboratory for a minimum of 10 years after the completion of the EE/CA. GLS, or its designated representatives, will retain copies of the analytical data reports according to the requirements of the laboratory QA Manual. All field records will be kept in the central project file at the TRC office at 708 Heartland Trail, Madison, Wisconsin; and records will be included in project reports, as appropriate, or upon request by the FWS RPM. All laboratory and field analytical data, survey data, and photographs will be provided to FWS in an electronic format, as specified by FWS. Field documentation will be included in an appendix to the EE/CA report. Copies of corrective action reports and a log of these actions will be maintained and included in the EE/CA investigation report.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Assessment/Audit tasks:	Performance and system audits will be completed in the field and laboratory, as described below and in Worksheets #31 and 32. ▪ **Field audits** - The TRC Project Manager will monitor day-to-day field performance through daily communications with the On-site Coordinator and the Construction Manager (if applicable). In addition, field performance audits and field system audits will be performed, as follows: — **Field performance audits** - Field performance audits will be conducted in order to confirm that the activities are being performed according to the established plans. The field performance audit(s) will be performed by the Project Manager (or designee) at a frequency that is appropriate for the field activities being performed. The audit(s) will include a discussion of the project progress with the Project Manager and/or the review of field reports, as appropriate. The Data QA Manager will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the Project Manager. — **Field system audits -** Field system audits will be performed by the Data QA Manager, including a review of rinse and trip blank data to identify potential deficiencies in field sampling and decontamination procedures, and a comparison of the scheduled QA/QC activities described in this QAPP with the QA/QC procedures being performed on the project. Field system audits will be performed at a frequency appropriate for the field activities. The Data QA Manager will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the Project Manager. ▪ **Laboratory audits -** Laboratory audits will be performed, as follows: — **Internal audits** - The Laboratory QA Manager (or designee) will periodically conduct internal laboratory audits. This will include an overall evaluation of the performance of laboratory staff and a comparison of laboratory procedures with the laboratory QA Manual and SOPs. Results of the audits will be summarized and distributed to appropriate laboratory staff. — **External audits -** The Data QA Manager will review the laboratory QA Manual and applicable SOPs, and will discuss laboratory procedures with the Laboratory QA Manager prior to the start of project sampling. The Data QA Manager will record and document any observations made during the review. In addition, as a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification. Audits include a review of sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are documented and submitted to the laboratory for corrective action, if necessary. Field and laboratory audits may also be performed by FWS personnel (or designee); FWS personnel may also submit blind samples to the laboratory for analysis.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Assessment/Audit tasks: (continued)	▪ **Corrective action** - Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP, as follows: — **Field measurement corrective action** - Corrective action in the field may be necessary when the sample network is changed (*i.e.*, more/fewer samples, sampling locations other than those specified in the FSP, etc.), or when sampling procedures and/or field analytical procedures require modification in response to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or deficiencies of any activity or issued document by reporting the situation to the TRC On-site Coordinator or designee. The On-site Coordinator will assess the suspected problems in consultation with the Project Manager or Data QA Manager or designee, and will assist in making a decision based on the potential for the situation to impact the data quality. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, the On-site Coordinator will initiate a nonconformance report. If appropriate, the On-site Coordinator will also ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed. The FWS Project Coordinator will be notified of all suspected technical or QA non-conformances or deficiencies and corrective actions as soon as possible. — **Laboratory corrective action** - Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. Corrective actions may be necessary if any of the following occur: ▪ QC data are outside the warning or acceptable windows for precision and accuracy. ▪ Blanks contain target analytes above acceptable levels. ▪ Undesirable trends are detected in spike recoveries or the RPD between duplicates. ▪ There are unusual changes in detection limits. ▪ Deficiencies are detected by the Data QA Manager during internal or external audits or from the results of performance evaluation samples. ▪ Inquiries concerning data quality are received. Corrective actions should be timely, and they should determine the root cause and evaluate any propagation of the error or problem. The investigative action taken is somewhat dependent on the analysis and the event. Corrective action in the laboratory may occur prior to, during, or after the initial analysis. Corrective action is under the supervision of the Laboratory QA Manager. Following a consultation with laboratory scientists, technicians, and team leaders, it may be necessary for the Data QA Manager to approve the implementation of the corrective action. Some conditions during or after analysis may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain quality control criteria are not met, etc. The analytical laboratory's corrective action procedures are documented in Laboratory SOPs specifying corrective action to be taken when an analytical error is discovered or the analytical system is found to be out of control.

QAPP Worksheet #14 (continued)
Summary of Project Tasks

DATA MANAGEMENT, DOCUMENTATION, RECORDS, AND AUDIT TASKS	
Assessment/Audit tasks: (continued)	Depending on the problem, the corrective action employed may be formal or informal. On-the-spot actions are used to correct minor problems, such as recalibration, retuning, or a minor repair (*e.g.*, replacement of a minor part) of a malfunctioning instrument or the correction of poor analytical technique being used. Corrective action procedures may be handled at the bench level by the analyst, who reviews the preparation or extraction procedure that was used for possible errors, and checks the instrument calibration, spike, and calibration mixes, and the instrument sensitivity. These occurrences are documented in the appropriate injection, run, or analysis logbooks. Similarly, routine instrument maintenance, malfunctions, and power failures are also documented in the appropriate instrument maintenance logbooks. If the problem persists or cannot be identified, the matter may be referred to the laboratory team leader, and/or QA/QC Manager for further investigation. Occurrence of the problem, the corrective action employed, and verification that the problem has been eliminated will be properly documented. The corrective action procedure will be discussed with the Laboratory Project Manager, and full documentation of the corrective action procedure, whether resolved or not, will be placed in the laboratory project file. Corrective actions specific to analytical methods are discussed in the operational-specific SOPs. The FWS RPM or the TRC Data QA Manager may request corrective action for any nonconformance identified by audits or data validation. — **Corrective action during data validation and data assessment** - The need for corrective actions may be identified during data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory. Data validation corrective actions may include notification of the laboratory of incomplete or erroneous reports and a request for issuance of corrected versions. When the Data QA Manager identifies a corrective action situation, the Project Manager will approve the implementation of corrective action, including possible resampling. The TRC Data QA Manager will notify the laboratory of incomplete or erroneous reports and will request the issuance of corrected versions. All corrective actions will be documented. Final summary data tables will not be issued until all data have been validated and all corrections have been made. Corrective action may include the following: ▪ Reanalysis of samples, if holding time requirements permit ▪ Resampling and analysis ▪ Evaluation and amendment of sampling procedures ▪ Evaluation and amendment of analytical procedures ▪ Acceptance of data and acknowledgment of the level of uncertainty
Data Review tasks:	See Worksheets #36 and 37.

QAPP Worksheet #15-1

Reference Limits and Evaluation (Pesticides – Groundwater)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	AQUEOUS MDL[1][2] (µg/L)	AQUEOUS RL[1][2] (µg/L)	SCREENING LEVELS – HUMAN HEALTH: IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS I GW (µg/L)[3][4]	SCREENING LEVELS – HUMAN HEALTH: IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS II GW (µg/L)[3][4]	SCREENING LEVELS – HUMAN HEALTH: FEDERAL MCL (µg/L)[5]	SCREENING LEVELS – HUMAN HEALTH: OSWER VAPOR INTRUSION (µg/L)[6]	SCREENING LEVELS – ECOLOGICAL: GROUNDWATER ESV (µg/L)[7]	PRELIMINARY REMEDIATION GOALS[9]: ILLINOIS PART 620 CLASS I GW (µg/L)[8]	PRELIMINARY REMEDIATION GOALS[9]: ILLINOIS PART 620 CLASS II GW (µg/L)[8]
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A										
Aldrin	309-00-02	0.0063	0.025	14	70	--	--	--	--	--
alpha-BHC	319-84-6	0.0063	0.025	0.11	0.55	--	--	--	0.11	0.55
beta-BHC	319-85-7	0.01	0.025	--	--	--	--	--	--	--
delta-BHC	319-86-8	0.0045	0.025	--	--	--	--	--	--	--
gamma-BHC (Lindane)	58-89-9	0.0059	0.025	0.2	1	0.2	--	--	0.2	1
alpha-Chlordane [10]	5103-71-9	0.0046	0.025	2[10]	10[10]	2[10]	--	--	2[10]	10[10]
gamma-Chlordane [10]	5103-74-2	0.0045	0.025	2[10]	10[10]	2[10]	--	--	2[10]	10[10]
Chlordane (technical) [10]	57-74-9	0.042	0.5	2[10]	10[10]	2[10]	--	--	2[10]	10[10]
4,4'-DDD	72-54-8	0.011	0.05	14	70	--	--	--	--	--
4,4'-DDE	72-55-9	0.01	0.05	10	50	--	--	--	--	--
4,4'-DDT	50-29-3	0.012	0.05	6	30	--	--	--	--	--
Dieldrin	60-57-1	0.0088	0.05	9	45	--	--	--	--	--
Endosulfan I [11]	959-98-8	0.0046	0.025	42[11]	210[11]	--	--	--	--	--
Endosulfan II [11]	33213-65-9	0.0084	0.05	42[11]	210[11]	--	--	--	--	--
Endosulfan Sulfate [11]	1031-07-8	0.013	0.05	42[11]	210[11]	--	--	--	--	--
Endrin [12]	72-20-8	0.013	0.05	2[12]	10[12]	2[12]	--	--	2[12]	10[12]
Endrin Aldehyde [12]	7421-93-4	0.0086	0.05	2[12]	10[12]	2[12]	--	--	2[12]	10[12]
Endrin Ketone [12]	53494-70-5	0.0079	0.05	2[12]	10[12]	2[12]	--	--	2[12]	10[12]
Heptachlor	76-44-8	0.0064	0.025	0.4	2	0.4	--	--	0.4	2
Heptachlor Epoxide	1024-57-3	0.0049	0.025	0.2	1	0.2	--	--	0.2	1
Hexachlorobenzene	118-74-1	0.0016	0.01	0.06	0.3	1	--	--	--	--
Isodrin	465-73-6	NE	0.02	--	--	--	--	--	--	--
Methoxychlor	72-43-5	0.088	0.25	40	200	40	--	--	40	200
Toxaphene	8001-35-2	0.28	1.3	3	15	3	--	--	3	15

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.
(2) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.
(3) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table E (Tier 1 Groundwater Objectives), effective date February 23, 2007.
(4) Table of objectives for chemicals not contained in TACO Tier I Tables; Groundwater objectives established using methodologies presented in 35 IAC Part 620 Subpart F. Standards presented in IEPA Table accessed on 5/28/2013.
(5) National Primary Drinking Water Regulations, EPA 816-F-09-004 May 2009.
(6) Values from USEPA's Office of Solid Waste and Emergency Response (OSWER) Vapor Intrusion Screening Level (VISL) Calculator, Revision 3.0 (3/7/2013).
(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.
(8) 35 IAC Part 620 Groundwater Quality, effective date October 5, 2012.
(9) PRGs for site groundwater are defined in the Work Plan as the water quality standards in IAC 35 Part 620. Site groundwater has not yet been classified. Therefore both Class I and Class II groundwater standards have been included as PRG values.
(10) The standard shown is for Chlordane CAS # 57-74-9, the sum of alpha plus gamma Chlordane must be compared against the groundwater standards for Chlordane to show compliance.
(11) The standard shown is for Endosulfan, the sum of endosulfan 1 and 2 plus endosulfan sulfate must be added and compared to the standard for endosulfan to show compliance.
(12) The standard shown is for Endrin, the sum of endrin plus endrin aldehyde plus endrin ketone must be compared to the standard for endrin to show compliance.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.
-- No standard established.
NE = An MDL has not been established for this compound. Laboratory will include in 8-point ICAL mix and report to the low standard.
MCL = Maximum Contaminant Level
ESV = Ecological Screening Value

QAPP Worksheet #15-2

Reference Limits and Evaluation (Pesticides – Surface Water)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	AQUEOUS MDL[1][2] (µg/L)	AQUEOUS RL[1][2] (µg/L)	SCREENING LEVELS					PRELIMINARY REMEDIATION GOALS (µg/L)[8]
				HUMAN HEALTH				ECOLOGICAL	
				ILLINOIS SW STANDARDS HUMAN HEALTH NON-CANCER (µg/L)[3]	ILLINOIS SW STANDARDS HUMAN HEALTH CANCER (µg/L)[3]	USEPA WATER QUALITY CRITERIA WATER + ORGANISM (µg/L)[4]	USEPA RSL FOR TAP WATER (µg/L)[5][6]	SURFACE WATER ESV[7] (µg/L)	
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A									
Aldrin	309-00-02	0.0063	0.025	--	**0.000046**	**0.000049**	--	0.017	--
alpha-BHC	319-84-6	0.0063	0.025	--	**0.0042**	**0.0026**	--	2.5	--
beta-BHC	319-85-7	0.01	0.025	--	**0.015**	**0.0091**	--	2.2	--
delta-BHC	319-86-8	0.0045	0.025	--	[0.0414]	--	--	2.2	--
gamma-BHC (Lindane)	58-89-9	0.0059	0.025	--	--	0.98	--	0.08	--
alpha-Chlordane[9]	5103-71-9	0.0046	0.025	--	**0.00072**[9]	**0.0008**[9]	--	**0.0043**[9]	--
gamma-Chlordane[9]	5103-74-2	0.0045	0.025	--	**0.00072**[9]	**0.0008**[9]	--	**0.0043**[9]	--
Chlordane (technical)[9]	57-74-9	0.042	0.5	--	**0.00072**[9]	**0.0008**[9]	--	**0.0043**[9]	--
4,4'-DDD	72-54-8	0.011	0.05	--	**0.00027**	**0.00031**	--	**0.0064**	--
4,4'-DDE	72-55-9	0.01	0.05	--	**0.00019**	**0.00022**	--	10.5	--
4,4'-DDT	50-29-3	0.012	0.05	--	**0.00019**	**0.00022**	--	**0.000001**	--
Dieldrin	60-57-1	0.0088	0.05	--	**0.000046**	**0.000052**	--	0.056	--
Endosulfan I	959-98-8	0.0046	0.025	--	--	62	--	0.0056	--
Endosulfan II	33213-65-9	0.0084	0.05	--	--	62	--	**0.0056**	--
Endosulfan Sulfate	1031-07-8	0.013	0.05	--	--	62	--	**0.0056**	--
Endrin	72-20-8	0.013	0.05	--	--	0.059	--	0.033	--
Endrin Aldehyde	7421-93-4	0.0086	0.05	--	--	0.29	--	0.15	--
Endrin Ketone	53494-70-5	0.0079	0.05	--	--	--	--	--	--
Heptachlor	76-44-8	0.0064	0.025	--	**0.000068**	**0.000079**	--	**0.0038**	--
Heptachlor Epoxide	1024-57-3	0.0049	0.025	--	**0.000036**	**0.000039**	--	**0.0038**	--
Hexachlorobenzene	118-74-1	0.0016	0.01	--	**0.00025**	**0.00028**	--	**0.0003**	--
Isodrin	465-73-6	NE	0.02	--	--	--	--	0.1	--
Methoxychlor	72-43-5	0.088	0.25	--	--	100	--	**0.02**	--
Toxaphene	8001-35-2	0.28	1.3	--	**0.00024**	**0.00028**	--	**0.0002**	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(2) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(3) IEPA Derived Water Quality Criteria for General Use Waters (35 IAC 302.210 and Subpart F), revised April 2013.

(4) USEPA National Recommended Water Quality Criteria updated January 8, 2013.

(5) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(6) USEPA RSLs for Tap Water are only presented for parameters with no other surface water standards.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) PRGs for Surface Water have not yet been developed.

(9) The standard shown is for Chlordane CAS # 57-74-9, the sum of alpha plus gamma Chlordane must be compared against the groundwater standards for Chlordane to show compliance.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = An MDL has not been established for this compound. Laboratory will include in 8-point ICAL mix and report to the low standard.

RSL = Regional Screening Level

MCL = Maximum Contaminant Level

ESV = Ecological Screening Value

[ ]= National criteria should be used for advisory purposes only.

QAPP Worksheet #15-3

Reference Limits and Evaluation (Pesticides – Surface Soil)[1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A																		
Aldrin	309-00-02	0.19	2	100	300	6,600	6,100	9,300	500	2,500	0.65	--	--	3.32	110	5	9	500
alpha-BHC	319-84-6	0.22	2	270	900	1,500	20,000	2,100	0.5	3	**0.036**	--	--	99.4	--	--	--	--
beta-BHC	319-85-7	1.6	2	960	--	--	--	--	--	--	**0.13**	--	--	3.98	--	--	--	--
delta-BHC	319-86-8	0.22	2	--	--	--	--	--	--	--	--	--	--	9,940	--	--	--	--
gamma-BHC (Lindane)	58-89-9	0.24	2	2,100	4,000	--	96,000	--	9	47	**0.21**	1.2	--	32	--	--	--	--
alpha-Chlordane[10]	5103-71-9	0.25	2	6,500[10]	16,000[10]	140,000[10]	100,000[10]	22,000[10]	10,000[10]	48,000[10]	13[10]	140[10]	--	224[10]	--	--	--	--
gamma-Chlordane [10]	5103-74-2	0.36	2	6,500[10]	16,000[10]	140,000[10]	100,000[10]	22,000[10]	10,000[10]	48,000[10]	13[10]	140[10]	--	224[10]	--	--	--	--
Chlordane(technical)[10]	57-74-9	4.4	40	6,500[10]	16,000[10]	140,000[10]	100,000[10]	22,000[10]	10,000[10]	48,000[10]	13[10]	140[10]	--	224[10]	--	--	--	--
4,4'-DDD	72-54-8	0.64	4	7,200	24,000	--	520,000	--	16,000	80,000	6.4	--	21	758	--	--	--	--
4,4'-DDE	72-55-9	0.35	4	5,100	17,000	--	370,000	--	54,000	270,000	46	--	21	596	--	--	--	--
4,4'-DDT	50-29-3	0.44	4	7,000	17,000	1,500,000	100,000	2,100,000	32,000	160,000	67	--	21	3.5	NA	14	140	32,000
Dieldrin	60-57-1	0.47	4	110	400	2,200	7,800	3,100	4	20	**0.061**	--	4.9	50,000	120	10	20	4
Endosulfan I [9]	959-98-8	0.36	2	3,700,000 [9]	12,000,000 [9]		1,200,000 [9]		18,000[9]	90,000[9]	1,100[9]	--	--	119	--	--	--	--
Endosulfan II[9]	33213-65-9	0.6	4	3,700,000 [9]	12,000,000 [9]	--	1,200,000 [9]	--	18,000[9]	90,000[9]	1,100[9]	--	--	119	--	--	--	--
Endosulfan Sulfate[9]	1031-07-8	1	4	3,700,000 [9]	12,000,000 [9]	--	1,200,000[9]	--	18,000[9]	90,000[9]	1,100[9]	--	--	35.8	--	--	--	--
Endrin [11]	72-20-8	0.39	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--	10.1	NA	28[11]	80[11]	NA
Endrin Aldehyde[11]	7421-93-4	0.69	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--	10.5	NA	28[11]	80[11]	NA
Endrin Ketone[11]	53494-70-5	0.56	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--	--	NA	28[11]	80[11]	NA
Heptachlor	76-44-8	0.22	2	380	1,000	11,000	28,000	16,000	23,000	110,000	**0.14**	33	--	5.98	--	--	--	--
Heptachlor Epoxide	1024-57-3	0.24	2	190	600	9,200	2,700	13,000	700	3,300	**0.068**	4.1	--	152	--	--	--	--
Hexachlorobenzene	118-74-1	0.47	2	1,100	4,000	1,800	78,000	2,600	2,000	11,000	0.53	13	--	1,000,000	--	--	--	2,000
Isodrin	465-73-6	NE	4	--	--	--	--	--	--	--	--	--	--	3.32	NA	11	45	NA
Methoxychlor	72-43-5	3.2	20	3,100,000	10,000,000	--	1,000,000	--	160,000	780,000	1,500	2,200	--	19.9	--	--	--	--
Toxaphene	8001-35-2	31	100	1,600	5,200	170,000	110,000	240,000	31,000	150,000	**2.1**	460	--	119	--	--	--	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Surface soil is defined as the upper 6 inches for human health PRGs and the upper 2 feet for ecological PRGs

(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) These values were obtained from the "Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7, Additional and Uncharacterized Sites Operable Unit (AUSOU)", April 2012. FWS may refine or develop additional PRGs.

(9) Standard listed is for Endosulfan CAS # 115-29-7, the sum of Endosulfan I, Endosulfan II, and Endosulfan Sulfate will be compared to this standard

(10) Standard listed is for Chlordane CAS # 57-74-9, the sum of the sum of alpha-, and gamma-chlordane or total chlordane will be compared to this standard

(11) Standard listed is for Endrin CAS # 72-20-8, the sum of the sum of Endrin, Endrin Aldehyde, and Endrin Ketone will be compared to this standard

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = An MDL has not been established for this compound. Laboratory will include in 8-point ICAL mix and report to the low standard.

NA = Not applicable

NOAEL = No observed adverse affect level

LOAEL = Lowest observed adverse affect level

QAPP Worksheet #15-4

Reference Limits and Evaluation (Pesticides – Subsurface Soil)[1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A																		
Aldrin	309-00-02	0.19	2	100	300	6,600	6,100	9,300	500	2,500	0.65	--	--	3.32	720	NA	NA	500
alpha-BHC	319-84-6	0.22	2	270	900	1,500	20,000	2,100	0.5	3	**0.036**	--	--	99.4	--	--	--	--
beta-BHC	319-85-7	1.6	2	960	--	--	--	--	--	--	**0.13**	--	--	3.98	--	--	--	--
delta-BHC	319-86-8	0.22	2	--	--	--	--	--	--	--	--	--	--	9,940	--	--	--	--
gamma-BHC (Lindane)	58-89-9	0.24	2	2,100	4,000	--	96,000	--	9	47	**0.21**	1.2	--	32	--	--	--	--
alpha-Chlordane[9]	5103-71-9	0.25	2	6,500[9]	16,000[9]	140,000[9]	100,000[9]	22,000[9]	10,000[9]	48,000[9]	13[9]	140[9]	--	224[9]	--	--	--	--
gamma-Chlordane[9]	5103-74-2	0.36	2	6,500[9]	16,000[9]	140,000[9]	100,000[9]	22,000[9]	10,000[9]	48,000[9]	13[9]	140[9]	--	224[9]	--	--	--	--
Chlordane (technical)[9]	57-74-9	4.4	40	6,500[9]	16,000[9]	140000[9]	100,000[9]	22,000[9]	10,000[9]	48,000[9]	13[9]	140[9]	--	224[9]	--	--	--	--
4,4'-DDD	72-54-8	0.64	4	7,200	24,000	--	520,000	--	16,000	80,000	6.4	--	21	758	--	--	--	--
4,4'-DDE	72-55-9	0.35	4	5,100	17,000	--	370,000	--	54,000	270,000	46	--	21	596	--	--	--	--
4,4'-DDT	50-29-3	0.44	4	7,000	17,000	1,500,000	100,000	2,100,000	32,000	160,000	67	--	21	3.5	14,000	NA	NA	32,000
Dieldrin	60-57-1	0.47	4	110	400	2,200	7,800	3,100	4	20	**0.061**	--	4.9	50,000	1,000	NA	NA	4
Endosulfan I [10]	959-98-8	0.36	2	3,700,000[10]	12,000,000 [10]		1,200,000 [10]		18,000[10]	90,000[10]	1,100[10]	--	--	119	--	--	--	--
Endosulfan II	33213-65-9	0.6	4	3,700,000[10]	12,000,000 [10]		1,200,000 [10]		18,000[10]	90,000[10]	1,100[10]	--	--	119	--	--	--	--
Endosulfan Sulfate	1031-07-8	1	4	3,700,000[10]	12,000,000 [10]		1,200,000 [10]		18,000[10]	90,000[10]	1,100[10]	--	--	35.8	--	--	--	--
Endrin [11]	72-20-8	0.39	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--	10.1	--	--	--	--
Endrin Aldehyde[11]	7421-93-4	0.69	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--	10.5	--	--	--	--
Endrin Ketone[11]	53494-70-5	0.56	4	180,000[11]	610,000[11]	--	61,000[11]	--	1,000[11]	5,000[11]	68[11]	81[11]	--		--	--	--	--
Heptachlor	76-44-8	0.22	2	380	1,000	11,000	28,000	16,000	23,000	110,000	**0.14**	33	--	5.98	--	--	--	--
Heptachlor Epoxide	1024-57-3	0.24	2	190	600	9,200	2,700	13,000	700	3,300	**0.068**	4.1	--	152	--	--	--	--
Hexachlorobenzene	118-74-1	0.47	2	1,100	4,000	1,800	78,000	2,600	2,000	11,000	0.53	13	--	1,000,000	47	NA	NA	2,000
Isodrin	465-73-6	NE	4	--	--	--	--	--	--	--	--	--	--	3.32	--	--	--	--
Methoxychlor	72-43-5	3.2	20	3,100,000	10,000,000	--	1,000,000	--	160,000	780,000	1,500	2,200	--	19.9	--	--	--	--
Toxaphene	8001-35-2	31	100	1,600	5,200	170,000	110,000	240,000	31,000	150,000	**2.1**	460	--	119	--	--	--	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Subsurface soil is defined below 6 inches for human health PRGs.

(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) These values were obtained from the "Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7, Additional and Uncharacterized Sites Operable Unit (AUSOU)", April 2012. FWS may refine or develop additional PRGs.

(9) The sum of alpha plus gamma Chlordane must be compared against the groundwater standards for Chlordane to show compliance.

(10) The sum of endosulfan 1 and 2 plus endosulfan sulfate must be added and compared to the standard for endosulfan to show compliance.

(11) The sum of endrin plus endrin aldehyde plus endrin ketone must be compared to the standard for endrin to show compliance.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = An MDL has not been established for this compound. Laboratory will include in 8-point ICAL mix and report to the low standard.

NA = Not applicable

NOAEL = No observed adverse affect level

LOAEL = Lowest observed adverse affect level

QAPP Worksheet #15-5

Reference Limits and Evaluation (Pesticides – Sediment)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[1][2] (µg/kg)	SOLID MATRIX RL[1][2] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[3] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[4][5] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[4][5] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[4][5] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[4][5] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[4][5] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[4][5] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[3] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[3] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SEDIMENT ESV (µg/kg)[6]	PRELIMINARY REMEDIATION GOALS (PRGs)[7]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[7]: ECOLOGICAL RISK-BASED PRG (µg/kg)
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A															
Aldrin	309-00-02	0.19	2	100	300	6,600	6,100	9,300	500	2,500	0.65	--	2	--	--
alpha-BHC	319-84-6	0.22	2	270	900	1,500	20,000	2,100	0.5	3	**0.036**	--	6	--	--
beta-BHC	319-85-7	1.6	2	960	--	--	--	--	--	--	**0.13**	--	5	--	--
delta-BHC	319-86-8	0.22	2	--	--	--	--	--	--	--	--	--	30	--	--
gamma-BHC (Lindane)	58-89-9	0.24	2	2,100	4,000	--	96,000	--	9	47	**0.21**	1.2	2.37	--	--
alpha-Chlordane[8]	5103-71-9	0.25	2	6,500[8]	16,000[8]	140,000[8]	100,000[8]	22,000[8]	10,000[8]	48,000[8]	13[8]	140[8]	5.2	--	--
gamma-Chlordane[8]	5103-74-2	0.36	2	6,500[8]	16,000[8]	140,000[8]	100,000[8]	22,000[8]	10,000[8]	48,000[8]	13[8]	140[8]	5.2	--	--
Chlordane (technical) [8]	57-74-9	4.4	40	6,500[8]	16,000[8]	140,000[8]	100,000[8]	22,000[8]	10,000[8]	48,000[8]	13[8]	140[8]	**3.24**	--	--
4,4'-DDD	72-54-8	0.64	4	7,200	24,000	--	520,000	--	16,000	80,000	6.4	--	4.88	--	--
4,4'-DDE	72-55-9	0.35	4	5,100	17,000	--	370,000	--	54,000	270,000	46	--	3.16	--	--
4,4'-DDT	50-29-3	0.44	4	7,000	17,000	1,500,000	100,000	2,100,000	32,000	160,000	67	--	4.16	--	--
Dieldrin	60-57-1	0.47	4	110	400	2,200	7,800	3,100	4	20	**0.061**	--	1.9	--	--
Endosulfan I[9]	959-98-8	0.36	2	3,700,000[9]	12,000,000 [9]		1,200,000 [9]		18,000[9]	90,000[9]	1,100[9]	--	2.9	--	--
Endosulfan II[9]	33213-65-9	0.6	4	3,700,000[9]	12,000,000 [9]		1,200,000 [9]		18,000[9]	90,000[9]	1,100[9]	--	14	--	--
Endosulfan Sulfate[9]	1031-07-8	1	4	3,700,000[9]	12,000,000 [9]		1,200,000 [9]		18,000[9]	90,000[9]	1,100[9]	--	**0.32**	--	--
Endrin[10]	72-20-8	0.39	4	180,000[10]	610,000[10]	--	61,000[10]	--	1,000[10]	5,000[10]	68[10]	81[10]	2.22	--	--
Endrin Aldehyde[10]	7421-93-4	0.69	4	180,000[10]	610,000[10]	--	61,000[10]	--	1,000[10]	5,000[10]	68[10]	81[10]	29	--	--
Endrin Ketone[10]	53494-70-5	0.56	4	180,000[10]	610,000[10]	--	61,000[10]	--	1,000[10]	5,000[10]	68[10]	81[10]	--	--	--
Heptachlor	76-44-8	0.22	2	380	1,000	11,000	28,000	16,000	23,000	110,000	**0.14**	33	10	--	--
Heptachlor Epoxide	1024-57-3	0.24	2	190	600	9,200	2,700	13,000	700	3,300	**0.068**	4.1	2.47	--	--
Hexachlorobenzene	118-74-1	0.47	2	1,100	4,000	1,800	78,000	2,600	2,000	11,000	0.53	13	100	--	--
Isodrin	465-73-6	NE	4	--	--	--	--	--	--	--	--	--	3.3	--	--
Methoxychlor	72-43-5	3.2	20	3,100,000	10,000,000	--	1,000,000	--	160,000	780,000	1,500	2,200	19	--	--
Toxaphene	8001-35-2	31	100	1,600	5,200	170,000	110,000	240,000	31,000	150,000	**2.1**	460	**28**	--	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(2) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(3) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(4) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(5) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(6) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(7) Preliminary Remediation Goals have not been established for sediment.

(8) The sum of alpha plus gamma Chlordane must be compared against the groundwater standards for Chlordane to show compliance.

(9) The sum of endosulfan 1 and 2 plus endosulfan sulfate must be added and compared to the standard for endosulfan to show compliance.

(10) The sum of endrin plus endrin aldehyde plus endrin ketone must be compared to the standard for endrin to show compliance.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = An MDL has not been established for this compound. Laboratory will include in 8-point ICAL mix and report to the low standard.

QAPP Worksheet #15-6

Reference Limits and Evaluation (Pesticides – Fish Tissue)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	TISSUE MDL[1][2] (µg/kg)	TISSUE RL[1][2] (µg/kg)	SCREENING LEVELS				PRELIMINARY REMEDIATION GOALS[6] (µg/kg)
				HUMAN HEALTH		ECOLOGICAL TISSUE ESV		
				CANCER RISK[3] (µg/kg)	NONCANCER RISK[3] (µg/kg)	SHEPHERD TSC[4] (µg/kg)	FISH TRVS[5] (µg/kg)	
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081B								
Aldrin	309-00-02	0.19	1	0.19	41	--	--	--
alpha-BHC	319-84-6	0.12	1	0.5	11,000	--	25,000	--
beta-BHC	319-85-7	0.53	1	1.8	--	--	6,130	--
delta-BHC	319-86-8	0.18	1	--	--	--	6,130	--
gamma-BHC (Lindane)	58-89-9	0.21	1	2.9	410	10	6,130	--
alpha-Chlordane [9]	5103-71-9	0.24	1	9[9]	680[9]	56[9]	600	--
gamma-Chlordane[9]	5103-74-2	0.2	1	9[9]	680[9]	56[9]	600	--
Chlordane (technical)[9]	57-74-9	3.1	10	9[9]	680[9]	56[9]	--	--
4,4'-DDD	72-54-8	0.41	1	13	--	56	120	--
4,4'-DDE	72-55-9	1	1	9.3	--	54	58	--
4,4'-DDT	50-29-3	1	1	9.3	680	54	760	--
Dieldrin	60-57-1	0.23	1	**0.2**	68	9	2,130	--
Endosulfan I[7]	959-98-8	0.28	1	--	8,100[7]	2.3[7]	--	--
Endosulfan II[7]	33213-65-9	0.3	1	--	8,100[7]	2.3[7]	--	--
Endosulfan Sulfate[7]	1031-07-8	0.25	1	--	8,100[7]	2.3[7]	195	--
Endrin [8]	72-20-8	0.21	1	--	410[8]	9.1[8]	230	--
Endrin Aldehyde [8]	7421-93-4	0.4	1	--	410[8]	9.1[8]	230	--
Endrin Ketone [8]	53494-70-5	0.34	1	--	410[8]	9.1[8]	230	--
Heptachlor	76-44-8	0.13	1	0.7	680	--	17,730	--
Heptachlor Epoxide	1024-57-3	0.28	1	0.35	18	--	17,730	--
Hexachlorobenzene	118-74-1	0.15	1	2	1,100	32	--	--
Isodrin	465-73-6	0.18	1	--	--	--	--	--
Methoxychlor	72-43-5	0.61	1	--	6,800	47	2500	--
Toxaphene	8001-35-2	9.3	50	**2.9**	--	**2.6**	200	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(2) MDL/RL values are from ALS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(3) USEPA Region 3 Fish Tissue Screening Levels, Table updated November 2012.

(4) Tissue Screening Concentrations are from Dryer et. al. (2000).

(5) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(6) PRGs have not been established for fish tissue.

(6) PRGs have not been established for fish tissue.

(7) The sum of endosulfan 1 and 2 plus endosulfan sulfate must be added and compared to the standard for endosulfan to show compliance.

(8) The sum of endrin, endrin aldehyde, and endrin ketone must be added and compared to the standard for endrin

(9) The sum of alpha chlordane and gamma chlordane, or total chlordane will be compared to the standard for Chlordane to show compliance

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

QAPP Worksheet #15-7

Reference Limits and Evaluation (Pesticides – Wipe Samples)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	WIPE MDL[(1)(2)] (µg)	WIPE RL[(1)(2)] (µg)	PRELIMINARY REMEDIATION GOAL (PRG)[(3)]
PESTICIDES – TARGET ANALYTE LIST (TAL) – SW-846 Method 8081A				
Aldrin	309-00-02	NE	0.025	--
alpha-BHC	319-84-6	NE	0.025	--
beta-BHC	319-85-7	NE	0.025	--
delta-BHC	319-86-8	NE	0.025	--
gamma-BHC (Lindane)	58-89-9	NE	0.025	--
alpha-Chlordane	5103-71-9	NE	0.025	--
gamma-Chlordane	5103-74-2	NE	0.025	--
Chlordane (technical)	57-74-9	NE	0.5	--
4,4'-DDD	72-54-8	NE	0.05	--
4,4'-DDE	72-55-9	NE	0.05	--
4,4'-DDT	50-29-3	NE	0.05	--
Dieldrin	60-57-1	NE	0.05	--
Endosulfan I	959-98-8	NE	0.025	--
Endosulfan II	33213-65-9	NE	0.05	--
Endosulfan Sulfate	1031-07-8	NE	0.05	--
Endrin	72-20-8	NE	0.05	--
Endrin Aldehyde	7421-93-4	NE	0.05	--
Endrin Ketone	53494-70-5	NE	0.05	--
Heptachlor	76-44-8	NE	0.025	--
Heptachlor Epoxide	1024-57-3	NE	0.025	--
Hexachlorobenzene	118-74-1	NE	0.01	--
Isodrin	465-73-6	NE	0.025	--
Methoxychlor	72-43-5	NE	0.25	--
Toxaphene	8001-35-2	NE	1.3	--

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(2) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(3) Preliminary Remediation Goals (PRGs) for wipe samples have not been established.

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

QAPP Worksheet #15-8

Reference Limits and Evaluation (Volatile Organic Compounds – Groundwater)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	AQUEOUS MDL[1][2] (µg/L)	AQUEOUS RL[1][2] (µg/L)	SCREENING LEVELS					PRELIMINARY REMEDIATION GOALS[9]	
				HUMAN HEALTH				ECOLOGICAL		
				IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS I GW (µg/L)[3][4]	IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS II GW (µg/L)[3][4]	FEDERAL MCL (µg/L)[5]	OSWER VAPOR INTRUSION (µg/L)[6]	GROUNDWATER ESV (µg/L)[7]	ILLINOIS PART 620 CLASS I GW (µg/L)[8]	ILLINOIS PART 620 CLASS II GW (µg/L)[8]
VOLATILE ORGANIC COMPOUNDS – TARGET ANALYTE LIST (TAL) – SW 846 Method 8260B										
1,1,1,2-Tetrachloroethane	630-20-06	0.11	0.5	210	1,050	--	16	--	--	--
1,1,1-Trichloroethane	71-55-6	0.1	0.5	200	1,000	200	31,000	--	200	1,000
1,1,2,2-Tetrachloroethane	79-34-5	0.099	0.5	4.3	4.3	--	14	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	0.13	0.5	210,000	1,050,000	--	6,100	--	--	--
1,1,2-Trichloroethane	79-00-5	0.1	0.5	5	50	5	23	--	5	25
1,1-Dichloroethane	75-34-3	0.12	0.5	700	3,500	--	33	--	1,400	7,000
1,1-Dichloroethene	75-35-4	0.14	0.5	7	35	7	820	--	7	35
1,2,3-Trichlorobenzene	87-61-6	0.045	2	5.6	28	--	--	--	--	--
1,2,3-Trichloropropane	96-18-4	0.15	1	1	1	--	94	--	--	--
1,2,4-Trichlorobenzene	120-82-1	0.077	2	70	700	70	150	--	70	700
1,2,4-Trimethylbenzene	95-63-6	0.06	0.5	--	--	--	120	--	--	--
1,2-Dibromo-3-chloropropane	96-12-8	0.25	0.5	**0.2**	2	**0.2**	0.34	--	**0.2**	2
1,2-Dibromoethane	106-93-4	0.13	0.5	**0.05**	0.5	**0.05**	0.77	--	**0.05**	0.5
1,2-Dichlorobenzene	95-50-1	0.076	0.5	600	1,500	600	11,000	--	600	1,500
1,2-Dichloroethane	107-06-2	0.078	0.5	5	25	5	9.8	--	5	25
1,2-Dichloropropane	78-87-5	0.1	0.5	5	25	5	11	--	5	25
1,3,5-Trimethylbenzene	108-67-8	0.075	0.5	70	350	--	--	--	--	--
1,3-Dichlorobenzene	541-73-1	0.096	0.5	--	--	--	--	--	--	--
1,3-Dichloropropene	542-75-6	0.11	0.5	1	5	--	21	--	--	--
1,4-Dichlorobenzene	106-46-7	0.07	0.5	75	375	75	11	--	75	375
2-Butanone	78-93-3	3	20	4,200	4,200	--	9400000	--	4,200	4,200
2-Hexanone	591-78-6	0.95	20	35	35	--	34,000	--	--	--
4-Methyl-2-pentanone	108-10-1	0.77	20	560	560	--	2,300,000	--	--	--
Acetone	67-64-1	3.4	20	6,300	6,300	--	95,000,000	--	6,300	6,300
Benzene	71-43-2	0.089	0.5	5	25	5	6.9	--	5	25
Bromobenzene	108-86-1	0.084	0.5	56	280	--	2,600	--	--	--
Bromodichloromethane	75-27-4	0.077	0.5	0.2	0.2	--	3.8	--	--	--
Bromoform	75-25-2	0.088	0.5	1	1	--	--	--	--	--
Bromomethane	74-83-9	0.59	5	9.8	49	--	73	--	--	--
Carbon disulfide	75-15-0	0.053	0.5	700	3,500	--	5,200	--	700	3,500
Carbon tetrachloride	56-23-5	0.038	0.5	5	25	5	1.8	--	5	25
Chlorobenzene	108-90-7	0.073	0.5	100	500	100	1,700	--	100	500
Chloroethane	75-00-3	0.25	5	--	--	--	97,000	--	--	--
Chloroform	67-66-3	0.062	0.5	0.2	1	--	3.6	--	70	350
Chloromethane	74-87-3	0.16	2	--	--	--	1,100	--	--	--
cis-1,2-Dichloroethene	156-59-2	0.11	0.5	70	200	70	--	--	70	200
cis-1,3-Dichloropropene	10061-01-5	0.061	0.5	1	5	--	21	--	--	--
Cyclohexane	110-82-7	NE	0.5	--	--	--	4,300	--	--	--
Dibromochloromethane	124-48-1	0.091	0.5	140	140	--	14	--	--	--
Dichlorodifluoromethane	75-71-8	0.11	0.5	1,400	7,000	--	31	--	1,400	7,000

QAPP Worksheet #15-8

Reference Limits and Evaluation (Volatile Organic Compounds – Groundwater)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	AQUEOUS MDL[1][2] (µg/L)	AQUEOUS RL[1][2] (µg/L)	SCREENING LEVELS					PRELIMINARY REMEDIATION GOALS[9]	
				HUMAN HEALTH				ECOLOGICAL		
				IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS I GW (µg/L)[3][4]	IEPA TACO TIER 1 OR NON-TACO OBJECTIVES CLASS II GW (µg/L)[3][4]	FEDERAL MCL (µg/L)[5]	OSWER VAPOR INTRUSION (µg/L)[6]	GROUNDWATER ESV (µg/L)[7]	ILLINOIS PART 620 CLASS I GW (µg/L)[8]	ILLINOIS PART 620 CLASS II GW (µg/L)[8]
Ethylbenzene	100-41-4	0.054	0.5	700	1,000	700	15	--	700	1,000
Isopropylbenzene	98-82-8	0.081	0.5	700	3,500	--	3,700	--	700	3,500
Methyl acetate	79-20-9	NE	0.5	7,000	7,000	--	--	--	--	--
Methyl tert-butyl ether	1634-04-4	0.14	0.5	70	70	--	2,000	--	70	70
Methylcyclohexane	108-87-2	NE	0.5	--	--	--	--	--	--	--
Methylene chloride	75-09-2	0.14	2	5	50	5	9,200	--	--	--
n-Butylbenzene	104-51-8	0.14	0.5	350	1,750	--	--	--	--	--
n-Propylbenzene	103-65-1	0.1	0.5	700	3,500	--	10,000	--	--	--
p-Isopropyltoluene	99-87-6	0.085	0.5	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	0.13	0.5	--	--	--	--	--	--	--
Styrene	100-42-5	0.065	0.5	100	500	100	39,000	--	100	500
tert-Butylbenzene	98-06-6	0.12	0.5	--	--	--	--	--	--	--
Tetrachloroethene	127-18-4	0.081	0.5	5	25	5	65	--	5	25
Toluene	108-88-3	0.053	0.5	1,000	2,500	1,000	81,000	--	1,000	2,500
trans-1,2-Dichloroethene	156-60-5	0.11	0.5	100	500	100	1,600	--	100	500
trans-1,3-Dichloropropene	10061-02-6	0.096	0.5	1	5	--	21	--	--	--
Trichloroethene	79-01-6	0.062	0.5	5	25	5	7.4	--	5	--
Trichlorofluoromethane	75-69-4	0.13	0.5	2,100	10,500	--	770	--	2,100	10,500
Vinyl chloride	75-01-4	0.16	0.5	2	10	2	2.5	--	2	10
Xylenes	1330-20-7	1	1.5	10,000	10,000	10,000	2,100	--	10,000	10,000

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(2) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(3) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table E (Tier 1 Groundwater Objectives), effective date February 23, 2007.

(4) Table of objectives for chemicals not contained in TACO Tier I Tables; Groundwater objectives established using methodologies presented in 35 IAC Part 620 Subpart F. Standards presented in IEPA Table accessed on 5/28/2013.

(5) National Primary Drinking Water Regulations, EPA 816-F-09-004 May 2009.

(6) Values from USEPA's Office of Solid Waste and Emergency Response (OSWER) Vapor Intrusion Screening Level (VISL) Calculator, Revision 3.0 (3/7/2013).

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) 35 IAC Part 620 Groundwater Quality, effective date October 5, 2012.

(9) PRGs for site groundwater are defined in the Work Plan as the water quality standards in IAC 35 Part 620. Site groundwater has not yet been classified. Therefore both Class I and Class II groundwater standards have been included as PRG values.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

MCL = Maximum Contaminant Level

ESV = Ecological Screening Value

QAPP Worksheet #15-9

Reference Limits and Evaluation (Volatile Organic Compounds – Surface Soil) [1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
VOLATILE ORGANIC COMPOUNDS – TARGET ANALYTE LIST (TAL) – SW-846 Method 8260B																		
1,1,1,2-Tetrachloroethane	630-20-06	2.4	25	9,300	61,000,000	--	18,000,000	--	3,400	17,000	**0.19**	--	--	225,000	--	--	--	--
1,1,1-Trichloroethane	71-55-6	3	25	38,000,000	--	1,200,000	--	1,200,000	2,000	9,600	2600	70	--	29,800	--	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	6.6	25	2,800	27,000	1,200	620,000	1,700	**3.5**	**3.5**	**0.026**	--	--	127	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	8.2	25	180,000,000	1,000,000,000	1,000,000	610,000,000	350,000	450,000	450,000	130000	--	--	--	--	--	--	--
1,1,2-Trichloroethane	79-00-5	6.6	25	5,300	8,200,000	1,800,000	8,200,000	1,800,000	20	300	**0.077**	**1.6**	--	28,600	--	--	--	--
1,1-Dichloroethane	75-34-3	3.8	25	17,000	200,000,000	1,700,000	200,000,000	130,000	23,000	110,000	**0.68**	-	--	20,100	--	--	--	--
1,1-Dichloroethene	75-35-4	3.1	25	1,100,000	100,000,000	470,000	10,000,000	3,000	60	300	93	**2.5**	--	8,280	--	--	--	--
1,2,3-Trichlorobenzene	87-61-6	4.7	100	490,000	1,600,000	--	1,600,000	--	460	2,300	15	--	--	10	--	--	--	--
1,2,3-Trichloropropane	96-18-4	5.2	50	95	190	5,000	4,100	320	**0.017**	**0.017**	**0.00028**	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	120-82-1	4.7	100	99,000	20,000,000	3,200,000	2,000,000	920,000	5,000	53,000	**2.9**	200	--	20,000	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	7.2	25	260,000	--	140,000	--	8,900	--	--	21	-	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	96-12-8	9.5	25	69	4,000	17,000	89,000	110	**2**	20	**0.00014**	**0.086**	--	35.2	--	--	--	--
1,2-Dibromoethane	106-93-4	4.1	25	170	2,900	120	62,000	160	**0.4**	**4**	**0.0018**	**0.014**	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	2.3	25	9,800,000	180,000,000	560,000	18,000,000	310,000	17,000	43,000	270	580	--	2,960	--	--	--	--
1,2-Dichloroethane	107-06-2	4.5	25	2,200	63,000	700	1,400,000	990	20	100	**0.042**	**1.4**	--	21,200	--	--	--	--
1,2-Dichloropropane	78-87-5	4	25	4,700	84,000	23,000	1,800,000	500	30	150	**0.13**	**1.7**	--	700,000	--	--	--	--
1,3,5-Trimethylbenzene	108-67-8	2.1	25	10,000,000	20,000,000	--	20,000,000	790	2,000	10,000	120	--	--	--	--	--	--	--
1,3-Dichlorobenzene	541-73-1	2.3	25	--	--	--	--	--	--	--	--	--	--	37,700	--	--	--	--
1,3-Dichloropropene	542-75-6	3.2	25	20,000,000	57,000	2,100	1,200,000	390	4	20	**0.15**	--	--	--	--	--	--	--
1,4-Dichlorobenzene	106-46-7	2	25	12,000	--	17,000,000	--	340,000	2,000	11,000	**0.4**	72	--	20,000	--	--	--	--
2-Butanone	78-93-3	110	1000	200,000,000	1,000,000,000	25,000,000	120,000,000	730,000	17,000	17,000	1000	--	--	89,600	--	--	--	--
2-Hexanone	591-78-6	77	1000	1,400,000	10,000,000	720,000	1,000,000	47,000	160	160	**7.9**	--	--	12,600	--	--	--	--
4-Methyl-2-pentanone	108-10-1	88	1000	53,000,000	160,000,000	3,100,000	160,000,000	340,000	2,500	2,500	230	--	--	443,000	--	--	--	--
Acetone	67-64-1	290	1000	630,000,000	--	100,000,000	--	100,000,000	25,000	25,000	2400	--	--	2,500	--	--	--	--
Benzene	71-43-2	2.5	25	5,400	100,000	1,600	2,300,000	2,200	30	170	**0.2**	2.6	--	16,000	--	--	--	--
Bromobenzene	108-86-1	2.6	25	1,800,000	16,000,000	810,000	4,100,000	22,000	860	4,300	36	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	1.4	25	1,400	92,000	3,000,000	2,000,000	3,000,000	600	600	**0.032**	22	--	540	--	--	--	--
Bromoform	75-25-2	4.2	25	220,000	720,000	100,000	16,000,000	140,000	800	800	**2.1**	21	--	15,900	--	--	--	--
Bromomethane	74-83-9	49	250	32,000	2,900,000	15,000	1,000,000	3,900	200	1,200	**1.8**	--	--	235	--	--	--	--
Carbon disulfide	75-15-0	1.9	25	3,700,000	200,000,000	720,000	20,000,000	9,000	32,000	160,000	210	--	--	94.1	--	--	--	--
Carbon tetrachloride	56-23-5	5.7	25	3,000	44,000	640	410,000	900	70	330	**0.15**	**1.9**	--	1,000,000	--	--	--	--
Chlorobenzene	108-90-7	2.2	25	1,400,000	41,000,000	210,000	4,100,000	1,300	1,000	6,500	49	68	--	40,000	--	--	--	--
Chloroethane	75-00-3	150	250	61,000,000	--	1,500,000	20,000,000	39,000	--	--	5900	--	--	--	--	--	--	--
Chloroform	67-66-3	2.6	25	1,500	940,000	540	2,000,000	760	600	2,900	**0.053**	22	--	1,190	--	--	--	--
Chloromethane	74-87-3	5.3	50	500,000	--	180,000	--	5,000	--	--	49	--	--	10,400	--	--	--	--
cis-1,2-Dichloroethene	156-59-2	3.4	25	2,000,000	20,000,000	1,200,000	20,000,000	1,200,000	400	1,100	8.2	21	--	784	--	--	--	--
cis-1,3-Dichloropropene	10061-01-5	3.4	25	--	--	--	--	--	--	--	--	--	--	398	--	--	--	--
Cyclohexane	110-82-7	NE	25	29,000,000	--	280,000	--	280,000	--	--	13000	--	--	--	--	--	--	--
Dibromochloromethane	124-48-1	2.4	25	3,300	41,000,000	1,300,000	41,000,000	1,300,000	400	400	**0.039**	21	--	2,050	--	--	--	--
Dichlorodifluoromethane	75-71-8	3.7	25	400,000	410,000,000	310,000	180,000,000	20,000	43,000	220,000	300	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	2	25	27,000	200,000,000	400,000	20,000,000	58,000	13,000	19,000	**1.5**	780	--	5,000	--	--	--	--
Isopropylbenzene	98-82-8	1.8	25	11,000,000	200,000,000	800,000	82,000,000	52,000	91,000	400,000	640	--	--	--	--	--	--	--
Methyl acetate	79-20-9	NE	25	1,000,000,000	1,000,000,000		1,000,000,000	9,200	28,000	28,000	3200	--	--	--	--	--	--	--
Methyl tert-butyl ether	1634-04-4	3.6	25	220,000	20,000,000	8,800,000	2,000,000	140,000	320	320	**2.8**	--	--	--	--	--	--	--

QAPP Worksheet #15-9

Reference Limits and Evaluation (Volatile Organic Compounds – Surface Soil) [1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
Methylcyclohexane	108-87-2	NE	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	2.5	100	960,000	760,000	24,000	12,000,000	34,000	20	200	2.5	**1.3**	--	4,050	--	--	--	--
n-Butylbenzene	104-51-8	4.7	25	51,000,000	100,000,000	--	20,000,000	--	52,000	87,000	2500	--	--	--	--	--	--	--
n-Propylbenzene	103-65-1	2.3	25	21,000,000	200,000,000	300,000	20,000,000	91,000	31,000	120,000	990	--	--	--	--	--	--	--
p-Isopropyltoluene	99-87-6	2.9	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	2.1	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	100-42-5	1.5	25	36,000,000	410,000,000	1,500,000	41,000,000	430,000	4,000	18,000	1200	110	--	300,000	--	--	--	--
tert-Butylbenzene	98-06-6	3.2	25	-	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	127-18-4	3.7	25	110,000	110,000	20,000	2,400,000	28,000	60	300	4.4	**2.3**	--	13,000	--	--	--	--
Toluene	108-88-3	1.7	25	45,000,000	410,000,000	650,000	410,000,000	42,000	12,000	29,000	590	690	--	3,000	--	--	--	--
trans-1,2-Dichloroethene	156-60-5	4.5	25	690,000	41,000,000	3,100,000	41,000,000	3,100,000	700	3,400	25	29	--	784	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	5.3	25	--	--	--	--	--	--	--	--	--	--	398	--	--	--	--
Trichloroethene	79-01-6	4	25	6,400	520,000	8,900	1,200,000	12,000	60	300	**0.16**	**1.8**	--	9,000	--	--	--	--
Trichlorofluoromethane	75-69-4	1.6	25	3,400,000	610,000,000	1,400,000	140,000,000	13,000	34,000	170,000	690	--	--	--	--	--	--	--
Vinyl chloride	75-01-4	7.6	25	1,700	7,900	1,100	170,000	1,100	10	70	**0.0053**	**0.69**	--	646	--	--	--	--
Xylenes	1330-20-7	75	75	2,700,000	410,000,000	320,000	41,000,000	5,600	150,000	150,000	190	9,800	--	600	--	--	--	--

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Surface soil is defined as the upper 6 inches for human health PRGs and the upper 2 feet for ecological PRGs

(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) FWS may refine or develop additional PRGs.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

NOAEL = No observed adverse affect level

LOAEL = Lowest observed adverse affect level

QAPP Worksheet #15-10

Reference Limits and Evaluation (Volatile Organic Compounds – Subsurface Soil) [1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
VOLATILE ORGANIC COMPOUNDS – TARGET ANALYTE LIST (TAL) – SW-846 Method 8260B																		
1,1,1,2-Tetrachloroethane	630-20-06	2.4	25	9,300	61,000,000	--	18,000,000	--	3,400	17,000	**0.19**	--	--	225,000	--	--	--	--
1,1,1-Trichloroethane	71-55-6	3	25	38,000,000	--	1,200,000	--	1,200,000	2,000	9,600	2600	70	--	29,800	--	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	6.6	25	2,800	27,000	1,200	620,000	1,700	**3.5**	**3.5**	**0.026**	--	--	127	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	8.2	25	180,000,000	1,000,000,000	1,000,000	610,000,000	350,000	450,000	450,000	130000	--	--	--	--	--	--	--
1,1,2-Trichloroethane	79-00-5	6.6	25	5,300	8,200,000	1,800,000	8,200,000	1,800,000	20	300	**0.077**	**1.6**	--	28,600	--	--	--	--
1,1-Dichloroethane	75-34-3	3.8	25	17,000	200,000,000	1,700,000	200,000,000	130,000	23,000	110,000	**0.68**	-	--	20,100	--	--	--	--
1,1-Dichloroethene	75-35-4	3.1	25	1,100,000	100,000,000	470,000	10,000,000	3,000	60	300	93	**2.5**	--	8,280	--	--	--	--
1,2,3-Trichlorobenzene	87-61-6	4.7	100	490,000	1,600,000	--	1,600,000	--	460	2,300	15	--	--	10	--	--	--	--
1,2,3-Trichloropropane	96-18-4	5.2	50	95	190	5,000	4,100	320	**0.017**	**0.017**	**0.00028**	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	120-82-1	4.7	100	99,000	20,000,000	3,200,000	2,000,000	920,000	5,000	53,000	**2.9**	200	--	20,000	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	7.2	25	260,000	--	140,000	--	8,900	--	--	21	-	--	--	140	NA	NA	1,800
1,2-Dibromo-3-chloropropane	96-12-8	9.5	25	69	4,000	17,000	89,000	110	**2**	20	**0.00014**	**0.086**	--	35.2	--	--	--	--
1,2-Dibromoethane	106-93-4	4.1	25	170	2,900	120	62,000	160	**0.4**	4	**0.0018**	**0.014**	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	2.3	25	9,800,000	180,000,000	560,000	18,000,000	310,000	17,000	43,000	270	580	--	2,960	--	--	--	--
1,2-Dichloroethane	107-06-2	4.5	25	2,200	63,000	700	1,400,000	990	20	100	**0.042**	**1.4**	--	21,200	--	--	--	--
1,2-Dichloropropane	78-87-5	4	25	4,700	84,000	23,000	1,800,000	500	30	150	**0.13**	**1.7**	--	700,000	35	NA	NA	30
1,3,5-Trimethylbenzene	108-67-8	2.1	25	10,000,000	20,000,000	--	20,000,000	790	2,000	10,000	120	--	--	--	150	NA	NA	NA
1,3-Dichlorobenzene	541-73-1	2.3	25	--	--	--	--	--	--	--	--	--	--	37,700	--	--	--	--
1,3-Dichloropropene	542-75-6	3.2	25	20,000,000	57,000	2,100	1,200,000	390	4	20	**0.15**	--	--	--	--	--	--	--
1,4-Dichlorobenzene	106-46-7	2	25	12,000	--	17,000,000	--	340,000	2,000	11,000	**0.4**	72	--	20,000	--	--	--	--
2-Butanone	78-93-3	110	1000	200,000,000	1,000,000,000	25,000,000	120,000,000	730,000	17,000	17,000	1000	--	--	89,600	--	--	--	--
2-Hexanone	591-78-6	77	1000	1,400,000	10,000,000	720,000	1,000,000	47,000	160	160	**7.9**	--	--	12,600	--	--	--	--
4-Methyl-2-pentanone	108-10-1	88	1000	53,000,000	160,000,000	3,100,000	160,000,000	340,000	2,500	2,500	230	--	--	443,000	--	--	--	--
Acetone	67-64-1	290	1000	630,000,000	--	100,000,000	--	100,000,000	25,000	25,000	2400	--	--	2,500	--	--	--	--
Benzene	71-43-2	2.5	25	5,400	100,000	1,600	2,300,000	2,200	30	170	**0.2**	2.6	--	16,000	--	--	--	--
Bromobenzene	108-86-1	2.6	25	1,800,000	16,000,000	810,000	4,100,000	22,000	860	4,300	36	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	1.4	25	1,400	92,000	3,000,000	2,000,000	3,000,000	600	600	**0.032**	22	--	540	--	--	--	--
Bromoform	75-25-2	4.2	25	220,000	720,000	100,000	16,000,000	140,000	800	800	**2.1**	21	--	15,900	--	--	--	--
Bromomethane	74-83-9	49	250	32,000	2,900,000	15,000	1,000,000	3,900	200	1,200	**1.8**	--	--	235	--	--	--	--
Carbon disulfide	75-15-0	1.9	25	3,700,000	200,000,000	720,000	20,000,000	9,000	32,000	160,000	210	--	--	94.1	--	--	--	--
Carbon tetrachloride	56-23-5	5.7	25	3,000	44,000	640	410,000	900	70	330	**0.15**	**1.9**	--	1,000,000	--	--	--	--
Chlorobenzene	108-90-7	2.2	25	1,400,000	41,000,000	210,000	4,100,000	1,300	1,000	6,500	49	68	--	40,000	--	--	--	--
Chloroethane	75-00-3	150	250	61,000,000	--	1,500,000	20,000,000	39,000	--	--	5900	--	--	--	--	--	--	--
Chloroform	67-66-3	2.6	25	1,500	940,000	540	2,000,000	760	600	2,900	**0.053**	22	--	1,190	--	--	--	--
Chloromethane	74-87-3	5.3	50	500,000	--	180,000	--	5,000	--	--	49	--	--	10,400	--	--	--	--
cis-1,2-Dichloroethene	156-59-2	3.4	25	2,000,000	20,000,000	1,200,000	20,000,000	1,200,000	400	1,100	8.2	21	--	784	--	--	--	--
cis-1,3-Dichloropropene	10061-01-5	3.4	25	--	--	--	--	--	--	--	--	--	--	398	--	--	--	--
Cyclohexane	110-82-7	NE	25	29,000,000	--	280,000	--	280,000	--	--	13000	--	--	--	--	--	--	--
Dibromochloromethane	124-48-1	2.4	25	3,300	41,000,000	1,300,000	41,000,000	1,300,000	400	400	**0.039**	21	--	2,050	--	--	--	--
Dichlorodifluoromethane	75-71-8	3.7	25	400,000	410,000,000	310,000	180,000,000	20,000	43,000	220,000	300	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	2	25	27,000	200,000,000	400,000	20,000,000	58,000	13,000	19,000	**1.5**	780	--	5,000	24,000	NA	NA	13,000
Isopropylbenzene	98-82-8	1.8	25	11,000,000	200,000,000	800,000	82,000,000	52,000	91,000	400,000	640	--	--	--	--	--	--	--
Methyl acetate	79-20-9	NE	25	1,000,000,000	1,000,000,000		1,000,000,000	9,200	28,000	28,000	3200	--	--	--	--	--	--	--

QAPP Worksheet #15-10

Reference Limits and Evaluation (Volatile Organic Compounds – Subsurface Soil) [1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{NOAEL} (µg/kg)	LOWEST SOIL ECOLOGICAL RISK-BASED PRG_{LOAEL} (µg/kg)	IEPA TACO TIER I MIGRATION TO GW (CLASS I) (µg/kg)
Methyl tert-butyl ether	1634-04-4	3.6	25	220,000	20,000,000	8,800,000	2,000,000	140,000	320	320	**2.8**	--	--	--	--	--	--	--
Methylcyclohexane	108-87-2	NE	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	2.5	100	960,000	760,000	24,000	12,000,000	34,000	20	200	2.5	**1.3**	--	4,050	--	--	--	--
n-Butylbenzene	104-51-8	4.7	25	51,000,000	100,000,000	--	20,000,000	--	52,000	87,000	2500	--	--	--	--	--	--	--
n-Propylbenzene	103-65-1	2.3	25	21,000,000	200,000,000	300,000	20,000,000	91,000	31,000	120,000	990	--	--	--	--	--	--	--
p-Isopropyltoluene	99-87-6	2.9	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	135-98-8	2.1	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	100-42-5	1.5	25	36,000,000	410,000,000	1,500,000	41,000,000	430,000	4,000	18,000	1200	110	--	300,000	--	--	--	--
tert-Butylbenzene	98-06-6	3.2	25	-	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	127-18-4	3.7	25	110,000	110,000	20,000	2,400,000	28,000	60	300	4.4	**2.3**	--	13,000	--	--	--	--
Toluene	108-88-3	1.7	25	45,000,000	410,000,000	650,000	410,000,000	42,000	12,000	29,000	590	690	--	3,000	--	--	--	--
trans-1,2-Dichloroethene	156-60-5	4.5	25	690,000	41,000,000	3,100,000	41,000,000	3,100,000	700	3,400	25	29	--	784	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	5.3	25	--	--	--	--	--	--	--	--	--	--	398	--	--	--	--
Trichloroethene	79-01-6	4	25	6,400	520,000	8,900	1,200,000	12,000	60	300	**0.16**	**1.8**	--	9,000	--	--	--	--
Trichlorofluoromethane	75-69-4	1.6	25	3,400,000	610,000,000	1,400,000	140,000,000	13,000	34,000	170,000	690	--	--	--	--	--	--	--
Vinyl chloride	75-01-4	7.6	25	1,700	7,900	1,100	170,000	1,100	10	70	**0.0053**	**0.69**	--	646	--	--	--	--
Xylenes	1330-20-7	75	75	2,700,000	410,000,000	320,000	41,000,000	5,600	150,000	150,000	190	9,800	--	600	3,800	NA	NA	150,000

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Subsurface soil is defined below 6 inches for human health PRGs.

(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) PRGs are based on the draft HHRA, draft BERA, and Illinois TACO. Illinois TACO values are updated to reflect the most current values. FWS may refine or develop additional PRGs.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

NA = Not applicable

NOAEL = No observed adverse affect level

LOAEL = Lowest observed adverse affect level

QAPP Worksheet #15-11

Reference Limits and Evaluation (Polycyclic Aromatic Hydrocarbons – Surface Soil)[1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	ECOLOGICAL RISK-BASED PRG (µg/kg)
POLYCYCLIC AROMATIC HYDROCARBONS – TARGET ANALYTE LIST (TAL) – SW-846 Method 8270D																
Acenaphthene	83-32-9	1.8	10	33,000,000	120,000,000	--	120,000,000	--	570,000	2,900,000	4,100	--	100,000	29,000	PAH TEQ[9] = 240 µg/kg	--
Acenaphthylene	208-96-8	1.6	10	--	61,000,000	--	61,000,000	--	85,000	420,000	--	--	100,000	29,000		
Anthracene	120-12-7	5.8	10	170,000,000	610,000,000	--	610,000,000	--	12,000,000	59,000,000	42,000	--	100,000	29,000		
Benzo(a)anthracene	56-55-3	2.8	10	2,100	8,000	--	170,000	--	2,000	8,000	10	--	1,100	18,000		
Benzo(a)pyrene	50-32-8	3.7	10	210	800	--	17,000	--	8,000	82,000	**3.5**	240	1,100	18,000		
Benzo(e)pyrene	192-97-2	NE	10	--	--	--	--	--	--	--	--	--	--	--		
Benzo(b)fluoranthene	205-99-2	2.4	10	2,100	8,000	--	170,000	--	5,000	25,000	35	--	1,100	18,000		
Benzo(k)fluoranthene	207-08-9	3.4	10	21,000	78,000	--	1,700,000	--	49,000	250,000	350	--	1,100	18,000		
Benzo(j)fluoranthene	205-82-3	NE	10	1,300	--	--	--	--	--	--	67	--	--	--		
Benzo(g,h,i)perylene	191-24-2	1.2	10	--	61,000,000	--	61,000,000	--	27,000,000	130,000,000	--	--	1,100	18,000		
Chrysene	218-01-9	1	10	210,000	780,000	--	17,000,000	--	160,000	800,000	1,100	--	1,100	18,000		
Dibenz(a,h)anthracene	53-70-3	3.7	10	210	800	--	17,000	--	2,000	7,600	11	--	1,100	18,000		
Fluoranthene	206-44-0	2	10	22,000,000	82,000,000	--	82,000,000	--	4,300,000	21,000,000	70,000	--	100,000	29,000		
Fluorene	86-73-7	2	10	22,000,000	82,000,000	--	82,000,000	--	560,000	2,800,000	4,000	--	100,000	29,000		
Indeno(1,2,3-cd)pyrene	193-39-5	5.7	10	2,100	8,000	--	170,000	--	14,000	69,000	200	--	1,100	18,000		
1-Methylnaphthalene	90-12-0	2.8	10	53,000	140,000,000	--	14,000,000	--	130,000	330,000	5.1	--	100,000	29,000		
2-Methylnaphthalene	91-57-6	2.6	10	2,200,000	8,200,000	--	820,000	--	1,900	9,500	140	--	100,000	29,000		
Naphthalene	91-20-3	2.2	10	18,000	41,000,000	270,000	4,100,000	1,800	12,000	18,000	**0.47**	--	100,000	29,000		
Phenanthrene	85-01-8	1.7	10	--	61,000,000	--	61,000,000	--	210,000	1,100,000	--	--	100,000	29,000		
Pyrene	129-00-0	2.4	10	17,000,000	61,000,000	--	61,000,000	--	4,200,000	21,000,000	9,500	--	1,100	18,000		

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Surface soil is defined as the upper 6 inches for human health PRGs and the upper 2 feet for ecological PRGs.
(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.
(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.
(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.
(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.
(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.
(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.
(8) These values were obtained from the "Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7, Additional and Uncharacterized Sites Operable Unit (AUSOU)", April 2012. FWS may refine or develop additional PRGs.
(9) PAH Toxicity Equivalency Quotient for carcinogenic polycyclic aromatic hydrocarbons calculated in accordance with EPA Region 4, as requested by EPA Region 5 for the AUS OU.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.
-- No standard established.
NE = MDL has not been established for this compound.

QAPP Worksheet #15-12

Reference Limits and Evaluation (Polycyclic Aromatic Hydrocarbons – Subsurface Soil)[1]

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	SOLID MATRIX MDL[2][3] (µg/kg)	SOLID MATRIX RL[2][3] (µg/kg)	SCREENING LEVELS – HUMAN HEALTH: USEPA RSL INDUSTRIAL SOIL[4] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - INDUSTRIAL/ COMMERCIAL INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INGESTION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - CONST. WORKER INHALATION[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS I)[5][6] (µg/kg)	IEPA TACO TIER I/ NON-TACO - MIGRATION TO GW (CLASS II)[5][6] (µg/kg)	USEPA SSL MIGRATION TO GW (RISK)[4] (µg/kg)	USEPA SSL MIGRATION TO GW (MCL)[4] (µg/kg)	SCREENING LEVELS – ECOLOGICAL: SOIL ESV - INGESTION[7] (µg/kg)	SOIL ESV - DIRECT CONTACT[7] (µg/kg)	PRELIMINARY REMEDIATION GOALS (PRGs)[8]: HUMAN HEALTH RISK-BASED PRG (µg/kg)	ECOLOGICAL RISK-BASED PRG (µg/kg)
POLYCYCLIC AROMATIC HYDROCARBONS – TARGET ANALYTE LIST (TAL) – SW-846 Method 8270D																
Acenaphthene	83-32-9	1.8	10	33,000,000	120,000,000	--	120,000,000	--	570,000	2,900,000	4,100	--	100,000	29,000	--	--
Acenaphthylene	208-96-8	1.6	10	--	61,000,000	--	61,000,000	--	85,000	420,000	--	--	100,000	29,000		
Anthracene	120-12-7	5.8	10	170,000,000	610,000,000	--	610,000,000	--	12,000,000	59,000,000	42,000	--	100,000	29,000		
Benzo(a)anthracene	56-55-3	2.8	10	2,100	8,000	--	170,000	--	2,000	8,000	10	--	1,100	18,000		
Benzo(a)pyrene	50-32-8	3.7	10	210	800	--	17,000	--	8,000	82,000	**3.5**	240	1,100	18,000		
Benzo(e)pyrene	192-97-2	NE	10	--	--	--	--	--	--	--	--	--	--	--		
Benzo(b)fluoranthene	205-99-2	2.4	10	2,100	8,000	--	170,000	--	5,000	25,000	35	--	1,100	18,000		
Benzo(k)fluoranthene	207-08-9	3.4	10	21,000	78,000	--	1,700,000	--	49,000	250,000	350	--	1,100	18,000		
Benzo(j)fluoranthene	205-82-3	NE	10	1,300	--	--	--	--	--	--	67	--	--	--		
Benzo(g,h,i)perylene	191-24-2	1.2	10	--	61,000,000	--	61,000,000	--	27,000,000	130,000,000	--	--	1,100	18,000		
Chrysene	218-01-9	1	10	210,000	780,000	--	17,000,000	--	160,000	800,000	1,100	--	1,100	18,000		
Dibenz(a,h)anthracene	53-70-3	3.7	10	210	800	--	17,000	--	2,000	7,600	11	--	1,100	18,000		
Fluoranthene	206-44-0	2	10	22,000,000	82,000,000	--	82,000,000	--	4,300,000	21,000,000	70,000	--	100,000	29,000		
Fluorene	86-73-7	2	10	22,000,000	82,000,000	--	82,000,000	--	560,000	2,800,000	4,000	--	100,000	29,000		
Indeno(1,2,3-cd)pyrene	193-39-5	5.7	10	2,100	8,000	--	170,000	--	14,000	69,000	200	--	1,100	18,000		
1-Methylnaphthalene	90-12-0	2.8	10	53,000	140,000,000	--	14,000,000	--	130,000	330,000	5.1	--	100,000	29,000		
2-Methylnaphthalene	91-57-6	2.6	10	2,200,000	8,200,000	--	820,000	--	1,900	9,500	140	--	100,000	29,000		
Naphthalene	91-20-3	2.2	10	18,000	41,000,000	270,000	4,100,000	1,800	12,000	18,000	**0.47**	--	100,000	29,000		
Phenanthrene	85-01-8	1.7	10	--	61,000,000	--	61,000,000	--	210,000	1,100,000	--	--	100,000	29,000		
Pyrene	129-00-0	2.4	10	17,000,000	61,000,000	--	61,000,000	--	4,200,000	21,000,000	9,500	--	1,100	18,000		

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Footnotes:

(1) Subsurface soil is defined below 6 inches for human health PRGs.

(2) Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

(3) MDL/RL values are from ECCS. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

(4) USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, Table updated November 2012.

(5) 35 Illinois Administrative Code (IAC) Part 742 Tiered Approach to Corrective Action Objectives (TACO), Appendix B Table B (Tier 1 Soil Objectives), effective date February 23, 2007.

(6) Table of objectives for chemicals not contained in TACO Tier I Tables; Soil objectives calculated using risk-based SSLs, default parameters, and calculations from TACO. Standards presented in IEPA Table accessed on 5/28/2013.

(7) Selection of Ecological Screening Values, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge, Appendix A of the Baseline Ecological Risk Assessment (BERA), Revised May 2011.

(8) These values were obtained from the "Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7, Additional and Uncharacterized Sites Operable Unit (AUSOU)", April 2012. FWS may refine or develop additional PRGs.

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NE = MDL has not been established for this compound.

QAPP Worksheet #15-13

Reference Limits and Evaluation (Total Organic Carbon – Sediment)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	LABORATORY METHOD	SOLID MATRIX MDL[(1)(2)] (mg/kg)	SOLID MATRIX RL[(1)(2)] (mg/kg)	HUMAN HEALTH SCREENING LEVEL[(3)] (mg/kg)	ECOLOGICAL SCREENING LEVEL[(3)] (mg/kg)	PRELIMINARY REMEDIATION GOAL[(3)] (mg/kg)
Total Organic Carbon	NA	Walkley-Black	183.79	400	NA	NA	NA

Footnotes:

[(1)] Analyte concentrations will be reported down to the Reporting Limit (RL). In the event that a Preliminary Remediation Goal (PRG) is lower than the RL, detected concentrations between the laboratory Method Detection Limit (MDL) and the RL will be reported and flagged as an estimated concentration.

[(2)] MDL/RL values are from Pace. Limits are periodically updated by the laboratory. The current limits at the time of sample analysis will be used.

[(3)] Screening Levels and PRGs are not applicable to Total Organic Carbon.

Created by: MLW/OF, 6/2013
Checked by: NK/TMO, 6/2013

Notes:

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

-- No standard established.

NA = Not applicable.

QAPP Worksheet #15-14

Reference Limits and Evaluation (Lipids – Fish Tissue)

PARAMETER	CHEMICAL ABSTRACT SERVICE NUMBER	LABORATORY METHOD	TISSUE MDL (µg/kg)	TISSUE RL (µg/kg)	HUMAN HEALTH SCREENING LEVEL (mg/kg)	ECOLOGICAL SCREENING LEVEL (mg/kg)	PRELIMINARY REMEDIATION GOAL (mg/kg)
Lipids	NA	NA	NA	NA	NA	NA	NA

Notes:

NA = Not applicable.

BOLD = Bolded values indicate that the screening level (or preliminary remediation goal) is below the Method Detection Limit.

Created by: MLW/OF, 6/2013

Checked by: NK/TMO, 6/2013

QAPP Worksheet #16-1
Project Schedule/Timeline

ACTIVITIES	ORGANIZATION	DATES (MM/DD/YY)[1][2]		DELIVERABLE	DELIVERABLE DUE DATE[1][2]
		ANTICIPATED DATE(S) OF INITIATION	ANTICIPATED DATE OF COMPLETION		
Phase I Fieldwork	GLS	August 2014[3]	September 2014	Data transmittal to FWS Field notes to FWS	November 2014 (Within 60 days of completion of field activities)[4]
Risk Assessment	FWS	November 2014	April 2015	Final Risk Assessment	April 2015
Phase 2 Fieldwork	GLS	September 2015	October 2015	Data transmittal to FWS Field notes to FWS	December 2015
EE/CA	GLS	October 2015	January 2016 (Draft) March 2016 (Final)	EE/CA Report to FWS	March 2016

Footnotes:

(1) See Attachment 5 for detailed project schedule.

(2) Dates subject to change based on time for document review and revisions and field conditions for on-site activities.

(3) Land based portions of the Phase I fieldwork may be completed prior to August 2014, based on site conditions and contractor availability.

(4) Fish tissue data will be submitted within 21 days from receipt of final data from laboratory or within 60 days of completion of field activities, whichever is greater.

QAPP Worksheet #17-1
Sampling Design and Rationale
(EE/CA – Phase I Investigation)

Describe and provide a rationale for choosing the sampling approach (*e.g.*, grid system, biased statistical approach):

The sampling program rationale is described in detail in the "Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge NPL Site" – April 2012 (FWS, 2012)

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

The sampling program is described in detail in the FSP (TRC, 2014). Analytical sample matrices include solid (soil/sediment), aqueous (surface water/groundwater), fish tissue, and wipe samples. Phase I of the EE/CA investigation is to provide the data to characterize the nature and extent of contamination including contaminant fate and transport at the Site and to refine the baseline risk assessment (human health and ecological risks). Analytes include pesticides (all matrices); VOCs (groundwater only); TOC (sediment only); and lipids (fish tissue only). The analytical program for each of the monitoring tasks is summarized in Attachment 1 of this QAPP; QC sample requirements are summarized in Worksheet 20.

QAPP Worksheet #18-1
Sampling Locations and Methods/SOP Requirements
(EE/CA – Phase I Investigation)

SAMPLING LOCATION/ID NUMBER	MATRIX	ANALYTICAL GROUP[1]	CONCENTRATION LEVEL	NUMBER OF SAMPLES[2] (identify field duplicates)	SAMPLING SOP REFERENCE[3]	RATIONALE FOR SAMPLING LOCATIONS
Surface Water Samples: A through Z	Aqueous (Surface Water)	Pesticides TAL	Low, Medium, and High	One grab sample per location, collected from approximately 6 inches above the sediment/surface water interface, or midpoint of the water column when less than one-foot of water is present	SOP-0025 003	Sample locations chosen to complete contaminant characterization, provide data for refinement of baseline risk assessments, assess potential contributions for drainage and provide sufficient data for statistical evaluation. See Field Sampling Plan (FSP) Sections 2.3.1 and 2.3.2 for details.
Sediment Samples: A through Z	Solid (Sediment)	Pesticides TAL (all intervals); Total Organic Carbon, (top 6-inches only)	Low, Medium, and High	Locations A through U: One core sample per location; total sampling depth to base of sediment; sample 0.0-0.5 ft; 0.5-1.0 ft; then at 1 ft intervals to base of core Locations V through Z: One sample per location, 0.0 to 0.5-foot interval only	SOP-0025 002	Sample locations chosen to complete contaminant characterization, provide data for refinement of baseline risk assessments, assess potential contributions for drainage and provide sufficient data for statistical evaluation. See Field Sampling Plan (FSP) Sections 2.3.1 and 2.3.2 for details.

QAPP Worksheet #18-1
Sampling Locations and Methods/SOP Requirements
(EE/CA – Phase I Investigation)

SAMPLING LOCATION/ID NUMBER	MATRIX	ANALYTICAL GROUP[1]	CONCENTRATION LEVEL	NUMBER OF SAMPLES[2] (identify field duplicates)	SAMPLING SOP REFERENCE[3]	RATIONALE FOR SAMPLING LOCATIONS

QAPP Worksheet #18-1 (continued)
Sampling Locations and Methods/SOP Requirements
(EE/CA – Phase I Investigation)

SAMPLING LOCATION/ID NUMBER	MATRIX	ANALYTICAL GROUP[1]	CONCENTRATION LEVEL	NUMBER OF SAMPLES[2] (identify field duplicates)	SAMPLING SOP REFERENCE[3]	RATIONALE FOR SAMPLING LOCATIONS
Fish Tissue Samples: (TBD)	Tissue	Pesticides TAL; Lipids	Low, Medium, and High	(8) samples of each of (2) species of game fish from inside the embayment (8) samples of each of (2) species of game fish from the Lake near the embayment (8) samples of each of (2) forage fish species from inside the embayment (8) samples of each of (2) forage fish species from the Lake near the embayment	SOP-10	Sample locations chosen for contaminant characterization and to provide data to refine baseline risk assessments.
		Necropsy; histopathology (TBD by FWS)	Not Applicable	(8) samples of each of (2) species of game fish from inside the embayment (8) samples of each of (2) species of game fish from the Lake near the embayment (1) sample of each of (2) forage fish species from inside the embayment	SOP-10	Sample locations chosen to provide adequate data for contaminant characterization and to provide data to refine baseline risk assessments.

QAPP Worksheet #18-1
Sampling Locations and Methods/SOP Requirements
(EE/CA – Phase I Investigation)

SAMPLING LOCATION/ID NUMBER	MATRIX	ANALYTICAL GROUP[1]	CONCENTRATION LEVEL	NUMBER OF SAMPLES[2] (identify field duplicates)	SAMPLING SOP REFERENCE[3]	RATIONALE FOR SAMPLING LOCATIONS
Groundwater Samples: W01, W02, W03, W15, W17, W21, W22, W23	Aqueous (ground-water)	Pesticides TAL; VOCs TAL Static water level	Low, Medium, and High	One grab sample per location	SOP-07	Sample locations chosen for contaminant characterization, fate and transport, and current groundwater conditions. Includes an assessment of exceedences of regulatory standards (i.e., Illinois Groundwater Standards and Federal Maximum Contaminant Levels).
Building Interior Wipe Samples: Building IN-1-3	Wipe	Pesticides TAL	Low, Medium, and High	(2) wipe samples from the building floor (3) wipe samples from the steel building walls (3) wipe samples from the wooden building frame	ECCS-01	Sample locations chosen for contaminant characterization and to provide data to assess the building's suitability for use.

Footnotes:
(1) The Target Analyte List (TAL) for each parameter group is included in Worksheets 15-1 through 15-14.
(2) This column indicates the number of primary samples collected. Field duplicates will be collected at a frequency as specified in QAPP Worksheet #20. The duplicate sample frequency will be based on the total number of samples of a given matrix collected during the sampling period.
(3) See project Sampling SOP References table (Worksheet #21).

QAPP Worksheet #19
Analytical SOP Requirements

MATRIX	ANALYTICAL GROUP	CONCENTRATION LEVEL	ANALYTICAL AND PREPARATION METHOD/SOP REFERENCE[1]	SAMPLE VOLUME[2]	CONTAINERS (number, size, and type)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
Water	Pesticides (TAL)	Low, Medium, and High	▪ ECCS-LAM-003 ▪ ECCS-PRE-002	1-L	(2) 1-L amber bottle	4° ± 2°C, amber jar	7 days/40 days
Soil/Sediment	Pesticides (TAL)	Low, Medium, and High	▪ ECCS-LAM-003 ▪ ECCS-PRE-003	5 g	4-oz amber jar	4° ± 2°C, amber jar	14 days/40 days
Fish Tissue	Pesticides (TAL)	Low, Medium, and High	▪ ALS-MET-TISP ▪ ALS-EXT-3541 ▪ ALS-SOC-8081	20 g	Whole fish wrapped in extra heavy duty aluminum foil in sealable plastic bag	4° ± 2°C	14 days to extraction 40 days to analysis
Wipes	Pesticides (TAL)	Low, Medium, and High	▪ ECCS-LAM-003 ▪ ECCS-PRE-007	1 wipe	4-oz amber jar	4° ± 2°C, amber jar	14 days/40 days
Water	VOC (TAL)	Low, Medium, and High	▪ LAM-004	10 mL	(2) 40-mL vials	HCl (pH <2 SU), 4° ± 2°C	14 days
Soil/Sediment	VOC (TAL)	Low, Medium, and High	▪ LAM-004	10 g	Lock-n-Load™ glass vials and 4-oz plastic jar	10 mLs of methanol, 4° ± 2°C Unpreserved	14 days
Soil/Sediment	PAH (TAL)	Low, Medium, and High	▪ ECCS-LAM-030 ▪ ECCS-PRE-003	5 g	4-oz amber jar	4° ± 2°C, amber jar	14 days/40 days
Soil/Sediment	TOC	Low, Medium, and High	▪ PACE-01	0.05 g	4-oz amber jar	4° ± 2°C, amber jar	28 days
Fish Tissue	Lipids	Low, Medium, and High	▪ ALS-MET-TISP ▪ ALS-EXT-LIPID	20 g	Whole fish wrapped in extra heavy duty aluminum foil in sealable plastic bag	4° ± 2°C	1 year

QAPP Worksheet #20
Field Quality Control Sample Summary

MATRIX	ANALYTICAL GROUP	CONCENTRATION LEVEL	ANALYTICAL AND PREPARATION SOP REFERENCE(1)	NUMBER OF SAMPLING LOCATIONS(2)	NUMBER OF FIELD DUPLICATE PAIRS(3)(4)	MATRIX SPIKES(3)(4)	NUMBER OF EQUIPMENT BLANKS(3)(4)	TOTAL NUMBER OF SAMPLES TO LABORATORY(2)
Solid (soil/sediment)	Pesticides (TAL)	All	ECCS-PRE-002 ECCS-LAM-003	26 locations; 5 estimated samples per location (110 samples)	1/10 (11 duplicates)	1/20 (6 MS/MSD)	1/10 (none)	127
Solid (soil/sediment)	TOC	All	PACE-01	26 locations; one sample per location	1/10 (3 duplicates)	1/20 (2 MS/MSD)	1/10 (none)	31
Surface Water	Pesticides (TAL)	All	ECCS-PRE-002 ECCS-LAM-003	26 locations	1/10 (3 duplicates)	1/20 (2 MS/MSD)	1/10 (none)	31
Fish Tissue	Pesticides (TAL)	All	ALS-MET-TISP ALS-EXT-3541 ALS-SOC-8081	Locations TBD (64 samples)	None	1/20 (3 MS/MSD)	1/20	67
Fish Tissue	Lipids	All	ALS-MET-TISP ALS-EXT-LIPID	Locations TBD (64 samples)	None	None	None	67
Fish Tissue	Necropsy and histo-pathology	All	SOP-10(5)	Locations TBD (34 samples)	None	NA	NA	34
Groundwater	Pesticides (TAL)	All	ECCS-PRE-002 ECCS-LAM-003	8 locations	1/10 (1 duplicate)	1/20 (1 MS/MSD)	1/10 (1 blank)	11
Groundwater	VOCs (TAL)	All	ECCS-LAM-004	8 locations	1/10 (1 duplicate)	1/20 (1 MS/MSD)	1/10 (1 blank)	11
Wipe Samples	Pesticides (TAL)	All	ECCS-PRE-007 ECCS-LAM-003	8 locations	None	None	1/20 (1 blank)	9

Footnotes:
(1) See Analytical SOP Reference Table (Worksheet #23).
(2) Number of samples is estimated. Actual number of samples will be determined in the field. See project specific Field Sampling Plan for planned numbers of samples (TRC, 2014).
(3) Equipment blanks will be collected at the specified frequency only when non-disposable and non-dedicated sampling equipment is used.
(4) "1/10" means one QC sample collected for every 10 (or fewer) primary samples; "1/20" means one QC sample collected for every 20 (or fewer) samples.
(5) SOP-10 is included in the FSP (TRC, 2014), Attachment 1.

QAPP Worksheet #21
Project Sampling SOP Reference

REFERENCE NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	ORIGINATING ORGANIZATION	EQUIPMENT TYPE	MODIFIED FOR PROJECT WORK? (Y/N)	COMMENTS
SOP-01	SOP 1: Decontamination of Drilling Rigs and Equipment, Crab Orchard National Wildlife Refuge; April 2012	FWS	Heated pressure washer; buckets; brushes; trash pumps; storage tanks and drums; decontamination fluids	N	
SOP-02	SOP 2: Decontamination of Field Equipment, Crab Orchard National Wildlife Refuge; April 2012	FWS	Buckets; brushes; storage tanks and drums; decontamination fluids	N	
SOP-03	SOP 3: Borehole Installation and Sampling (Overburden), Crab Orchard National Wildlife Refuge; April 2012	FWS	Photoionization detector (PID); compositing supplies (as appropriate); appropriate sample containers	N	
SOP-04	SOP 4: Surface Soil Sampling, Crab Orchard National Wildlife Refuge; April 2012	FWS	Photoionization detector (PID); compositing supplies (as appropriate); appropriate sample containers	N	
SOP-05	SOP-5: Overburden Monitoring Well Construction and Development, Crab Orchard National Wildlife Refuge; April 2012	FWS	Well construction materials; portable electrical supply; well development pumps; water quality meters; storage tanks/drums	N	
SOP-06	SOP-6: Groundwater and Fluid Level Monitoring, Crab Orchard National Wildlife Refuge; April 2012	FWS	Photoionization detector (PID); electronic water level indicator	N	

QAPP Worksheet #21 (continued)
Project Sampling SOP Reference

REFERENCE NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	ORIGINATING ORGANIZATION	EQUIPMENT TYPE	MODIFIED FOR PROJECT WORK? (Y/N)	COMMENTS
SOP-07	SOP-7: Groundwater Sampling, Crab Orchard National Wildlife Refuge; April 2012	FWS	Bladder pump, submersible electric pump (or equivalent); PTFE tubing; water quality meters and flow through cell; appropriate sample containers; buckets; storage tanks/drums	N	
SOP-08	SOP-8: Single Well Response Tests, Crab Orchard National Wildlife Refuge; April 2012	FWS	Air slug/purge pump/bailer; tubing and rope, as appropriate; electronic water level meter; photoionization detector (PID); pressure transducer/datalogger; portable computer; buckets; storage tanks/drums	N	
SOP-09	SOP-9: Sample Management and Field QA/QC, Crab Orchard National Wildlife Refuge; April 2012	FWS	Appropriate sample containers and paperwork	N	
SOP-10	SOP-10: Fish Sampling, Crab Orchard National Wildlife Refuge; April 2012	FWS	Electrofishing unit, live wells, sealable bags	N	
SOP-11	SOP-11: Management of Investigation Derived Waste, Crab Orchard National Wildlife Refuge; April 2012	FWS	DOT-approved steel drums; Super Sacs; steel trash receptacle; polyethylene spill berm	N	
SOP-12	SOP-12: Decontaminating Re-usable Dissection and Sample Collection Tools	Hudson River Natural Resource Trustees	Scale knives, wire side cutters, dissecting scissors, forceps, scalpels	N	

QAPP Worksheet #21 (continued)
Project Sampling SOP Reference

REFERENCE NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	ORIGINATING ORGANIZATION	EQUIPMENT TYPE	MODIFIED FOR PROJECT WORK? (Y/N)	COMMENTS
SOP-0025-002	ENTRIX SOP #0025 002: Standard Operating Procedure for Collecting Sediment Samples; Revision 3.5 (February 27, 2009; Addendum April 29, 2010	ENTRIX	Core barrel sampler; core liners (aluminum/stainless steel); compositing supplies, appropriate sample containers	N	
SOP-0025-003	ENTRIX SOP #0025 003: Standard Operating Procedure for Collecting Surface Water Samples; Revision 3.7 (March 11, 2009; Addendum April 29, 2010	ENTRIX	Peristaltic pump; portable power source; silicon and PTFE (or PTFE lined polyethylene) tubing; vacuum transfer containers, water quality meters; appropriate sample containers	N	
ECCS-01	PCB and Pesticide Wipe Analysis, Supplemental Sample Collection Guidance	ECCS	Sterile gauze pads, solvent, appropriate sample containers	N	
TRC-004	Calibration of Field Instruments for Water Quality Parameters	TRC	NA	N	

Note:
All field sampling SOPs are included in Attachment 1 of the FSP (TRC, 2014).

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection

FIELD EQUIPMENT	CALIBRATION ACTIVITY	MAINTENANCE ACTIVITY	TESTING ACTIVITY	INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE(1)
Water Level Meter	Per manufacturer's specifications	Per manufacturer's specifications	Water levels	Check probe response Check tape for wear	Daily	Probe is responsive Tape is legible and intact.	Battery replacement Tape will be replaced when worn	TRC On-Site Coordinator	SOP-06 TRC-004
Flow-through cell and water quality meters	Per manufacturer's specifications.	Per manufacturer's specifications; battery changing	Field measurements of temperature, redox potential, dissolved oxygen, specific conductance, and pH	Check probe response	Daily	Meters must power up; probes are responsive. pH, specific conductance redox must calibrate to standard solutions w/in manufacturers specs	Replace unresponsive probes or meters Recalibrate meters as needed	TRC On-Site Coordinator	SOP-07 TRC-004
Turbidity meter	Per manufacturer's specifications	Per manufacturer's specifications; battery changing	Field turbidity measurements	Check sample device	Daily	Meter must calibrate to standard solutions within manufacturer's specifications	Replace unresponsive meter; replace meters that will not calibrate	TRC On-Site Coordinator	SOP-07 TRC-004
Bladder pump; Submersible electric pumps	Per manufacturer's specifications	Per manufacturer's specifications	Water sample collection	Check pump function	Daily	Pump produces water	Replace inoperable pumps	TRC On-Site Coordinator	SOP-07

QAPP Worksheet #22 (continued)
Field Equipment Calibration, Maintenance, Testing, and Inspection

FIELD EQUIPMENT	CALIBRATION ACTIVITY	MAINTENANCE ACTIVITY	TESTING ACTIVITY	INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE[1]
Core barrel samplers	NA	None	None	Check pistons and valves for appropriate fit	Daily	Corer collects an undisturbed sample core	Replace parts that fail to function	TRC On-Site Coordinator	SOP-0025 002
Pressure transducer/ data logger	Per manufacturer's specifications	Per manufacturer's specifications	Single well response testing	Check transducer response	Daily	Pressure transducer is responsive Data logger records data	Replace pressure transducers that are un-responsive	TRC On-Site Coordinator	SOP-08
Electrofishing unit	Per manufacturer's specifications	Per manufacturer's specifications	Per manufacturer's specifications	Check power source, cables, electrodes	Daily		Repair and/or replace	Fish Sampling Crew Leader	SOP-10
Photoionization detector (PID)	Per manufacturer's specifications	Per manufacturer's specifications	Sample screening Air monitoring	Check detector response	Daily	Meter is responsive, and calibrates to standard gas within manufacturer's specifications	Recalibrate meter Replace meters that will not calibrate	TRC On-Site Coordinator	SOP-03
Global positioning system receiver	Per manufacturer's specifications	Per manufacturer's specifications	Per manufacturer's specifications	Check case for cracks and batteries for power output	Daily	Batteries at 100% at beginning of day	Recharge and/or replace batteries	TRC On-Site Coordinator	All

Footnote:
(1) See project Sampling SOP References table (Worksheet #21).

Note:
NA = not applicable.

QAPP Worksheet #23
Analytical SOP References

REFERENCE NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	DEFINITIVE OR SCREENING DATA	ANALYTICAL GROUP	INSTRUMENT	ORGANIZATION PERFORMING ANALYSIS	MODIFIED FOR PROJECT WORK? (Y/N)	ADDITIONAL EPA COMMENTS (BEYOND EXPIRATION DATE)?
ECCS-LAM-003	Organochlorine Pesticides by Gas Chromatography (GC); SW-846 Method 8081; Revision 6; February 28, 2011	Definitive	Pesticides	GC/ECD	ECCS	N	No
ECCS-LAM-004	Volatile Organic Compounds by Purge and Trap/Gas Chromatography/Mass Spectrometry; SW-846 Method 8260B; Revision 5.2; June 27, 2012	Definitive	VOC	GC/MS	ECCS	N	No
ECCS-LAM-030	Polycyclic Aromatic Hydrocarbons by Gas Chromatography/Mass Spectrometry (GC/MS) using Selective Ion Monitoring (SIM); SW-846 Method 8270D; Revision 0.2; August 16, 2013	Definitive	PAH	GC/MS	ECCS	N	No
ECCS-PRE-002	Self-contained Water Extraction; Method 3511; Revision 0, September 23, 2011	NA	Pesticides	NA	ECCS	N	No
ECCS-PRE-003	Self-contained Soil Extraction; Method 3570; Revision 0.1; September 23, 2011	NA	Pesticides, PAH	NA	ECCS	N	No

QAPP Worksheet #23 (continued)
Analytical SOP References

REFERENCE NUMBER	TITLE, REVISION DATE, AND/OR NUMBER	DEFINITIVE OR SCREENING DATA	ANALYTICAL GROUP	INSTRUMENT	ORGANIZATION PERFORMING ANALYSIS	MODIFIED FOR PROJECT WORK? (Y/N)	ADDITIONAL EPA COMMENTS (BEYOND EXPIRATION DATE)?
ECCS-PRE-007	Wipe Sample Extraction; Revision 0; February 28, 2011	NA	Pesticides	NA	ECCS	N	No
PACE-01	The Determination of Total Organic Carbon Using the Walkley-Black Procedure	Definitive	TOC	Hach Spectro-photometer	Pace Analytical	N	No
ALS-MET-TISP	Tissue Sample Preparation, Revision 8, February 20, 2012	NA	Pesticides	NA	ALS	N	No
ALS-EXT-3541	Automated Soxhlet Extraction; SW-846 Method 3541, Revision 7, January 27, 2012	NA	Pesticides	NA	ALS	N	No
ALS-EXT-LIPID	Percent Lipids in Tissue; Revision 2; September 20, 2010	Definitive	Lipids	NA	ALS	N	No
ALS-SOC-8081	Organochlorine Pesticides by Gas Chromatography	Definitive	Pesticides	GC/ECD	ALS	N	No

Notes:
Analytical SOPs are included in Attachment 4.
GC = gas chromatograph
ECD = electron capture detector
MS = mass spectrometer

QAPP Worksheet #24
Analytical Instrument Calibration

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY OF CALIBRATION CHECKS	ACCEPTANCE CRITERIA	CORRECTIVE ACTION (CA)	PERSON RESPONSIBLE FOR CA	SOP REFERENCE[1]
GC/MS	Tuning	Initial and within 12-hr window	Method criteria	Inspect the instrument, correct the problems, and re-tune.	Analyst	ECCS-LAM-004
	Varies by analyte: see SOP	CCV and tune are analyzed within 12-hr window	$R^2 > 0.990$ CCVs: Varies, see SOP	Inspect the instrument, correct the problems, and recalibrate.	Analyst	
GC/MS (SIM)	Tuning	Before 12 hour sample analysis	Verification of the alignment of the mass spectral axis.	Inspect the instrument, correct the problems, and re-tune.	Analyst	ECCS-LAM-030
	Varies by analyte: see SOP	CCV and tune are analyzed within 12-hr window	$R^2 > 0.990$ CCVs: Varies, see SOP	Inspect the instrument, correct the problems, recalibrate.	Analyst	
GC/ECD	Power Regression	CCV is analyzed after every 10 samples and the end of sequence.	$R^2 > 0.990$ CCV : ± 20 %	Inspect system, correct problem, and recalibrate.	Analyst	ECCS-LAM-003
	Endrin/DDT Breakdown Checks	Initial and within 12-hr window	Method criteria	Inspect the instrument, correct the problems, and re-analyze.	Analyst	
Hach DR2000 Spectrophotometer	Linear Regression	CCV is analyzed after every 10 samples and the end of sequence.	$R^2 > 0.990$ CCVs: ± 10 %	Inspect system, correct problem, and recalibrate.	Analyst	PACE-01
Balance	Calibration check, periodic servicing by vendor	Daily	NA	Inspect system, correct problems, recalibrate	Analyst	ALS-EXT-LIPID

Footnote:
(1) See Analytical SOP References (Worksheet #23).

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection

INSTRUMENT/ EQUIPMENT	MAINTENANCE ACTIVITY	TESTING ACTIVITY	INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE(1)
GC	Change septum. Clean injection port. Check and replace liner. Clip or replace column. Condition column. Replace gas filter.	None specified	Fill wash vials. Check gas pressures on tanks. Check injector needle.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	ECCS-LAM-003 ECCS-LAM-003
ECD	Condition at 300°C for a minimum of 24 hrs.	Conduct leak test.	None specified	Per instrument setup	Acceptable signal	None specified	Analyst	ECCS-LAM-003
MS (Mass Spectrometer)	Clean source. Replace electron multiplier. Replace filament. Replace turbo pump oil.	None specified	Check gas pressures on tanks. Check vacuum and interface nut.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	ECCS-LAM-004 ECCS-LAM-030

QAPP Worksheet #25 (continued)
Analytical Instrument and Equipment Maintenance, Testing, and Inspection

INSTRUMENT/ EQUIPMENT	MAINTENANCE ACTIVITY	TESTING ACTIVITY	INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE(1)
Purge & Trap (Concentrator)	Replace trap. Leak check.	None specified	Check for 10-mL transfer. Check pressure gauges and purge flow.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	ECCS-LAM-004
Purge & Trap (Autosampler)	Flush IS / IS/SS sipper tube. Syringe replacement (plunger assembly). Check calibrating arm. Leak check. Clean unit.	None specified	Check/clean sample cup/waste line. Replace internal and surrogate standard solutions. Check purge flow rate.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	ECCS-LAM-004
Balance	Per maintenance schedule in the operator's manual.	Per maintenance schedule in the operator's manual.	Per maintenance schedule in the operator's manual.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	ECCS-GEN-005 ALS-EXT-LIPID

QAPP Worksheet #25 (continued)
Analytical Instrument and Equipment Maintenance, Testing, and Inspection

INSTRUMENT/ EQUIPMENT	MAINTENANCE ACTIVITY	TESTING ACTIVITY	INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE[1]
DR2000 Spectro-photometer	Per maintenance schedule in the manufacturer's manual.	Per maintenance schedule in the manufacturer's manual.	Per maintenance schedule in the manufacturer's manual.	See SOP Reference	See SOP Reference	Inspect system, correct problem, rerun calibration, and reanalyze affected samples, if necessary.	Analyst	PACE-01

Footnote:
(1) See Analytical SOP References (Worksheet #23).

QAPP Worksheet #26
Sample Handling System (ECCS, ALS, Necropsy/Histopathology Laboratory)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (personnel/organization): TRC field sampling team/TRC On-site Coordinator
Sample Packaging (personnel/organization): TRC field sampling team/TRC On-site Coordinator
Coordination of Shipment (personnel/organization): TRC field sampling team/TRC On-site Coordinator
Type of Shipment/Carrier: Common carrier; private carrier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (personnel/organization): Michael Linskens, ECCS (or designee); Suzanne LeMay, ALS (or designee); Laboratory Manager, Necropsy/Histopathology Laboratory (to be determined) (or designee)
Sample Custody and Storage (personnel/organization): Michael Linskens, ECCS (or designee); Suzanne LeMay, ALS (or designee); Laboratory Manager, Necropsy/Histopathology Laboratory (to be determined) (or designee)
Sample Preparation (personnel/organization): Michael Linskens, ECCS (or designee); Suzanne LeMay, ALS (or designee); Laboratory Manager, Necropsy/Histopathology Laboratory (to be determined) (or designee)
Sample Determinative Analysis (personnel/organization): Michael Linskens, ECCS (or designee); Suzanne LeMay, ALS (or designee); Laboratory Manager, Necropsy/Histopathology Laboratory (to be determined) (or designee)
SAMPLE ARCHIVING
Field Sample Storage (number of days from sample collection): 30 days from submittal of final report
Sample Extract/Digestate Storage (number of days from extraction/digestion): 60 days from submittal of final report
Biological Sample Storage (number of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Michael Linskens, ECCS (or designee); Suzanne LeMay, ALS (or designee); Laboratory Manager, Necropsy/Histopathology Laboratory (to be determined) (or designee)
Number of Days from Analysis: minimum of 60 days from submittal of final report

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

- The field sampler is personally responsible for the care and custody of the samples until they are transferred to the laboratory or properly dispatched. Keep the number of people handling the samples to a minimum to ensure proper field Chain-of-Custody.
- At least one copy of the Chain-of-Custody Record will accompany all analytical samples and sample shipping containers to document their transfer from the field to the analytical laboratory (two copies for ECCS and one for ALS). One copy will be retained in the field ("sampler/submitter" - pink copy for ECCS, yellow copy for ALS). The procedures to be implemented are as follows:
  - Complete Chain-of-Custody Records Indicating sample identification, containers filled, sampling date, sampling time, sample collector's name, and sample preservation, if applicable. Also note this information in the field notebooks.
  - Repack shipping containers with samples, Chain-of-Custody Records, and water ice. Assign a Chain-of-Custody Record to each set of sample containers to be shipped.
  - Place the laboratory copies of the Chain-of-Custody Record (see above) in a plastic bag, seal the bag, and tape it to the inside cover of the shipping container. The Chain-of-Custody Record should be signed and dated by the sampler when transferring samples. Identify common carriers or intermediate individuals on the Chain-of-Custody Record, and retain copies of all bills-of-lading. When the samples are received in the laboratory, handle and process them in accordance with laboratory SOPs, or specified analytical methods, as defined in this QAPP.
  - The laboratory receiving the samples will check shipping containers for completeness of paperwork, damaged sample containers, and sample preservation as specified by the analytical method. The laboratory's sample management staff will note any problems, log the samples into the laboratory, and complete the Chain-of-Custody Record. The person relinquishing the samples to the laboratory will request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is to be noted in the "Received By" space on the Record.
  - The laboratory will scan the original report copy ("white") to their Laboratory Information Management System (LIMS) and provide a copy with the analytical data. The laboratory will return the executed original with the data deliverables package.
- A separate sample receipt is prepared whenever samples are split with a government agency. The receipt is marked to indicate with whom the samples are being split. The person relinquishing the samples to the agency should request the agency representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is to be noted on the receipt and in the field notebook.
- If a Chain-of-Custody Record Is damaged in shipment, the field copy will be made available. A written statement will be prepared by the person who collected the samples, listing the samples that were recorded on the damaged record, and describing when and how the samples were collected. The statement should include information such as field notebook entries regarding the sample. This statement is submitted to the On-Site Coordinator and the TRC Project Manager for further action, as necessary.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

The laboratory assigns a unique, sequentially numbered sample code to each sample received. Laboratory custody procedures for sample receiving and log-in, storage, tracking, and holding time requirements are described in the Laboratory SOPs (see Attachment 4).

Sample Identification Procedures:

- Label each bottle with the sample identifier, the sample type, the sampler's initials, and the date and time of sample collection.
- Complete sample labels for each sample and custody seals for each shipment container using waterproof ink, unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ink pen would not function in freezing weather.

Chain-of-Custody Procedures:

Example Chain-of-Custody Records from ECCS Laboratory and ALS Laboratory are shown in Attachment 4. The Records should be legibly completed. Errors will be corrected by drawing a single line through the incorrect information and entering the correct information. All corrections are to be initialed and dated by the person making the correction. This procedure applies to words or figures inserted or added to a previously recorded statement.

The following information must be included on the Chain-of-Custody Record:

- ECCS: Project Number, project name, project location, and the printed names of the sampler. ALS: Project name, project number, printed names of the project manager, company name and address, and sampler's signature.
- The "Sample ID" (ALS) / "Sample Description" (ECCS), sample date, and sample time portion of the Record must be completed for each sample. The "Sample ID" / "Sample Description" field must follow the sample identification format described in SOP-09 in the FSP (TRC, 2014). The sampling time MUST also be noted on the sample bottle (except for blind field duplicates, where the sample time would <u>not</u> be noted on the bottle label or Chain-of-Custody Record).
- The number of sample containers, sample matrix, preservative, and requested analysis must be designated by checking the appropriate box and/or writing the required information. In addition, note if water samples are filtered by either adding a comment, or circling the appropriate analysis type.

Sample custody is documented on the lower portion of the Record, and includes the sampler's signature, signatures of persons involved in the possession of the sample with dates and times, and the date on which the sample was received at the laboratory, as described further below.

- *Relinquished by/Received by* - This part of the Chain-of-Custody Record is a record of the individuals who actually had the samples in their custody. The spaces must be used in chronological order as the Chain-of-Custody Record is transferred with the samples.
  - Sampler signs when relinquishing custody.
  - Person 1 accepting custody of samples from sampler signs.
  - Person 1 must sign when relinquishing custody to the laboratory.
- *Sampler* - The person/persons collecting the samples must <u>sign</u> their name and <u>print</u> their name under their signature, and record the date and time they relinquish the samples to either the laboratory or the shipper. The final signature is that of the person receiving the samples at the laboratory.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

Chain-of-Custody Procedures (continued):

- *"Special Instructions/Comments" (ALS) or "Comments" (ECCS)* – The sampler may provide additional information about a sample, *e.g.*, if an odor is present, high or low pH, etc.

Note: If commercial carriers are used, the name of the carrier, any airbill number, and the date and time of relinquishing the sample containers are written on the airbill by sample entry or field personnel, and the airbill is attached to the Chain-of-Custody Record.

A copy of the Chain-of-Custody Record should be returned with the sample results. The laboratory service request number should be written on the Chain-of-Custody Record to facilitate its use during project data entry.

QAPP Worksheet #28-1
QC Samples – Organochlorine Pesticides (Water)

Matrix: Water
Sampling SOP: SOP-07; SOP-0025-003
Field Sampling Organization: TRC
Analytical Group: Organochlorine Pesticides
Analytical Method/SOP Reference: ECCS-LAM-003
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 35%	Qualify data as needed	TRC data validation staff	Precision	RPD
Surrogates	2 per sample	Laboratory control limits	Re-extraction /re-analysis	Laboratory staff	Accuracy	% Recovery
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-extraction /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	<Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-extraction/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-2
QC Samples – Organochlorine Pesticides (Soil/Sediment)

Matrix: Soil/Sediment
Sampling SOP: SOP-03; SOP-04; SOP-0025-002
Field Sampling Organization: TRC
Analytical Group: Organochlorine Pesticides
Analytical Method/SOP Reference: ECCS-LAM-003
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 50%	Qualify data as needed	TRC data validation staff	Precision	RPD
Surrogates	2 per sample	Laboratory control limits	Re-extraction /re-analysis	Laboratory staff	Accuracy	% Recovery
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-extraction /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	<Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-extraction/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-3
QC Samples – Organochlorine Pesticides (Fish Tissue)

Matrix: Fish Tissue
Sampling SOP: SOP-10
Field Sampling Organization: TRC
Analytical Group: Organochlorine Pesticides
Analytical Method/SOP Reference: ALS-SOC-8081
Analytical Organization: ALS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	Not applicable	---	---	---	---	---
Surrogates	2 per sample	Laboratory control limits	Re-extraction /re-analysis	Laboratory staff	Accuracy	% Recovery
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-extraction /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-extraction/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-4
QC Samples – Organochlorine Pesticides (Wipe Samples)

Matrix: Wipe Samples
Sampling SOP: ECCS-01
Field Sampling Organization: TRC
Analytical Group: Organochlorine Pesticides
Analytical Method/SOP Reference: ECCS-LAM-003
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	Not applicable	---	---	---	---	---
Surrogates	2 per sample	Laboratory control limits	Re-extraction /re-analysis	Laboratory staff	Accuracy	% Recovery
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-extraction /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	<Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-extraction/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	Not applicable	---	---	---	---	---

QAPP Worksheet #28-5
QC Samples – VOCs (Water)

Matrix: Water
Sampling SOP: SOP-07; SOP-0025-003
Field Sampling Organization: TRC
Analytical Group: VOCs
Analytical Method/SOP Reference: ECCS-LAM-004
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 35%	Qualify data as needed	TRC data validation staff	Precision	RPD
Surrogates	3 per sample	Laboratory control limits	Re-analysis	Laboratory staff	Accuracy	% Recovery
Internal standards	4 per sample	Peak area within -50% to +100%, and retention times within ± 30 seconds of ICAL midpoint ISs	Re-analysis	Laboratory staff	Instrument performance, quantitation	Peak areas and retention times
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	< Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-6
QC Samples – VOCs (Soil/Sediment)

Matrix: Soil/Sediment
Sampling SOP: SOP-03; SOP-04; SOP-0025-002
Field Sampling Organization: TRC
Analytical Group: VOCs
Analytical Method/SOP Reference: ECCS-LAM-004
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 50%	Qualify data as needed	TRC data validation staff	Precision	RPD
Surrogates	3 per sample	Laboratory control limits	Re-analysis	Laboratory staff	Accuracy	% Recovery
Internal standards	4 per sample	Peak area within -50% to +100%, and retention times within ± 30 seconds of ICAL midpoint ISs	Re-analysis	Laboratory staff	Instrument performance, quantitation	Peak areas and retention times
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	< Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-7
QC Samples – Polycyclic Aromatic Hydrocarbons (Soil/Sediment)

Matrix: Soil/Sediment
Sampling SOP: SOP-03; SOP-04; SOP-0025-002
Field Sampling Organization: TRC
Analytical Group: PAHs by SIM
Analytical Method/SOP Reference: ECCS-LAM-030
Analytical Organization: ECCS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 35%	Qualify data as needed	TRC data validation staff	Precision	RPD
Surrogates	2 per sample	Laboratory control limits	Re-extraction /re-analysis	Laboratory staff	Accuracy	% Recovery
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-extraction /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	< Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-extraction/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-8
QC Samples – Total Organic Carbon (Soil/Sediment)

Matrix: Soil/Sediment
Sampling SOP: SOP-03; SOP-04; SOP-0025-002
Field Sampling Organization: TRC
Analytical Group: Total Organic Carbon
Analytical Method/SOP Reference: PACE-01
Analytical Organization: Pace
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	1 per 10 samples	RPD < 50%	Qualify data as needed	TRC data validation staff	Precision	RPD
Method blanks	1 per analytical batch	< Laboratory reporting limit	Re-digestion /re-analysis	Laboratory staff	Bias/Contamination	< Laboratory reporting limit
Equipment blanks	1 per 10 samples	< Laboratory reporting limit	Qualify data as needed	TRC data validation staff	Bias/Contamination	< Laboratory reporting limit
Laboratory control sample (LCS)	1 per analytical batch	Laboratory control limits	Re-digestion/re-analysis	Laboratory staff	Accuracy	% Recovery
MS/MSD	1 per 20 samples	Laboratory control limits	Qualify data as needed	Laboratory staff and TRC data validation staff	Accuracy/Precision	% Recovery/RPD

QAPP Worksheet #28-9
QC Samples – Lipids (Fish Tissue)

Matrix: Fish Tissue
Sampling SOP: SOP-10
Field Sampling Organization: TRC
Analytical Group: Lipids
Analytical Method/SOP Reference: ALS-EXT-LIPID
Analytical Organization: ALS
Concentration Level: All
Sampler's Name: NA
Number of Sample Locations: To be determined

QC SAMPLE	FREQUENCY/ NUMBER	METHOD/SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CORRECTIVE ACTION	DATA QUALITY INDICATOR (DQI)	MEASUREMENT PERFORMANCE CRITERIA
Field duplicate	Not applicable	---	---	---	---	---
Surrogates	Not applicable	---	---	---	---	---
Method blanks	1 per 20 samples	< abs. value of 0.5 mg	Re-analysis	Laboratory staff	Bias/Contamination	< abs. value of 0.5 mg
Equipment blanks	Not applicable	---	---	---	---	---
Laboratory control sample (LCS)	Not applicable	---	---	---	---	---
MS/MSD	Not applicable	---	---	---	---	---
Laboratory replicate	1 sample in triplicate per 20 samples	RPD < 20%	Qualify data as needed	TRC data validation staff	Precision	RPD

QAPP Worksheet #29
Project Documents and Records

SAMPLE COLLECTION DOCUMENTS AND RECORDS	ON-SITE ANALYSIS DOCUMENTS AND RECORDS	OFF-SITE ANALYSIS DOCUMENTS AND RECORDS	DATA ASSESSMENT DOCUMENTS AND RECORDS	OTHER
▪ Field notes ▪ Sampling logs ▪ Chain-of-Custody Records ▪ Air bills ▪ Custody seals	▪ Equipment calibration logs ▪ Field data records ▪ Field instrument maintenance logs	▪ Sample receipt, custody, and tracking records ▪ Standard traceability logs ▪ Equipment calibration logs ▪ Sample prep logs ▪ Run logs ▪ Equipment maintenance, testing, and inspection logs ▪ Corrective action forms ▪ Reported field sample results ▪ Reported results for standards, QC checks, and QC samples ▪ Instrument printouts (raw data) for field sample standards, QC checks, and QC sample ▪ Data package completeness checklists ▪ Sample disposal records ▪ Extraction/Cleanup records ▪ Raw data (stored on diskette or CD-R) ▪ Analytical reports	▪ Data validation checklists ▪ Data quality assessments	▪ Consent Decree documents ▪ Progress reports to the U.S. FWS ▪ Work Plans and Sampling and Analysis Plans ▪ Health and Safety Plans ▪ Quality Assurance Project Plan ▪ Quality Management Plan ▪ Remedial Investigation and Risk Assessment Reports ▪ Feasibility Studies ▪ EE/CA Reports ▪ Design Reports ▪ Construction Documentation Reports ▪ Monitoring Reports ▪ Communication logs

QAPP Worksheet #30
Analytical Services

MATRIX	ANALYTICAL GROUP	CONCENTRATION LEVEL	SAMPLE LOCATIONS/ ID NUMBERS	ANALYTICAL SOP	DATA PACKAGE TURNAROUND TIME	LABORATORY/ ORGANIZATION (name, address, contact person, and telephone number)	BACKUP LABORATORY/ ORGANIZATION (name, address, contact person, and telephone number)
Solid (soil/ sediment) Aqueous (surface water/ ground-water Wipes	Pesticides VOCs PAHs	All	TBD	ECCS-LAM-003 ECCS-LAM-004 ECCS-LAM-030	Standard turnaround time (14 business days for Level II reports; 28 business days for Level IV reports)	Environmental Chemistry Consulting Services (ECCS) 2525 Advance Road Madison, WI 53718 Jessica Esser (608) 221-8700 or Michael Linskens (Quality Manager) (608) 221-8700	Pace Analytical Services, Inc., Wisconsin 1241 Bellevue St. #9 Green Bay, WI 54302 Tod Noltemeyer (608) 232-3300 or Kate Grams (Quality Manager) (920) 469-2436
Solid (soil/ sediment)	TOC	All	TBD	PACE-01	Standard turnaround time (14 business days for Level II reports; 28 business days for Level IV reports)	(ECCS Subcontract) Pace Analytical Services, Inc., Wisconsin 1241 Bellevue St. #9 Green Bay, WI 54302 Tod Noltemeyer (608) 232-3300 or Kate Grams (Quality Manager) (920) 469-2436	--

QAPP Worksheet #30 (continued)
Analytical Services

MATRIX	ANALYTICAL GROUP	CONCENTRATION LEVEL	SAMPLE LOCATIONS/ ID NUMBERS	ANALYTICAL SOP	DATA PACKAGE TURNAROUND TIME	LABORATORY/ ORGANIZATION (name, address, contact person, and telephone number)	BACKUP LABORATORY/ ORGANIZATION (name, address, contact person, and telephone number)
Fish Tissue	Necropsy Histopathology	All	TBD	SOP-10	3 weeks	Necropsy/Histopathology Laboratory, to be determined	--
Fish Tissue	Pesticides Lipids	All	TBD	ALS-SOC-8081 ALS-EXT-LIPID	6 weeks	ALS Environmental 1317 S. 13th Avenue Kelso, WA 98626 Samy Shahryar 360.577.7222	--
Data Validation	All	All	--	All	--	TRC 708 Heartland Trail Madison, WI 53717 Gretchen Rahn	--

Notes:
NA = not applicable.
TBD = to be determined.

QAPP Worksheet #31-1
Planned Project Assessments
(EE/CA – Phase I Investigation)

ASSESSMENT TYPE	FREQUENCY	INTERNAL OR EXTERNAL	ORGANIZATION PERFORMING ASSESSMENT	PERSON(S) RESPONSIBLE FOR PERFORMING ASSESSMENT (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR RESPONDING TO ASSESSMENT FINDINGS (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR IDENTIFYING AND IMPLEMENTING CORRECTIVE ACTIONS (CA) (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CA (title and organizational affiliation)
Field performance audit	Periodic, based on field schedule	Internal	TRC	Alyssa Sellwood, TRC (Project Manager)	Alyssa Sellwood, TRC (Project Manager)	Meredith Westover, TRC (On-Site Coordinator)	Alyssa Sellwood, TRC (Project Manager)
Field systems audit	Periodic, based on field schedule	Internal	TRC	Meredith Westover, TRC (Data QA Manager)	Alyssa Sellwood, TRC (Project Manager)	Meredith Westover, TRC (On-Site Coordinator)	Alyssa Sellwood, TRC (Project Manager)
Laboratory audit	As needed, based on laboratory performance	External	TRC	Meredith Westover, TRC (Data QA Manager)	Michael Linskens, ECCS (Laboratory QA Manager) or Suzanne LeMay ALS (Laboratory QA Manager) or Project Manager Necropsy/Histopathology Laboratory (to be determined)	Michael Linskens, ECCS (Laboratory QA Manager) or Suzanne LeMay ALS (Laboratory QA Manager) or Project Manager Necropsy/Histopathology Laboratory (to be determined)	Meredith Westover, TRC (Data QA Manager)

QAPP Worksheet #31-1 (continued)
Planned Project Assessments
(EE/CA – Phase I Investigation)

ASSESSMENT TYPE	FREQUENCY	INTERNAL OR EXTERNAL	ORGANIZATION PERFORMING ASSESSMENT	PERSON(S) RESPONSIBLE FOR PERFORMING ASSESSMENT (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR RESPONDING TO ASSESSMENT FINDINGS (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR IDENTIFYING AND IMPLEMENTING CORRECTIVE ACTIONS (CA) (title and organizational affiliation)	PERSON(S) RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CA (title and organizational affiliation)
Laboratory audit	Per laboratory QA Plan	Internal	ECCS	Michael Linskens, ECCS (Laboratory QA Manager)	Michael Linskens, ECCS (Laboratory QA Manager)	Michael Linskens, ECCS (Laboratory QA Manager)	Meredith Westover, TRC (Data QA Manager)
			or	or	or	or	
			ALS	Suzanne LeMay ALS (Laboratory QA Manager)	Suzanne LeMay ALS (Laboratory QA Manager)	Suzanne LeMay ALS (Laboratory QA Manager)	
			or	or	or	or	
			To be determined	Project Manager Necropsy/ Histopathology Laboratory (to be determined)	Project Manager Necropsy/Histopathology Laboratory (to be determined)	Project Manager Necropsy/Histopathology Laboratory (to be determined)	

QAPP Worksheet #32-1
Assessment Findings and Corrective Action Responses
(EE/CA – Phase I Investigation)

ASSESSMENT TYPE	NATURE OF DEFICIENCIES DOCUMENTATION	INDIVIDUAL(S) NOTIFIED OF FINDINGS (name, title, organization)	TIME FRAME OF NOTIFICATION	NATURE OF CORRECTIVE ACTION RESPONSE DOCUMENTATION	INDIVIDUAL(S) RECEIVING CORRECTIVE ACTION RESPONSE (name, title, organization)	TIME FRAME FOR RESPONSE
Field performance audit	Checklist	Alyssa Sellwood, TRC (Project Manager)	Within 72 hours after audit (or sooner, as appropriate)	E-mail response	Meredith Westover, TRC (On-Site Coordinator)	Within 48 hours after notification (or sooner, as appropriate)
Field systems audit	Checklist	Meredith Westover, TRC (Data QA Manager), will notify Alyssa Sellwood, TRC (Project Manager)	Within 48 hours after audit (or sooner, as appropriate)	E-mail response	Meredith Westover, TRC (On-Site Coordinator)	Within 48 hours after notification (or sooner, as appropriate)
Internal laboratory audit	Executive Summary from Management Report	Analytical Laboratory QA Manager will notify Meredith Westover, TRC (Data QA Manager), and appropriate laboratory staff.	Within 48 hours after audit (or sooner, as appropriate)	Executive Summary from Management Report	Meredith Westover, TRC (Data QA Manager)	Within 48 hours after notification (or sooner, as appropriate)
External laboratory audit	Checklist	Meredith Westover, TRC (Data QA Manager), will notify the Analytical Laboratory QA Manager, and Alyssa Sellwood, TRC (Project Manager)	Within 1 week after audit	Memorandum	Analytical Laboratory QA Manager	Within 48 hours after notification (or sooner, as appropriate)

QAPP Worksheet #33
QA Management Reports

TYPE OF REPORT	FREQUENCY (daily, weekly, monthly, quarterly, annually, etc.)	PROJECTED DELIVERY DATE(S)	PERSON(S) RESPONSIBLE FOR REPORT PREPARATION (title and organizational affiliation)	REPORT RECIPIENT(S) (title and organizational affiliation)
Field audit reports	As needed	As generated	Alyssa Sellwood, TRC (Project Manager) and Meredith Westover (Data QA Manager)	Tom Stolzenburg, TRC (Project Coordinator)
Analytical laboratory audit (external)	As needed	As generated	Meredith Westover, TRC (Data QA Manager)	Tom Stolzenburg, TRC (Project Coordinator)
Data validation reports	As specified in data assessment section	As generated	Gretchen Rahn, TRC (data validator)	Meredith Westover, TRC (Data QA Manager)
Data quality summary	As appropriate for data use	As generated	Gretchen Rahn, TRC (data validator)	Meredith Westover, TRC (Data QA Manager)
Corrective Action Reports	As needed	Within 60 days of identification of data problem	Tom Stolzenburg, TRC (Project Coordinator)	FWS, USEPA, GLS

QAPP Worksheet #34
Verification (Step I) Process

VERIFICATION INPUT	DESCRIPTION	INTERNAL/ EXTERNAL	RESPONSIBLE FOR VERIFICATION (name, organization)
Chain-of-Custody Records and shipping documentation	Chain-of-Custody Records and shipping documentation will be reviewed by the laboratory upon receipt of samples for verification against the sample coolers they represent. The Chain-of-Custody Record will be signed by all parties who had custody of samples, with the exception of commercial carriers.	External	Analytical laboratory QA Manager (or designee)
Field notes and sampling logs	All field notes and sampling logs will be reviewed internally and placed in the project file. Copies of field notes and sampling logs will be included in the appendices to the EE/CA report.	Internal	Meredith Westover, TRC On-Site Coordinator
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	Analytical laboratory QA Manager (or designee)
Laboratory data	All final data packages will be verified for content upon receipt.	External	Gretchen Rahn (data validator)

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process

STEP IIa/IIb	VALIDATION INPUT	DESCRIPTION	RESPONSIBLE FOR VERIFICATION (Name, Organization)
Step IIa	Sampling methods and procedures	Verify that the required analytical methods were used and that any deviations were noted.	Gretchen Rahn, TRC
Step IIa	Analytical methods	Verify that the required sampling methods were used and that any deviations were noted. The laboratory will verify that QC samples met the performance criteria, and that any deviations were noted on the sample narrative.	Analytical Laboratory QA Manager (Various) Gretchen Rahn, TRC
Step IIb	Documentation of QAPP QC sample results	Establish that all QC samples required by the QAPP were collected and analyzed.	Gretchen Rahn, TRC
Step IIb	Project Quantitation Limits	Determine that the QAPP-required Quantitation Limits were achieved.	Gretchen Rahn, TRC
Step IIb	Validation report	Summarize data findings of verification and validation components included in the QAPP. Include comments on any qualified data, and define all qualifiers.	Gretchen Rahn, TRC

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary

STEPS 1Ia AND IIb	MATRIX	ANALYTICAL GROUP	DATA PURPOSE	CONCENTRATION LEVEL	VALIDATION CRITERIA	DATA VALIDATOR (title and organizational affiliation)
IIa and IIb	Soil/Sediment	Pesticides, TOC	Update risk assessments; Delineation of extent; Site characterization	Low, medium, high	U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (June 2008); method criteria, QAPP criteria; and professional judgment	Gretchen Rahn, TRC (Data Validator)
IIa and IIb	Aqueous	Pesticides VOCs	Update risk assessments; Delineation of extent; Site characterization	Low, medium, high	U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (June 2008); method criteria, QAPP criteria; and professional judgment	Gretchen Rahn, TRC (Data Validator)
IIa and IIb	Wipes	Pesticides	Suitability for use; Site characterization	Low, medium, high	U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (June 2008); method criteria, QAPP criteria; and professional judgment	Gretchen Rahn, TRC (Data Validator)
IIa and IIb	Fish Tissue	Pesticides; Lipids	Update risk assessments; Site characterization	Low, medium, high	U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (June 2008); method criteria, QAPP criteria; and professional judgment	Gretchen Rahn, TRC (Data Validator)

QAPP Worksheet #37
Usability Assessment

Identify the personnel responsible for performing the usability assessment:

Thomas Stolzenburg, TRC Project Coordinator, Alyssa Sellwood, TRC Project Manager; Meredith Westover, TRC Data QA Manager/Senior Hydrogeologist; John Rice, TRC Senior Engineer; Gretchen Rahn, TRC Data Validator; and other scientists using the data.

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

All data that passes the verification and validation process must be included in the reports, but under certain conditions, data can be excluded from interpretation of trends and contours. In general, simple evaluation procedures, which apply when the true value is known or when there are many samples of the same groundwater, cannot be applied. However, using professional judgment and comparison to other data (comparability), it is possible to conclude that certain data, even when all documentation indicates that it should be valid, could not be representative, and therefore, should be excluded from interpretation of contours and trends. Examples are listed below:

- Water levels, which for no known reason, are grossly inconsistent with contours from the nearest observation points, and results in a pattern of groundwater flow that is inconsistent with historical data or hydrogeological principles, and is not confirmed by subsequent monitoring events.
- Detections that greatly differ from historical detections for no known reason, and that are not confirmed by subsequent analyses, or when data quality correlates to quality of another well.

In such situations, the first action should be to double check documentation, and to question samplers and analysts involved. If the documentation and questioning uncovers no reason to reject the data, but the scientists and engineers determine that it must be unrepresentative, these data will be included on maps and charts, but will be flagged (using markers, colors, fonts, or equivalent). Language within the figure legend will indicate that these data are not considered representative and were omitted from the interpretation of contours and trends. FWS and USEPA concurrence is required for this determination.

QAPP Worksheet #37 (continued)
Usability Assessment

Describe the evaluative procedures used to assess overall measurement error associated with the project:

The data quality indicator (DQIs) used to evaluate conformance with the project DQOs are presented below.

DQIs are generally defined in terms of the following six parameters;

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy
6. Sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this QAPP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements is intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared with another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in the QAPP, the established QA/QC procedures, and the use of appropriately trained personnel.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated with the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

QAPP Worksheet #37 (continued)
Usability Assessment

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to the established protocols presented in the QAPP. Checks for analytical precision will include the analysis of MS/MSDs, laboratory duplicates, and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100,$$

where

A = analytical result from one of two duplicate measurements,
B = analytical result from the second measurement.

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100,$$

where

A = value measured in spiked sample or standard,
X = value measured in original sample,
B = true value of amount added to sample or true value of standard.

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated MDLs can satisfy the project requirements as they relate to the project action limits. MDLs are updated annually by the laboratory.

QAPP Worksheet #37 (continued)
Usability Assessment

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data validation report will address the following items:

- Overall quality and usability of the data
- Evaluation of QC data, including precision, accuracy, and completeness of the data
- Potential sample contamination due to blank contributions
- Assessment of laboratory and field records
- Actions regarding specific QC criteria exceedences

Laboratory-applied data qualifiers will be defined within the analytical data package received from the laboratory. The sample narrative will also detail quality control issues identified by the laboratory.

Data validation qualifiers that may be applied to the data include the following:

- u The analyte/compound was analyzed for, but not detected. The associated value is the compound's Limit of Quantitation.
- j The compound was positively identified; however, the associated numerical value is an estimated concentration only.
- h The samples are past the allowable hold time. Sample results are estimated.
- r The sample results are rejected.

A data quality assessment (DQA) will be conducted after the data are validated. The steps in the DQA are as follows:

- Review project objectives and sampling design.
- Conduct preliminary data review.
- Select statistical method (if appropriate).
- Verify assumptions of the method (if appropriate).
- Draw conclusions from the data.

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TRC - GIS

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

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EE/CA INVESTIGATION PHASE I
AREA 7 PESTICIDE AREA, AUS OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

SITE LOCATION MAP

DRAWN BY:	PAPEZ J
APPROVED BY:	TRS
PROJECT NO:	194355
FILE NO.	194355-001-slm.mxd
DATE:	JUNE 2013

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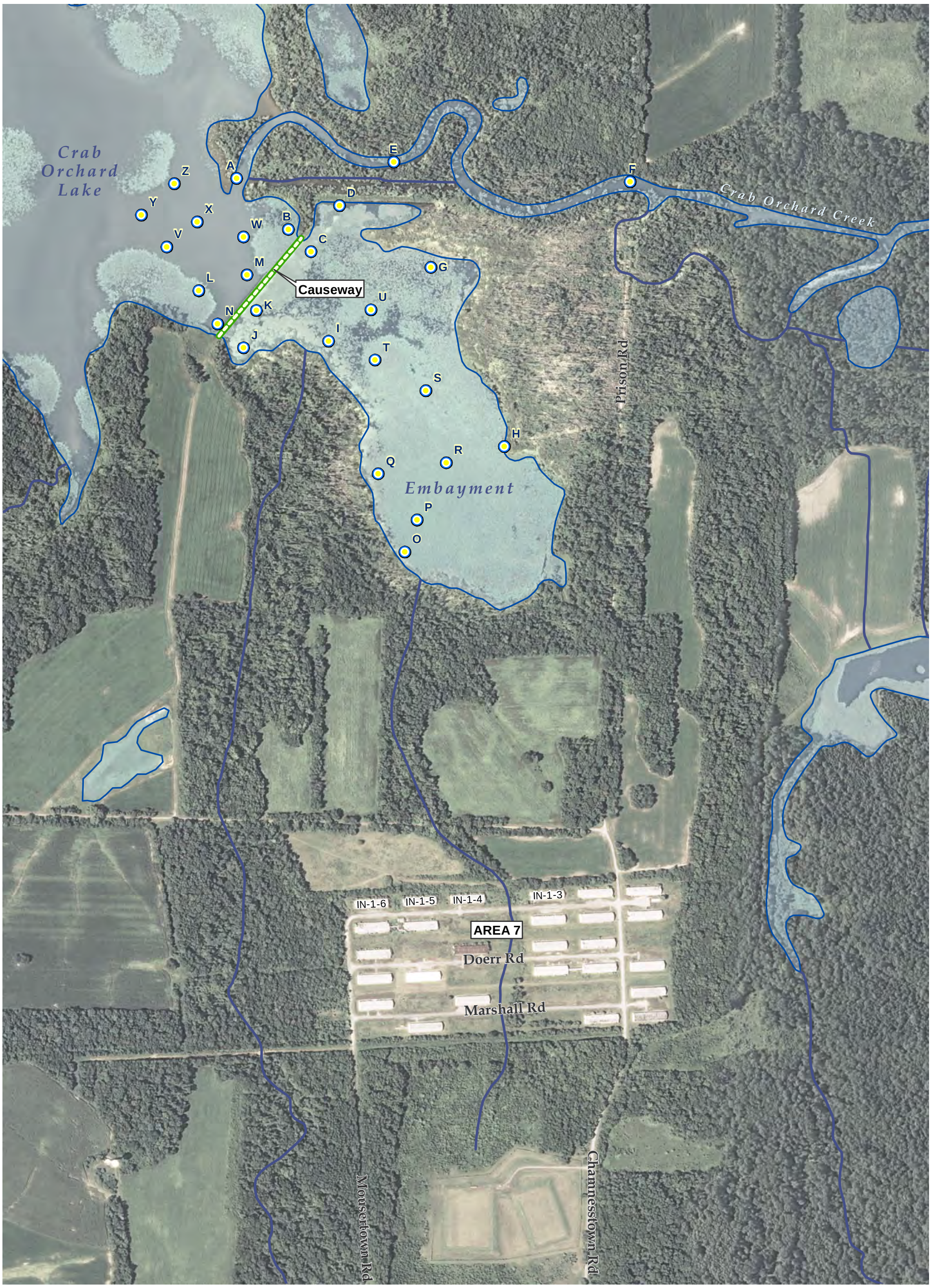
FIGURE 1



LEGEND

- PROPOSED SURFACE WATER AND SEDIMENT SAMPLE LOCATION
- DRAINAGE WAY
- WATER BODY

NOTES

1. BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, AUGUST 2011.
2. HYDROLOGY FEATURES FROM USGS - NATIONAL HYDROGRAPHY DATASET.

N

0 600 Feet

1 " = 600 '

1:7,200

EE/CA INVESTIGATION PHASE I
AREA 7 PESTICIDE AREA, AUS OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

PROPOSED SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

DRAWN BY:	PAPEZ J	SCALE:	1: 7,200	PROJ. NO.	194355-002
CHECKED BY:	AAS			FILE NO.	194355-002-pro.mxd
APPROVED BY:	TRS	DATE PRINTED:		FIGURE 2	
DATE:	JUNE 2013				

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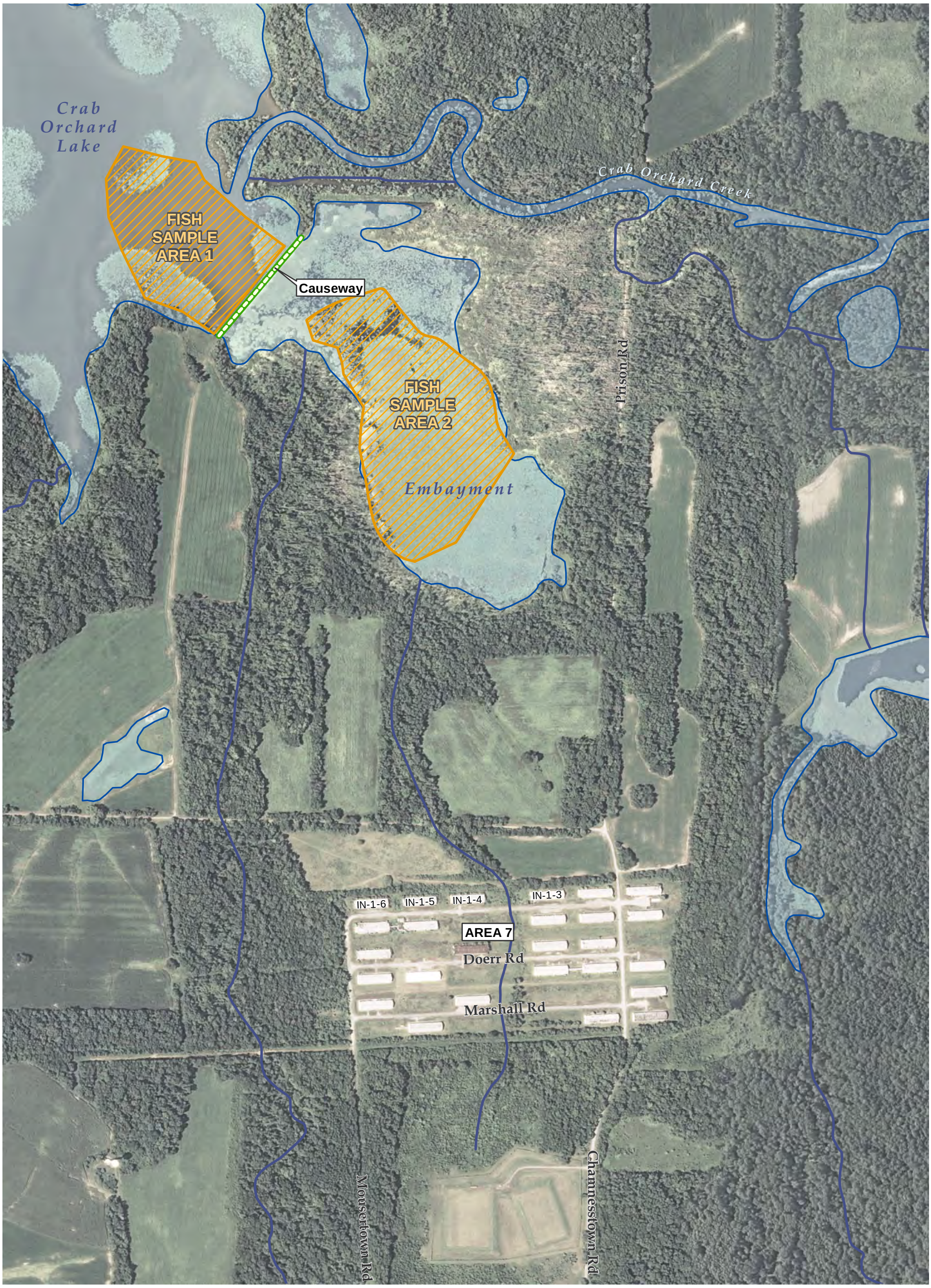
Coordinate System: NAD 1983 UTM Zone 16N (Meter)
Map Rotation: 0Degrees

TRC - GIS



LEGEND

- PROPOSED FISH SAMPLING AREA
- DRAINAGE WAY
- WATER BODY

NOTES

1. BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, AUGUST 2011.
2. HYDROLOGY FEATURES FROM USGS - NATIONAL HYDROGRAPHY DATASET.

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0 600 Feet

1 " = 600 '

1:7,200

EE/CA INVESTIGATION PHASE I
AREA 7 PESTICIDE AREA, AUS OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

PROPOSED FISH SAMPLING AREAS

DRAWN BY:	PAPEZ J	SCALE:	1: 7,200	PROJ. NO.	194355-002
CHECKED BY:	AAS			FILE NO.	194355-003-fsh.mxd
APPROVED BY:	TRS	DATE PRINTED:		**FIGURE 3**	
DATE:	JUNE 2013				

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Coordinate System: NAD 1983 UTM Zone 16N (Meter)
Map Rotation: 0Degrees

TRC - GIS

LEGEND

- EXISTING MONITORING WELL LOCATION
- TEMPORARY WELL LOCATION (PRESUMED TO BE ABANDONED)
- PROPOSED MONTORING WELL LOCATION
- FLOW LINE

NOTES

1. BASE MAP IMAGERY FROM USGS HIGH RESOLUTION STATE ORTHOIMAGERY FOR WILLIAMSON COUNTY, IL, MARCH 2011.
2. OTHER MAP INFORMATION FROM PHOTOGRAMMETRIC SITE SURVEY CONDUCTED IN 2000.

N

0 100 200 Feet

1 " = 100 '

1:1,200

EE/CA INVESTIGATION PHASE I
AREA 7 PESTICIDE AREA, AUS OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

PROPOSED MONITORING WELL LOCATIONS

DRAWN BY: PAPEZ J	SCALE: 1: 1,200	PROJ. NO. 194355-002	
CHECKED BY: AAS		FILE NO. 194355-004-pro.mxd	
APPROVED BY: TRS	DATE PRINTED:	FIGURE 4	
DATE: JANUARY 2014			

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Coordinate System: NAD 1983 UTM Zone 16N (Meter)
Map Rotation: 0
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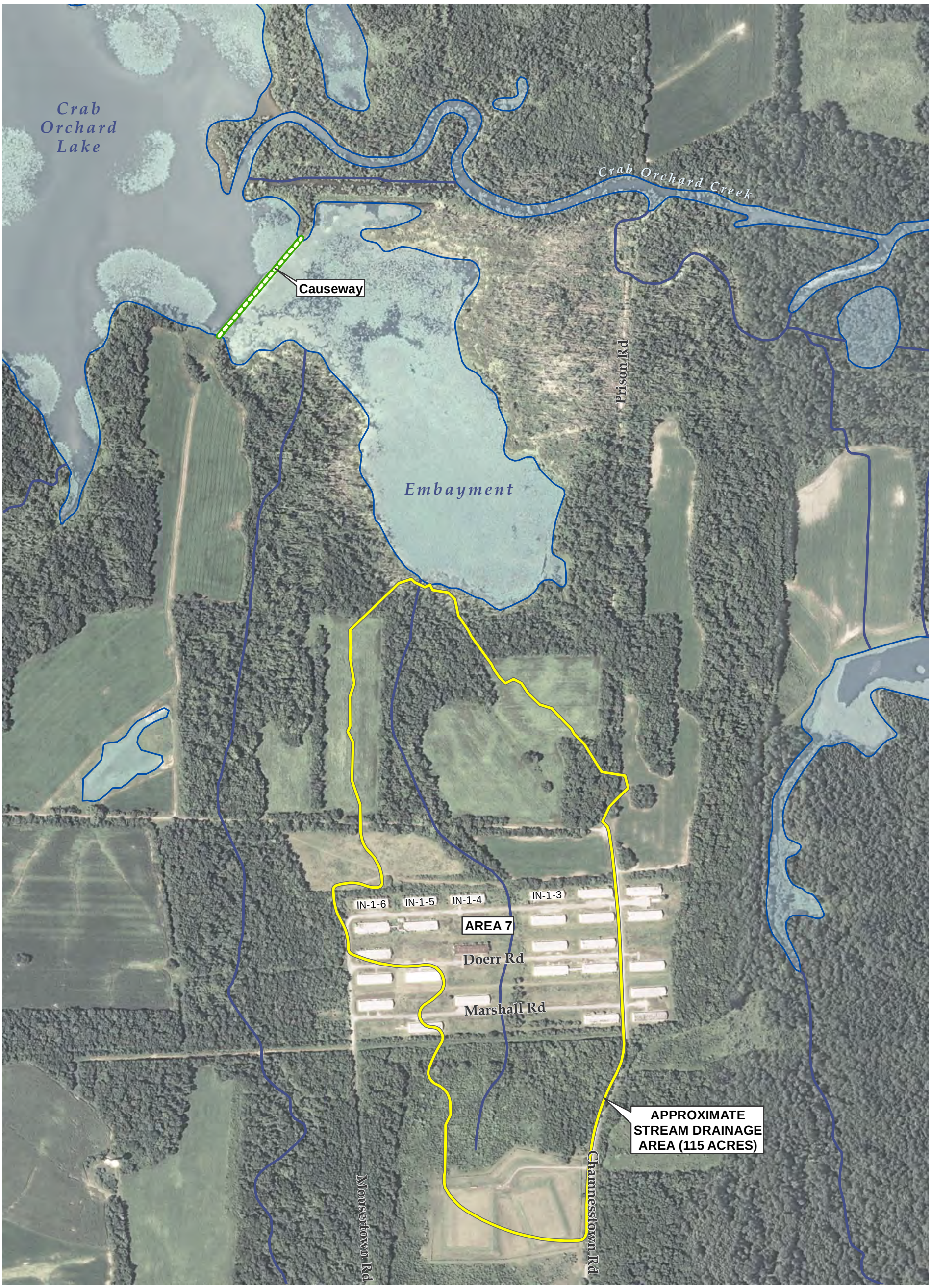

LEGEND

- DRAINAGE WAY
- WATER BODY
- WATERSHED BOUNDARY

NOTES

1. BASE MAP IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, AUGUST 2011.
2. HYDROLOGY FEATURES FROM USGS - NATIONAL HYDROGRAPHY DATASET.

N

0 600 Feet

1 " = 600 '

1:7,200

EE/CA INVESTIGATION PHASE I
AREA 7 PESTICIDE AREA, AUS OU
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

DRAINAGE AREA AND SURVEY EXTENT

DRAWN BY: PAPEZ J	SCALE: 1: 7,200	PROJ. NO. 194355-002	
CHECKED BY: AAS		FILE NO. 194355-005-ws.mxd	
APPROVED BY: TRS	DATE PRINTED:	FIGURE 5	
DATE: JUNE 2013			

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Coordinate System: NAD 1983 UTM Zone 16N (Meter)
Map Rotation: 0Degrees

TRC - GIS

Attachment 1
Sampling and Analytical Program Summary

Attachment 1
Sampling and Analytical Program Summary
EE/CA Investigation - Phase I
Area 7 Pesticide Area at AUS OU - Crab Orchard National Wildlife Refuge NPL

TASK ITEM	SUMMARY [FIELD SOP REFERENCE][1]	ANALYSIS/METHOD	ANALYTICAL LABORATORY [SOP REFERENCE]	EXAMPLE SAMPLE DESIGNATION
Building Interior - Wipe Samples	Building IN-1-3 with 3"x3"-gauze pad: (2) samples from floor (3) samples from metal wall (3) samples from wood frame. [ECCS-01]	Pesticides TAL/(SW846 8081A)	ECCS [ECCS-LAM-003]	"AUS-PEST-001-WI-IN13-FLR" (Bldg. IN-1-3 floor) "AUS-PEST-003-WI-IN13-WALL" (Bldg. IN-1-3 wall) "AUS-PEST-006-WI-IN13-FRM" (Bldg. IN-1-3 frame) [see SOP-09]
Sediment Sampling	Sediment samples at 21 locations (A - U) through thickness of soft sediment, or to refusal using a hand-driven coring device; sample intervals of 0.5 ft for top 1 ft of sediment; 1 ft intervals to total depth. [SOP-0025-002]	Pesticides TAL/(SW846 8081A); add TOC to uppermost interval (0.0-0.5 ft)/(Walkley Black)	ECCS [ECCS-LAM-003] ECCS (subcontract to Pace Analytical) [PACE-01]	"AUS-PEST-00A-SD-000005" (0 to 0.5' sample) "AUS-PEST-00A-SD-005010" (0.5 to 1.0' sample) [see SOP-09]
	Sediment samples at 5 additional locations (V - Z), 0.0 to 0.5 ft interval only. [SOP-0025-002]	Pesticides TAL/(SW846 8081A); TOC/(Walkley Black)	ECCS [ECCS-LAM-003] ECCS (subcontract to Pace Analytical) [PACE-01]	
Surface Water Sampling	Collect unfiltered surface water samples at locations coincident with sediment sample locations (26 locations). [SOP-0025-003]	Pesticides TAL/(SW846 8081A)	ECCS [ECCS-LAM-003]	"AUS-PEST-00A-SW" [see SOP-09]
Fish Sampling - HHRA	(8) Catfish fillets (no skin) and (8) Bass fillets from embayment. [SOP-10]	Pesticides TAL/(SW846 8081B); lipids; morphological assessment; necropsy (all); Histopathology (TBD by FWS)	ALS [ALS-SOC-8081] ALS [ALS-EXT-LIPID] SOP-10	"AUS-PEST-001-BI-LMB" (largemouth bass) "AUS-PEST-001-BI-CAT" (catfish) [see SOP-09]
	(8) Catfish fillets (no skin) and (8) Bass fillets from Crab Orchard Lake outside of embayment. [SOP-10]			
Fish Sampling - Eco Risk	(8) Specimens of each of two forage fish species, bluegill, plus either gizzard shad, common carp, or common minnow from the embayment. [SOP-10]	Pesticides TAL/(SW846 8081B); lipids; morphological assessment (all)	ALS [ALS-SOC-8081] ALS [ALS-EXT-LIPID] SOP-10	"AUS-PEST-001-BI-BLU" (bluegill) [see SOP-09]
	(8) Specimens of each of two forage fish species, bluegill, plus either gizzard shad, common carp, or common minnow from Crab Orchard Lake outside the embayment. [SOP-10]			
	(1) Specimen of two forage fish species (same species as selected for pesticide analysis) from the embayment. [SOP-10]	Necropsy; Histopathology (TBD by FWS)	SOP-10	
Groundwater Sampling	Collect groundwater samples from (5) existing and (3) new monitoring wells. [SOP-06, SOP-07]	Pesticides TAL/(SW846 8081A); VOCs TAL/(SW846 8260B)	ECCS [ECCS-LAM-003] ECCS (ECCS-LAM-004]	"AUS-PEST-W03-GW" [see SOP-09]

Notes:
TAL = Target Analyte List. The TALs for each analytical group are included in Worksheet #15.
TOC = Total Organic Carbon.
VOC = Volatile Organic Compounds.
[1] Field SOPs are included in Attachment 1 of the FSP (TRC, 2014).

Attachment 2
Laboratory Accuracy and Precision Objectives

CAS/KELSO DATA QUALITY OBJECTIVES

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8081B	2,4'-DDD	53-19-0	Tissue	0.38	1.0	ug/Kg	43-117	43-117	40
8081B	2,4'-DDE	3424-82-6	Tissue	0.21	1.0	ug/Kg	47-100	47-100	40
8081B	2,4'-DDT	789-02-6	Tissue	0.12	1.0	ug/Kg	49-100	49-100	40
8081B	4,4'-DDD	72-54-8	Tissue	0.41	1.0	ug/Kg	41-112	41-112	40
8081B	4,4'-DDE	72-55-9	Tissue	1.0	1.0	ug/Kg	39-118	39-118	40
8081B	4,4'-DDT	50-29-3	Tissue	1.0	1.0	ug/Kg	45-119	45-119	40
8081B	Aldrin	309-00-2	Tissue	0.19	1.0	ug/Kg	40-102	40-102	40
8081B	alpha-BHC	319-84-6	Tissue	0.12	1.0	ug/Kg	36-111	36-111	40
8081B	alpha-Chlordane	5103-71-9	Tissue	0.24	1.0	ug/Kg	39-111	39-111	40
8081B	beta-BHC	319-85-7	Tissue	0.53	1.0	ug/Kg	37-106	37-106	40
8081B	Chlordane	57-74-9	Tissue	3.1	10	ug/Kg	47-103	47-103	40
8081B	Chlorpyrifos	2921-88-2	Tissue	0.26	1.0	ug/Kg	18-108	18-108	40
8081B	cis-Nonachlor	5103-73-1	Tissue	0.22	1.0	ug/Kg	34-102	34-102	40
8081B	delta-BHC	319-86-8	Tissue	0.18	1.0	ug/Kg	41-117	41-117	40
8081B	Dieldrin	60-57-1	Tissue	0.23	1.0	ug/Kg	40-109	40-109	40
8081B	Endosulfan I	959-98-8	Tissue	0.28	1.0	ug/Kg	35-100	35-100	40
8081B	Endosulfan II	33213-65-9	Tissue	0.30	1.0	ug/Kg	38-102	38-102	40
8081B	Endosulfan Sulfate	1031-07-8	Tissue	0.25	1.0	ug/Kg	43-107	43-107	40
8081B	Endrin	72-20-8	Tissue	0.21	1.0	ug/Kg	37-126	37-126	40
8081B	Endrin Aldehyde	7421-93-4	Tissue	0.40	1.0	ug/Kg	24-100	24-100	40
8081B	Endrin Ketone	53494-70-5	Tissue	0.34	1.0	ug/Kg	39-112	39-112	40
8081B	gamma-BHC (Lindane)	58-89-9	Tissue	0.21	1.0	ug/Kg	38-113	38-113	40
8081B	gamma-Chlordane	5103-74-2	Tissue	0.20	1.0	ug/Kg	38-110	38-110	40
8081B	Heptachlor	76-44-8	Tissue	0.13	1.0	ug/Kg	40-111	40-111	40
8081B	Heptachlor Epoxide	1024-57-3	Tissue	0.28	1.0	ug/Kg	41-100	41-100	40
8081B	Hexachlorobenzene	118-74-1	Tissue	0.15	1.0	ug/Kg	20-102	20-102	40
8081B	Hexachlorobutadiene	87-68-3	Tissue	0.34	1.0	ug/Kg	10-100	10-100	40
8081B	Hexachloroethane	67-72-1	Tissue	0.17	1.0	ug/Kg	10-100	10-100	40
8081B	Isodrin	465-73-6	Tissue	0.18	1.0	ug/Kg	20-119	20-119	40
8081B	Methoxychlor	72-43-5	Tissue	0.61	1.0	ug/Kg	45-122	45-122	40
8081B	Mirex	2385-85-5	Tissue	0.24	1.0	ug/Kg	20-101	20-101	40
8081B	Oxychlordane	27304-13-8	Tissue	0.29	1.0	ug/Kg	34-100	34-100	40
8081B	Toxaphene	8001-35-2	Tissue	9.3	50	ug/Kg	38-126	38-126	40
8081B	trans-Nonachlor	39765-80-5	Tissue	0.24	1.0	ug/Kg	36-105	36-105	40
8081B	Decachlorobiphenyl (Surr.)	2051-24-3	Tissue	NA	NA	%	19-121	-	-
8081B	Tetrachloro-m-xylene (Surr.)	877-09-8	Tissue	NA	NA	%	27-107	-	-

a Method Detection Limits are subject to change as new MDL studies are completed.

a MDL is the smallest analyte concentration that can be demonstrated to be different from zero with 99% confidence

b The LOD is the smallest amount of a substance that must be present in a sample in order to be detected with 99% confidence.

Verification is acceptable if the response is > 3x instrument noise & 2nd column confirmed or pattern.

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Organochlorine Pesticides by EPA Method 8081A in Soil											
EPA 8081A	alpha-BHC	0.22	2.0	ug/kg dry wt	-	20	68.5-146	20	71.2-135	20	319-84-6
EPA 8081A	alpha-BHC [2C]	0.31	2.0	ug/kg dry wt	-	20	46.9-184	20	71.2-135	20	319-84-6
EPA 8081A	beta-BHC	1.6	2.0	ug/kg dry wt	-	20	62.6-144	20	76.7-128	20	319-85-7
EPA 8081A	beta-BHC [2C]	0.37	2.0	ug/kg dry wt	-	20	36.8-186	20	76.7-128	20	319-85-7
EPA 8081A	gamma-BHC (Lindane)	0.24	2.0	ug/kg dry wt	-	20	65.3-149	20	73.3-134	20	58-89-9
EPA 8081A	gamma-BHC (Lindane) [2C]	0.29	2.0	ug/kg dry wt	-	20	47.9-187	20	73.3-134	20	58-89-9
EPA 8081A	delta-BHC	0.22	2.0	ug/kg dry wt	-	20	62.4-148	20	70.7-136	20	319-86-8
EPA 8081A	delta-BHC [2C]	0.37	2.0	ug/kg dry wt	-	20	42.7-191	20	70.7-136	20	319-86-8
EPA 8081A	Heptachlor	0.22	2.0	ug/kg dry wt	-	20	67.1-141	20	70.2-135	20	76-44-8
EPA 8081A	Heptachlor [2C]	0.27	2.0	ug/kg dry wt	-	20	43.9-175	20	70.2-135	20	76-44-8
EPA 8081A	Aldrin	0.19	2.0	ug/kg dry wt	-	20	69.2-137	20	71.5-130	20	309-00-2
EPA 8081A	Aldrin [2C]	0.40	2.0	ug/kg dry wt	-	20	51.2-173	20	71.5-130	20	309-00-2
EPA 8081A	Heptachlor epoxide	0.24	2.0	ug/kg dry wt	-	20	68.3-142	20	66.3-140	20	1024-57-3
EPA 8081A	Heptachlor epoxide [2C]	0.32	2.0	ug/kg dry wt	-	20	53.2-177	20	66.3-140	20	1024-57-3
EPA 8081A	gamma-Chlordane	0.36	2.0	ug/kg dry wt	-	20	65.1-141	20	70.5-134	20	5566-34-7
EPA 8081A	gamma-Chlordane [2C]	0.30	2.0	ug/kg dry wt	-	20	51.8-177	20	70.5-134	20	5566-34-7
EPA 8081A	Endosulfan I	0.36	2.0	ug/kg dry wt	-	20	67.5-137	20	63.8-139	20	959-98-8
EPA 8081A	Endosulfan I [2C]	0.36	2.0	ug/kg dry wt	-	20	67.5-137	20	63.8-139	20	959-98-8
EPA 8081A	alpha-Chlordane	0.25	2.0	ug/kg dry wt	-	20	67.5-144	20	72.6-136	20	5103-71-9
EPA 8081A	alpha-Chlordane [2C]	0.25	2.0	ug/kg dry wt	-	20	67.5-144	20	72.6-136	20	5103-71-9
EPA 8081A	4,4´-DDE	0.35	4.0	ug/kg dry wt	-	20	70.6-141	20	74.1-132	20	72-55-9
EPA 8081A	4,4´-DDE [2C]	0.59	4.0	ug/kg dry wt	-	20	57.2-166	20	74.1-132	20	72-55-9
EPA 8081A	Dieldrin	0.47	4.0	ug/kg dry wt	-	20	52.6-156	20	70.9-135	20	60-57-1
EPA 8081A	Dieldrin [2C]	0.51	4.0	ug/kg dry wt	-	20	37.7-187	20	70.9-135	20	60-57-1
EPA 8081A	Endrin	0.39	4.0	ug/kg dry wt	-	20	38.6-163	20	60.4-140	20	72-20-8
EPA 8081A	Endrin [2C]	0.62	4.0	ug/kg dry wt	-	20	38.1-180	20	60.4-140	20	72-20-8
EPA 8081A	Endosulfan II	0.60	4.0	ug/kg dry wt	-	20	59.2-143	20	69.8-134	20	33213-65-9
EPA 8081A	Endosulfan II [2C]	0.76	4.0	ug/kg dry wt	-	20	57.7-158	20	69.8-134	20	33213-65-9
EPA 8081A	4,4´-DDD	0.64	4.0	ug/kg dry wt	-	20	64.2-145	20	70-135	20	72-54-8
EPA 8081A	4,4´-DDD [2C]	0.93	4.0	ug/kg dry wt	-	20	59.4-153	20	70-135	20	72-54-8
EPA 8081A	Endrin aldehyde	0.69	4.0	ug/kg dry wt	-	20	51.7-136	20	62.3-135	20	7421-93-4
EPA 8081A	Endrin aldehyde [2C]	0.68	4.0	ug/kg dry wt	-	20	46.7-173	20	62.3-135	20	7421-93-4
EPA 8081A	Endosulfan sulfate	1.0	4.0	ug/kg dry wt	-	20	40.3-154	20	66.4-135	20	1031-07-8
EPA 8081A	Endosulfan sulfate [2C]	0.69	4.0	ug/kg dry wt	-	20	42.8-168	20	66.4-135	20	1031-07-8
EPA 8081A	4,4´-DDT	0.44	4.0	ug/kg dry wt	-	20	47.3-153	20	66.1-136	20	50-29-3
EPA 8081A	4,4´-DDT [2C]	0.61	4.0	ug/kg dry wt	-	20	50.5-162	20	66.1-136	20	50-29-3
EPA 8081A	Endrin ketone	0.56	4.0	ug/kg dry wt	-	20	72.9-137	20	73.7-140	20	53494-70-5
EPA 8081A	Endrin ketone [2C]	0.73	4.0	ug/kg dry wt	-	20	43.7-169	20	73.7-140	20	53494-70-5
EPA 8081A	Methoxychlor	3.2	20	ug/kg dry wt	-	20	32.6-162	20	58.3-145	20	72-43-5
EPA 8081A	Methoxychlor [2C]	4.7	20	ug/kg dry wt	-	20	26.5-165	20	58.3-145	20	72-43-5
EPA 8081A	Chlordane (tech)	4.4	40	ug/kg dry wt	-	20	46.8-142	20	60-140	20	57-74-9
EPA 8081A	Toxaphene	31	100	ug/kg dry wt	-	20	31.1-155	20	62.6-140	20	8001-35-2
EPA 8081A	Decachlorobiphenyl			Surrogate	64.4-149	20	64.4-149	20	64.4-149	20	2051-24-3
EPA 8081A	Decachlorobiphenyl [2C]			Surrogate	75.2-162	20	75.2-162	20	75.2-162	20	2051-24-3
EPA 8081A	Tetrachloro-meta-xylene			Surrogate	73-138	20	73-138	20	73-138	20	877-09-8
EPA 8081A	Tetrachloro-meta-xylene [2C]			Surrogate	64.1-188	20	64.1-188	20	64.1-188	20	877-09-8
Organochlorine Pesticides by EPA Method 8081A in Water											
EPA 8081A	alpha-BHC	0.0011	0.010	ug/L	-	20	32.5-152	20	35.8-138	20	319-84-6

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Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8081A	alpha-BHC	0.0063	0.025	ug/L	-	20	75.4-154	20	60-140	20	319-84-6
EPA 8081A	alpha-BHC [2C]	0.0011	0.010	ug/L	-	20	32.5-152	20	35.8-138	20	319-84-6
EPA 8081A	alpha-BHC [2C]	0.0063	0.025	ug/L	-	20	75.4-154	20	60-140	20	319-84-6
EPA 8081A	beta-BHC	0.0010	0.010	ug/L	-	20	42.8-146	20	49.2-141	20	319-85-7
EPA 8081A	beta-BHC	0.010	0.025	ug/L	-	20	73.2-153	20	60-140	20	319-85-7
EPA 8081A	beta-BHC [2C]	0.0010	0.010	ug/L	-	20	42.8-146	20	49.2-141	20	319-85-7
EPA 8081A	beta-BHC [2C]	0.0060	0.025	ug/L	-	20	73.2-153	20	60-140	20	319-85-7
EPA 8081A	gamma-BHC (Lindane)	0.0011	0.010	ug/L	-	20	38.2-150	20	42.2-135	20	58-89-9
EPA 8081A	gamma-BHC (Lindane)	0.0059	0.025	ug/L	-	20	74.6-153	20	60-140	20	58-89-9
EPA 8081A	gamma-BHC (Lindane) [2C]	0.0011	0.010	ug/L	-	20	38.2-150	20	42.2-135	20	58-89-9
EPA 8081A	gamma-BHC (Lindane) [2C]	0.0060	0.025	ug/L	-	20	74.6-153	20	60-140	20	58-89-9
EPA 8081A	delta-BHC	0.0033	0.010	ug/L	-	20	49.2-143	20	55.3-131	20	319-86-8
EPA 8081A	delta-BHC	0.0045	0.025	ug/L	-	20	76.5-153	20	60-140	20	319-86-8
EPA 8081A	delta-BHC [2C]	0.0033	0.010	ug/L	-	20	49.2-143	20	55.3-131	20	319-86-8
EPA 8081A	delta-BHC [2C]	0.0058	0.025	ug/L	-	20	76.5-153	20	60-140	20	319-86-8
EPA 8081A	Heptachlor	0.0051	0.010	ug/L	-	20	26.7-150	20	29.6-117	20	76-44-8
EPA 8081A	Heptachlor	0.0064	0.025	ug/L	-	20	71.1-150	20	60-140	20	76-44-8
EPA 8081A	Heptachlor [2C]	0.0051	0.010	ug/L	-	20	26.7-150	20	29.6-117	20	76-44-8
EPA 8081A	Heptachlor [2C]	0.0069	0.025	ug/L	-	20	71.1-150	20	60-140	20	76-44-8
EPA 8081A	Aldrin	0.00093	0.010	ug/L	-	20	23.7-146	20	26.7-117	20	309-00-2
EPA 8081A	Aldrin	0.0063	0.025	ug/L	-	20	73.4-149	20	60-140	20	309-00-2
EPA 8081A	Aldrin [2C]	0.00093	0.010	ug/L	-	20	23.7-146	20	26.7-117	20	309-00-2
EPA 8081A	Aldrin [2C]	0.0056	0.025	ug/L	-	20	73.4-149	20	60-140	20	309-00-2
EPA 8081A	Heptachlor epoxide	0.0010	0.010	ug/L	-	20	43.9-142	20	46.7-136	20	1024-57-3
EPA 8081A	Heptachlor epoxide	0.0049	0.025	ug/L	-	20	75.8-150	20	60-140	20	1024-57-3
EPA 8081A	Heptachlor epoxide [2C]	0.0010	0.010	ug/L	-	20	43.9-142	20	46.7-136	20	1024-57-3
EPA 8081A	Heptachlor epoxide [2C]	0.0059	0.025	ug/L	-	20	75.8-150	20	60-140	20	1024-57-3
EPA 8081A	gamma-Chlordane	0.00099	0.010	ug/L	-	20	44.6-140	20	53.6-126	20	5566-34-7
EPA 8081A	gamma-Chlordane	0.0045	0.025	ug/L	-	20	75-150	20	60-140	20	5566-34-7
EPA 8081A	gamma-Chlordane [2C]	0.00099	0.010	ug/L	-	20	44.6-140	20	53.6-126	20	5566-34-7
EPA 8081A	gamma-Chlordane [2C]	0.0057	0.025	ug/L	-	20	75-150	20	60-140	20	5566-34-7
EPA 8081A	Endosulfan I	0.00078	0.010	ug/L	-	20	42.3-172	20	55.5-128	20	959-98-8
EPA 8081A	Endosulfan I	0.0046	0.025	ug/L	-	20	78-138	20	60-140	20	959-98-8
EPA 8081A	Endosulfan I [2C]	0.00078	0.010	ug/L	-	20	42.3-172	20	55.5-128	20	959-98-8
EPA 8081A	Endosulfan I [2C]	0.0046	0.025	ug/L	-	20	78-138	20	60-140	20	959-98-8
EPA 8081A	alpha-Chlordane	0.00074	0.010	ug/L	-	20	44.1-142	20	55.6-126	20	5103-71-9
EPA 8081A	alpha-Chlordane	0.0046	0.025	ug/L	-	20	80-148	20	60-140	20	5103-71-9
EPA 8081A	alpha-Chlordane [2C]	0.00074	0.010	ug/L	-	20	44.1-142	20	55.6-126	20	5103-71-9
EPA 8081A	alpha-Chlordane [2C]	0.0046	0.025	ug/L	-	20	80-148	20	60-140	20	5103-71-9
EPA 8081A	4,4´-DDE	0.0017	0.020	ug/L	-	20	45.7-145	20	56.9-126	20	72-55-9
EPA 8081A	4,4´-DDE	0.010	0.050	ug/L	-	20	77.7-147	20	60-140	20	72-55-9
EPA 8081A	4,4´-DDE [2C]	0.0017	0.020	ug/L	-	20	45.7-145	20	56.9-126	20	72-55-9
EPA 8081A	4,4´-DDE [2C]	0.012	0.050	ug/L	-	20	77.7-147	20	60-140	20	72-55-9
EPA 8081A	Dieldrin	0.0016	0.020	ug/L	-	20	47.6-145	20	55.8-127	20	60-57-1
EPA 8081A	Dieldrin	0.0088	0.050	ug/L	-	20	76.1-142	20	60-140	20	60-57-1
EPA 8081A	Dieldrin [2C]	0.0016	0.020	ug/L	-	20	47.6-145	20	55.8-127	20	60-57-1
EPA 8081A	Dieldrin [2C]	0.0096	0.050	ug/L	-	20	76.1-142	20	60-140	20	60-57-1
EPA 8081A	Endrin	0.0016	0.020	ug/L	-	20	49-147	20	49.4-132	20	72-20-8
EPA 8081A	Endrin	0.013	0.050	ug/L	-	20	62.2-156	20	60-140	20	72-20-8
EPA 8081A	Endrin [2C]	0.0016	0.020	ug/L	-	20	49-147	20	49.4-132	20	72-20-8
EPA 8081A	Endrin [2C]	0.012	0.050	ug/L	-	20	62.2-156	20	60-140	20	72-20-8
EPA 8081A	Endosulfan II	0.0018	0.020	ug/L	-	20	47.1-148	20	59.2-130	20	33213-65-9
EPA 8081A	Endosulfan II	0.0084	0.050	ug/L	-	20	76.8-141	20	60-140	20	33213-65-9
EPA 8081A	Endosulfan II [2C]	0.0018	0.020	ug/L	-	20	47.1-148	20	59.2-130	20	33213-65-9

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8081A	Endosulfan II [2C]	0.010	0.050	ug/L	-	20	76.8-141	20	60-140	20	33213-65-9
EPA 8081A	4,4´-DDD	0.0015	0.020	ug/L	-	20	49.4-147	20	61.6-132	20	72-54-8
EPA 8081A	4,4´-DDD	0.011	0.050	ug/L	-	20	74.8-143	20	60-140	20	72-54-8
EPA 8081A	4,4´-DDD [2C]	0.0015	0.020	ug/L	-	20	49.4-147	20	61.6-132	20	72-54-8
EPA 8081A	4,4´-DDD [2C]	0.013	0.050	ug/L	-	20	74.8-143	20	60-140	20	72-54-8
EPA 8081A	Endrin aldehyde	0.0022	0.020	ug/L	-	20	49.4-122	20	54.7-130	20	7421-93-4
EPA 8081A	Endrin aldehyde	0.0086	0.050	ug/L	-	20	33.7-160	20	60-140	20	7421-93-4
EPA 8081A	Endrin aldehyde [2C]	0.0022	0.020	ug/L	-	20	49.4-122	20	54.7-130	20	7421-93-4
EPA 8081A	Endrin aldehyde [2C]	0.011	0.050	ug/L	-	20	33.7-160	20	60-140	20	7421-93-4
EPA 8081A	Endosulfan sulfate	0.0039	0.020	ug/L	-	20	48.2-148	20	54.4-135	20	1031-07-8
EPA 8081A	Endosulfan sulfate	0.013	0.050	ug/L	-	20	67.9-141	20	60-140	20	1031-07-8
EPA 8081A	Endosulfan sulfate [2C]	0.0039	0.020	ug/L	-	20	48.2-148	20	54.4-135	20	1031-07-8
EPA 8081A	Endosulfan sulfate [2C]	0.011	0.050	ug/L	-	20	67.9-141	20	60-140	20	1031-07-8
EPA 8081A	4,4´-DDT	0.0016	0.020	ug/L	-	20	45-147	20	57.6-135	20	50-29-3
EPA 8081A	4,4´-DDT	0.012	0.050	ug/L	-	20	74.7-142	20	60-140	20	50-29-3
EPA 8081A	4,4´-DDT [2C]	0.0016	0.020	ug/L	-	20	45-147	20	57.6-135	20	50-29-3
EPA 8081A	4,4´-DDT [2C]	0.012	0.050	ug/L	-	20	74.7-142	20	60-140	20	50-29-3
EPA 8081A	Endrin ketone	0.0018	0.020	ug/L	-	20	53.9-148	20	68.5-136	20	53494-70-5
EPA 8081A	Endrin ketone	0.0079	0.050	ug/L	-	20	78.9-144	20	60-140	20	53494-70-5
EPA 8081A	Endrin ketone [2C]	0.0018	0.020	ug/L	-	20	53.9-148	20	68.5-136	20	53494-70-5
EPA 8081A	Endrin ketone [2C]	0.011	0.050	ug/L	-	20	78.9-144	20	60-140	20	53494-70-5
EPA 8081A	Methoxychlor	0.0092	0.10	ug/L	-	20	45.3-152	20	66.4-131	20	72-43-5
EPA 8081A	Methoxychlor	0.088	0.25	ug/L	-	20	71.7-146	20	60-140	20	72-43-5
EPA 8081A	Methoxychlor [2C]	0.0092	0.10	ug/L	-	20	45.3-152	20	66.4-131	20	72-43-5
EPA 8081A	Methoxychlor [2C]	0.072	0.25	ug/L	-	20	71.7-146	20	60-140	20	72-43-5
EPA 8081A	Chlordane (tech)	0.024	0.20	ug/L	-	20	60-140	20	60-140	20	57-74-9
EPA 8081A	Chlordane (tech)	0.042	0.50	ug/L	-	20	55.9-147	20	60-140	20	57-74-9
EPA 8081A	Toxaphene	0.28	1.3	ug/L	-	20	51.2-175	20	60-140	20	8001-35-2
EPA 8081A	Toxaphene	0.70	1.0	ug/L	-	20	60-140	20	60-140	20	8001-35-2
EPA 8081A	Decachlorobiphenyl			Surrogate	35.3-130	20	35.3-130	20	35.3-130	20	2051-24-3
EPA 8081A	Decachlorobiphenyl			Surrogate	37.4-150	20	37.4-150	20	37.4-150	20	2051-24-3
EPA 8081A	Decachlorobiphenyl [2C]			Surrogate	35.3-130	20	35.3-130	20	35.3-130	20	2051-24-3
EPA 8081A	Decachlorobiphenyl [2C]			Surrogate	42.4-169	20	42.4-169	20	42.4-169	20	2051-24-3
EPA 8081A	Tetrachloro-meta-xylene			Surrogate	21.7-126	20	21.7-126	20	21.7-126	20	877-09-8
EPA 8081A	Tetrachloro-meta-xylene			Surrogate	31.1-155	20	31.1-155	20	31.1-155	20	877-09-8
EPA 8081A	Tetrachloro-meta-xylene [2C]			Surrogate	21.7-126	20	21.7-126	20	21.7-126	20	877-09-8
EPA 8081A	Tetrachloro-meta-xylene [2C]			Surrogate	57.8-135	20	57.8-135	20	57.8-135	20	877-09-8

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Volatile Organic Compounds by Method 8260 - Direct Inject in Soil											
EPA 8260B	1,1,1-Trichloroethane	9.1	25	ug/kg dry wt	-	20	44.5-153	20	71.4-133	20	71-55-6
EPA 8260B	1,1,2,2-Tetrachloroethane	13	25	ug/kg dry wt	-	20	76.5-112	20	36.1-148	20	79-34-5
EPA 8260B	1,1,2-Trichloroethane	9.2	25	ug/kg dry wt	-	20	16-160	20	69.6-128	20	79-00-5
EPA 8260B	1,1-Dichloroethane	3.9	25	ug/kg dry wt	-	20	40.7-156	20	64.9-140	20	75-34-3
EPA 8260B	1,1-Dichloroethene	5.9	25	ug/kg dry wt	-	20	19.9-199	20	48.8-167	20	75-35-4
EPA 8260B	1,2,3-Trichlorobenzene	2.7	25	ug/kg dry wt	-	20	52-117	20	73.1-122	20	87-61-6
EPA 8260B	1,2,4-Trichlorobenzene	3.2	25	ug/kg dry wt	-	20	58.7-116	20	80.3-118	20	120-82-1
EPA 8260B	1,2,4-Trimethylbenzene	5.8	25	ug/kg dry wt	-	20	66.1-129	20	57.2-139	20	95-63-6
EPA 8260B	1,2-Dichlorobenzene	2.9	25	ug/kg dry wt	-	20	71.9-113	20	87.7-118	20	95-50-1
EPA 8260B	1,2-Dichloroethane	4.8	25	ug/kg dry wt	-	20	57.1-134	20	63.7-139	20	107-06-2
EPA 8260B	1,3,5-Trimethylbenzene	1.9	25	ug/kg dry wt	-	20	65.4-133	20	32-159	20	108-67-8
EPA 8260B	1,3-Dichlorobenzene	2.8	25	ug/kg dry wt	-	20	62.7-125	20	88.8-116	20	541-73-1
EPA 8260B	1,4-Dichlorobenzene	2.7	25	ug/kg dry wt	-	20	81.2-106	20	92.2-121	20	106-46-7
EPA 8260B	2-Chlorotoluene	6.0	25	ug/kg dry wt	-	20	67.4-133	20	87.3-130	20	95-49-8
EPA 8260B	4-Chlorotoluene	3.4	25	ug/kg dry wt	-	20	63.3-132	20	92.4-126	20	106-43-4
EPA 8260B	Benzene	3.6	25	ug/kg dry wt	-	20	57.3-149	20	78.5-125	20	71-43-2
EPA 8260B	Carbon tetrachloride	6.3	25	ug/kg dry wt	-	20	59.5-136	20	82.4-127	20	56-23-5
EPA 8260B	Chlorobenzene	4.9	25	ug/kg dry wt	-	20	74.2-118	20	93.4-115	20	108-90-7
EPA 8260B	Chloroform	3.3	25	ug/kg dry wt	-	20	73-118	20	76.1-134	20	67-66-3
EPA 8260B	Chloromethane	6.7	50	ug/kg dry wt	-	20	9.4-195	20	49.5-197	20	74-87-3
EPA 8260B	cis-1,2-Dichloroethene	8.9	25	ug/kg dry wt	-	20	26.5-170	20	62.9-140	20	156-59-2
EPA 8260B	Ethylbenzene	6.5	25	ug/kg dry wt	-	20	74.2-129	20	80.5-125	20	100-41-4
EPA 8260B	Isopropylbenzene	2.6	25	ug/kg dry wt	-	20	74.2-123	20	91.2-121	20	98-82-8
EPA 8260B	m,p-Xylene	5.4	50	ug/kg dry wt	-	20	69.6-129	20	83.7-119	20	108-38-3/1
EPA 8260B	Methylene chloride	11	100	ug/kg dry wt	-	20	67.2-127	20	83.2-129	20	75-09-2
EPA 8260B	Naphthalene	2.2	25	ug/kg dry wt	-	20	51.2-119	20	64.2-125	20	91-20-3
EPA 8260B	n-Butyl Benzene	7.6	25	ug/kg dry wt	-	20	70.8-124	20	90.2-122	20	104-51-8
EPA 8260B	n-Propyl Benzene	4.3	25	ug/kg dry wt	-	20	64.2-140	20	84-139	20	103-65-1
EPA 8260B	o-Xylene	4.1	25	ug/kg dry wt	-	20	58.7-141	20	85.1-117	20	95-47-6
EPA 8260B	p-Isopropyltoluene	12	25	ug/kg dry wt	-	20	69.8-128	20	89-129	20	99-87-6
EPA 8260B	sec-Butyl Benzene	8.6	25	ug/kg dry wt	-	20	68.2-129	20	87.6-126	20	135-98-8
EPA 8260B	Styrene	4.3	25	ug/kg dry wt	-	20	70.5-119	20	89-120	20	100-42-5
EPA 8260B	tert-Butylbenzene	8.0	25	ug/kg dry wt	-	20	68.3-131	20	83.4-139	20	98-06-6
EPA 8260B	Tetrachloroethene	4.7	25	ug/kg dry wt	-	20	32.1-167	20	62.9-145	20	127-18-4
EPA 8260B	Toluene	4.0	25	ug/kg dry wt	-	20	65.5-134	20	79.9-123	20	108-88-3
EPA 8260B	trans-1,2-Dichloroethene	9.5	25	ug/kg dry wt	-	20	12.6-184	20	58.7-152	20	156-60-5
EPA 8260B	Trichloroethene	2.9	25	ug/kg dry wt	-	20	11.5-220	20	56.9-152	20	79-01-6
EPA 8260B	Vinyl chloride	16	25	ug/kg dry wt	-	20	13.8-190	20	22.7-199	20	75-01-4
EPA 8260B	Xylenes, total		25	ug/kg dry wt	-	-	-	-	-	-	1330-20-7
EPA 8260B	1,1,1,2-Tetrachloroethane	0.15	250	ug/kg dry wt	-	20	70-130	20	70-130	20	630-20-6
EPA 8260B	1,1,2-Trichlorotrifluoroethane	0.20	250	ug/kg dry wt	-	20	70-130	20	70-130	20	76-13-1
EPA 8260B	1,1-Dichloropropene	0.10	250	ug/kg dry wt	-	20	70-130	20	70-130	20	563-58-6
EPA 8260B	1,2,3-Trichloropropane	0.83	250	ug/kg dry wt	-	20	70-130	20	70-130	20	96-18-4
EPA 8260B	1,2-Dibromo-3-chloropropan	0.23	250	ug/kg dry wt	-	20	70-130	20	60-140	20	96-12-8
EPA 8260B	1,2-Dibromoethane (EDB)	0.15	250	ug/kg dry wt	-	20	70-130	20	70-130	20	106-93-4
EPA 8260B	1,2-Dichloropropane	0.13	250	ug/kg dry wt	-	20	70-130	20	80-120	20	78-87-5
EPA 8260B	1,3-Dichloropropane	0.16	250	ug/kg dry wt	-	20	70-130	20	70-130	20	142-28-9
EPA 8260B	2,2-Dichloropropane	0.27	250	ug/kg dry wt	-	20	70-130	20	70-130	20	590-20-7
EPA 8260B	2-Butanone	12	250	ug/kg dry wt	-	20	70-130	20	0-200	20	78-93-3
EPA 8260B	2-Hexanone	16	250	ug/kg dry wt	-	20	70-130	20	0-200	20	591-78-6

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Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8260B	4-Methyl-2-pentanone	10	250	ug/kg dry wt	-	20	70-130	20	0-200	20	108-10-1
EPA 8260B	Acetone	17	250	ug/kg dry wt	-	20	70-130	20	0-200	20	67-64-1
EPA 8260B	Bromobenzene	0.14	250	ug/kg dry wt	-	20	70-130	20	70-130	20	108-86-1
EPA 8260B	Bromochloromethane	0.14	250	ug/kg dry wt	-	20	70-130	20	70-130	20	74-97-5
EPA 8260B	Bromodichloromethane	0.12	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-27-4
EPA 8260B	Bromoform	0.14	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-25-2
EPA 8260B	Bromomethane	0.88	250	ug/kg dry wt	-	20	70-130	20	0-200	20	74-83-9
EPA 8260B	Carbon disulfide	0.13	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-15-0
EPA 8260B	Chloroethane	0.90	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-00-3
EPA 8260B	cis-1,3-Dichloropropene	0.15	250	ug/kg dry wt	-	20	70-130	20	70-130	20	10061-01-5
EPA 8260B	Dibromochloromethane	0.17	250	ug/kg dry wt	-	20	70-130	20	70-130	20	124-48-1
EPA 8260B	Dibromomethane	0.19	250	ug/kg dry wt	-	20	70-130	20	70-130	20	74-95-3
EPA 8260B	Dichlorodifluoromethane	0.15	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-71-8
EPA 8260B	Diisopropyl Ether	0.13	250	ug/kg dry wt	-	20	70-130	20	70-130	20	108-20-3
EPA 8260B	Hexachlorobutadiene	0.82	250	ug/kg dry wt	-	20	70-130	20	70-130	20	87-68-3
EPA 8260B	Methyl t-Butyl Ether	0.14	250	ug/kg dry wt	-	20	70-130	20	70-130	20	1634-04-4
EPA 8260B	n-Hexane	0.13	250	ug/kg dry wt	-	20	70-130	20	70-130	20	110-54-3
EPA 8260B	Tetrahydrofuran	4.4	250	ug/kg dry wt	-	20	70-130	20	0-200	20	109-99-9
EPA 8260B	trans-1,3-Dichloropropene	0.13	250	ug/kg dry wt	-	20	70-130	20	70-130	20	10061-02-6
EPA 8260B	Trichlorofluoromethane	0.075	250	ug/kg dry wt	-	20	70-130	20	70-130	20	75-69-4
EPA 8260B	1,2-Dichloroethane-d4			Surrogate	56.4-179	20	56.4-179	20	56.4-179	20	10706-07-0
EPA 8260B	1-Bromo-2-chloroethane			Surrogate	75-118	20	75-118	20	75-118	20	00107-04-0
EPA 8260B	Dibromofluoromethane			Surrogate	70-130	20	70-130	20	70-130	20	1868-53-7
EPA 8260B	Toluene-d8			Surrogate	71.3-111	20	71.3-111	20	71.3-111	20	2037-26-5
EPA 8260B	4-Bromofluorobenzene			Surrogate	69.2-113	20	69.2-113	20	69.2-113	20	460-00-4
EPA 8260B	1,4-Difluorobenzene			ug/kg dry wt	-	-	-	-	-	-	540-36-3
EPA 8260B	Chlorobenzene-d5			ug/kg dry wt	-	-	-	-	-	-	3114-55-4
EPA 8260B	1,4-Dichlorobenzene-d4			ug/kg dry wt	-	-	-	-	-	-	NA
EPA 8260B	Pentafluorobenzene			ug/kg dry wt	-	-	-	-	-	-	NA
Volatile Organic Compounds by Method 8260 - Direct Inject in Water											
EPA 8260B	1,4-Dioxane	1.0	25	ug/L	-	-	70-130	20	70-130	20	123-91-1
EPA 8260B	Ethyl Acrylate	50	100	ug/L	-	-	70-130	20	70-130	20	140-88-5
EPA 8260B	Methyl Methacrylate	50	100	ug/L	-	-	70-130	20	70-130	20	80-62-6
EPA 8260B	Benzene	3.6	25	ug/L	-	20	65.5-125	20	80.9-127	20	71-43-2
EPA 8260B	Ethylbenzene	6.5	25	ug/L	-	20	74-137	20	81.5-132	20	100-41-4
EPA 8260B	m,p-Xylene	5.4	50	ug/L	-	20	68.1-127	20	42.9-156	20	108-38-3/1
EPA 8260B	o-Xylene	4.1	25	ug/L	-	20	70.9-123	20	86.8-119	20	95-47-6
EPA 8260B	Toluene	4.0	25	ug/L	-	20	75.1-124	20	83-135	20	108-88-3
EPA 8260B	Trichloroethene		5000	ug/L	-	20	11.5-220	20	56.9-152	20	79-01-6
EPA 8260B	Xylenes, total		25	ug/L	-	-	-	-	-	-	1330-20-7
EPA 8260B	Methyl t-Butyl Ether	0.14	25	ug/L	-	20	70-130	20	70-130	20	1634-04-4
EPA 8260B	1,4-dioxane-d8			Surrogate	60-140	-	-	-	-	-	17647-74-4
EPA 8260B	1-Bromo-2-chloroethane			Surrogate	69.4-126	20	69.4-126	20	69.4-126	20	00107-04-0
EPA 8260B	Toluene-d8			Surrogate	76.5-127	20	76.5-127	20	76.5-127	20	2037-26-5
EPA 8260B	4-Bromofluorobenzene			Surrogate	77.6-122	20	77.6-122	20	77.6-122	20	460-00-4
EPA 8260B	1,4-Difluorobenzene			ug/L	-	-	-	-	-	-	540-36-3
EPA 8260B	Chlorobenzene-d5			ug/L	-	-	-	-	-	-	3114-55-4
EPA 8260B	1,4-Dichlorobenzene-d4			ug/L	-	-	-	-	-	-	NA
EPA 8260B	Pentafluorobenzene			ug/L	-	-	-	-	-	-	NA
Volatile Organic Compounds by Method 8260 - Purge and Trap in Soil											

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8260B	Acetone	290	1000	ug/kg dry wt	-	20	80.7-148	20	40.6-149	20	67-64-1
EPA 8260B	Benzene	2.5	25	ug/kg dry wt	-	20	71.2-129	20	72.3-124	20	71-43-2
EPA 8260B	Bromobenzene	2.6	25	ug/kg dry wt	-	20	84.2-119	20	70.6-121	20	108-86-1
EPA 8260B	Bromochloromethane	3.0	25	ug/kg dry wt	-	20	78.6-133	20	65.5-120	20	74-97-5
EPA 8260B	Bromodichloromethane	1.4	25	ug/kg dry wt	-	20	85.6-122	20	71.6-128	20	75-27-4
EPA 8260B	Bromoform	4.2	25	ug/kg dry wt	-	20	90-115	20	65.1-117	20	75-25-2
EPA 8260B	Bromomethane	49	250	ug/kg dry wt	-	20	42.1-191	20	16.7-169	20	74-83-9
EPA 8260B	2-Butanone	110	1000	ug/kg dry wt	-	20	77.3-139	20	62.9-130	20	78-93-3
EPA 8260B	n-Butyl Benzene	4.7	25	ug/kg dry wt	-	20	85.1-116	20	67.4-133	20	104-51-8
EPA 8260B	sec-Butyl Benzene	2.1	25	ug/kg dry wt	-	20	87-114	20	68-131	20	135-98-8
EPA 8260B	tert-Butylbenzene	3.2	25	ug/kg dry wt	-	20	81-116	20	71.7-120	20	98-06-6
EPA 8260B	Carbon disulfide	1.9	25	ug/kg dry wt	-	20	66-130	20	60.4-119	20	75-15-0
EPA 8260B	Carbon tetrachloride	5.7	25	ug/kg dry wt	-	20	62.9-157	20	61.2-125	20	56-23-5
EPA 8260B	Chlorobenzene	2.2	25	ug/kg dry wt	-	20	78.1-127	20	73.3-119	20	108-90-7
EPA 8260B	Chloroethane	150	250	ug/kg dry wt	-	20	50.8-198	20	15.9-178	20	75-00-3
EPA 8260B	Chloroform	2.6	25	ug/kg dry wt	-	20	77.2-135	20	55.6-142	20	67-66-3
EPA 8260B	Chloromethane	5.3	50	ug/kg dry wt	-	20	56.5-154	20	42.7-160	20	74-87-3
EPA 8260B	2-Chlorotoluene	2.1	25	ug/kg dry wt	-	20	84.1-122	20	70.5-127	20	95-49-8
EPA 8260B	4-Chlorotoluene	3.2	25	ug/kg dry wt	-	20	86.4-115	20	65.1-134	20	106-43-4
EPA 8260B	1,2-Dibromo-3-chloropropan	9.5	25	ug/kg dry wt	-	20	61.7-142	20	49.9-137	20	96-12-8
EPA 8260B	Dibromochloromethane	2.4	25	ug/kg dry wt	-	20	81-117	20	66.7-123	20	124-48-1
EPA 8260B	1,2-Dibromoethane (EDB)	4.1	25	ug/kg dry wt	-	20	82.8-124	20	67.1-123	20	106-93-4
EPA 8260B	Dibromomethane	4.2	25	ug/kg dry wt	-	20	78.3-129	20	68.2-130	20	74-95-3
EPA 8260B	1,2-Dichlorobenzene	2.3	25	ug/kg dry wt	-	20	87.8-117	20	73.3-121	20	95-50-1
EPA 8260B	1,4-Dichlorobenzene	2.0	25	ug/kg dry wt	-	20	86.1-119	20	67.8-129	20	106-46-7
EPA 8260B	1,3-Dichlorobenzene	2.3	25	ug/kg dry wt	-	20	88.3-114	20	72.5-124	20	541-73-1
EPA 8260B	Dichlorodifluoromethane	3.7	25	ug/kg dry wt	-	20	44.3-175	20	23.9-139	20	75-71-8
EPA 8260B	1,1-Dichloroethane	3.8	25	ug/kg dry wt	-	20	81.7-139	20	55-144	20	75-34-3
EPA 8260B	1,2-Dichloroethane	4.5	25	ug/kg dry wt	-	20	71.7-142	20	60.6-147	20	107-06-2
EPA 8260B	trans-1,2-Dichloroethene	4.5	25	ug/kg dry wt	-	20	52.3-166	20	52-144	20	156-60-5
EPA 8260B	cis-1,2-Dichloroethene	3.4	25	ug/kg dry wt	-	20	56.5-155	20	57.8-136	20	156-59-2
EPA 8260B	1,1-Dichloroethene	3.1	25	ug/kg dry wt	-	20	78.2-131	20	25.1-168	20	75-35-4
EPA 8260B	2,2-Dichloropropane	5.4	25	ug/kg dry wt	-	20	68.6-130	20	45.9-147	20	590-20-7
EPA 8260B	1,2-Dichloropropane	4.0	25	ug/kg dry wt	-	20	81-126	20	69.2-129	20	78-87-5
EPA 8260B	1,3-Dichloropropane	3.2	25	ug/kg dry wt	-	20	84.5-122	20	69.2-125	20	142-28-9
EPA 8260B	cis-1,3-Dichloropropene	3.4	25	ug/kg dry wt	-	20	72.3-126	20	67.2-122	20	10061-01-5
EPA 8260B	trans-1,3-Dichloropropene	5.3	25	ug/kg dry wt	-	20	84.7-115	20	59.3-133	20	10061-02-6
EPA 8260B	1,1-Dichloropropene	1.5	25	ug/kg dry wt	-	20	65.4-143	20	64.5-131	20	563-58-6
EPA 8260B	Diisopropyl Ether	5.7	25	ug/kg dry wt	-	20	83.1-120	20	61.6-128	20	108-20-3
EPA 8260B	Ethylbenzene	2.0	25	ug/kg dry wt	-	20	70.4-132	20	78.6-124	20	100-41-4
EPA 8260B	Hexachlorobutadiene	5.7	100	ug/kg dry wt	-	20	80.5-121	20	67.9-123	20	87-68-3
EPA 8260B	n-Hexane	8.7	25	ug/kg dry wt	-	20	82.6-119	20	46.1-149	20	110-54-3
EPA 8260B	2-Hexanone	77	1000	ug/kg dry wt	-	20	76.3-134	20	67.8-128	20	591-78-6
EPA 8260B	Isopropylbenzene	1.8	25	ug/kg dry wt	-	20	90.6-111	20	73.4-119	20	98-82-8
EPA 8260B	p-Isopropyltoluene	2.9	25	ug/kg dry wt	-	20	80.6-122	20	71.1-122	20	99-87-6
EPA 8260B	Methylene chloride	2.5	100	ug/kg dry wt	-	20	40.2-153	20	62.7-121	20	75-09-2
EPA 8260B	4-Methyl-2-pentanone	88	1000	ug/kg dry wt	-	20	82.6-129	20	75.1-130	20	108-10-1
EPA 8260B	Methyl t-Butyl Ether	3.6	25	ug/kg dry wt	-	20	80.5-130	20	57.5-139	20	1634-04-4
EPA 8260B	Naphthalene	7.5	250	ug/kg dry wt	-	20	42.9-153	20	75-114	20	91-20-3
EPA 8260B	n-Propyl Benzene	2.3	25	ug/kg dry wt	-	20	83.1-117	20	65.7-136	20	103-65-1
EPA 8260B	Styrene	1.5	25	ug/kg dry wt	-	20	82.3-117	20	73.2-118	20	100-42-5
EPA 8260B	1,1,1,2-Tetrachloroethane	2.4	25	ug/kg dry wt	-	20	81-121	20	65.5-126	20	630-20-6
EPA 8260B	1,1,2,2-Tetrachloroethane	6.6	25	ug/kg dry wt	-	20	59.4-148	20	44.5-132	20	79-34-5
EPA 8260B	Tetrachloroethene	3.7	25	ug/kg dry wt	-	20	74.5-127	20	62.1-136	20	127-18-4

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8260B	Tetrahydrofuran	58	500	ug/kg dry wt	-	20	81.4-125	20	62.7-124	20	109-99-9
EPA 8260B	Toluene	1.7	25	ug/kg dry wt	-	20	76.4-121	20	79.7-119	20	108-88-3
EPA 8260B	1,2,3-Trichlorobenzene	4.7	100	ug/kg dry wt	-	20	74.8-125	20	71-121	20	87-61-6
EPA 8260B	1,2,4-Trichlorobenzene	4.7	100	ug/kg dry wt	-	20	84.8-119	20	71.2-119	20	120-82-1
EPA 8260B	1,1,1-Trichloroethane	3.0	25	ug/kg dry wt	-	20	86.7-126	20	58-141	20	71-55-6
EPA 8260B	1,1,2-Trichloroethane	6.6	25	ug/kg dry wt	-	20	89-122	20	67.6-124	20	79-00-5
EPA 8260B	Trichloroethene	4.0	25	ug/kg dry wt	-	20	73.8-133	20	70.2-130	20	79-01-6
EPA 8260B	Trichlorofluoromethane	1.6	25	ug/kg dry wt	-	20	56.5-168	20	50.8-137	20	75-69-4
EPA 8260B	1,2,3-Trichloropropane	5.2	50	ug/kg dry wt	-	20	72.8-137	20	62-124	20	96-18-4
EPA 8260B	1,1,2-Trichlorotrifluoroethane	8.2	25	ug/kg dry wt	-	20	58.7-157	20	37.7-165	20	76-13-1
EPA 8260B	1,3,5-Trimethylbenzene	2.1	25	ug/kg dry wt	-	20	79.1-118	20	65.7-132	20	108-67-8
EPA 8260B	1,2,4-Trimethylbenzene	7.2	25	ug/kg dry wt	-	20	77.2-118	20	60.9-135	20	95-63-6
EPA 8260B	Vinyl chloride	7.6	25	ug/kg dry wt	-	20	64.3-137	20	41.5-142	20	75-01-4
EPA 8260B	m,p-Xylene	3.2	50	ug/kg dry wt	-	20	83.3-117	20	76.4-123	20	108-38-3/1
EPA 8260B	o-Xylene	2.3	25	ug/kg dry wt	-	20	11.6-167	20	77.1-117	20	95-47-6
EPA 8260B	1,4-Dioxane	11	100	ug/kg dry wt	-	-	70-130	20	70-130	20	123-91-1
EPA 8260B	Xylenes, total	75	75	ug/kg dry wt	-	-	-	-	-	-	1330-20-7
EPA 8260B	Gasoline Range Organics	2500	2500	ug/kg dry wt	-	20	70-130	20	70-130	20	NA
EPA 8260B	Dibromofluoromethane			Surrogate	93.8-116	20	93.8-116	20	93.8-116	20	1868-53-7
EPA 8260B	Toluene-d8			Surrogate	94.9-106	20	94.9-106	20	94.9-106	20	2037-26-5
EPA 8260B	4-Bromofluorobenzene			Surrogate	91.9-110	20	91.9-110	20	91.9-110	20	460-00-4
EPA 8260B	Pentafluorobenzene			ug/kg dry wt	-	-	-	-	-	-	NA
EPA 8260B	1,4-Difluorobenzene			ug/kg dry wt	-	-	-	-	-	-	540-36-3
EPA 8260B	Chlorobenzene-d5			ug/kg dry wt	-	-	-	-	-	-	3114-55-4
EPA 8260B	1,4-Dichlorobenzene-d4			ug/kg dry wt	-	-	-	-	-	-	NA
Volatile Organic Compounds by Method 8260 - Purge and Trap in Water											
EPA 8260B	Acetone	3.4	20	ug/L	-	20	42.5-137	20	50.8-145	20	67-64-1
EPA 8260B	Benzene	0.089	0.50	ug/L	-	20	67-130	20	76.4-125	20	71-43-2
EPA 8260B	Bromobenzene	0.084	0.50	ug/L	-	20	82.7-116	20	82.8-118	20	108-86-1
EPA 8260B	Bromochloromethane	0.31	0.50	ug/L	-	20	80.7-124	20	79-122	20	74-97-5
EPA 8260B	Bromodichloromethane	0.077	0.50	ug/L	-	20	72.9-120	20	72.3-129	20	75-27-4
EPA 8260B	Bromoform	0.088	0.50	ug/L	-	20	75.8-125	20	74.5-127	20	75-25-2
EPA 8260B	Bromomethane	0.59	5.0	ug/L	-	20	51.2-157	20	63.3-148	20	74-83-9
EPA 8260B	2-Butanone	3.0	20	ug/L	-	20	47.2-139	20	53.2-141	20	78-93-3
EPA 8260B	n-Butyl Benzene	0.14	0.50	ug/L	-	20	69.1-122	20	74.4-125	20	104-51-8
EPA 8260B	sec-Butyl Benzene	0.13	0.50	ug/L	-	20	75-119	20	78.9-122	20	135-98-8
EPA 8260B	tert-Butylbenzene	0.12	0.50	ug/L	-	20	73.7-119	20	77.8-121	20	98-06-6
EPA 8260B	Carbon disulfide	0.053	0.50	ug/L	-	20	70-130	20	70.3-131	20	75-15-0
EPA 8260B	Carbon tetrachloride	0.038	0.50	ug/L	-	20	66.2-134	20	70.8-127	20	56-23-5
EPA 8260B	Chlorobenzene	0.073	0.50	ug/L	-	20	86.4-115	20	82.6-121	20	108-90-7
EPA 8260B	Chloroethane	0.25	5.0	ug/L	-	20	50.8-144	20	64.1-135	20	75-00-3
EPA 8260B	Chloroform	0.062	0.50	ug/L	-	20	70.4-123	20	65.8-137	20	67-66-3
EPA 8260B	Chloromethane	0.16	2.0	ug/L	-	20	36.2-155	20	59.6-124	20	74-87-3
EPA 8260B	2-Chlorotoluene	0.075	0.50	ug/L	-	20	72.5-119	20	76.1-122	20	95-49-8
EPA 8260B	4-Chlorotoluene	0.073	0.50	ug/L	-	20	70.4-123	20	73.8-124	20	106-43-4
EPA 8260B	1,2-Dibromo-3-chloropropane	0.25	0.50	ug/L	-	20	48-136	20	53.9-140	20	96-12-8
EPA 8260B	Dibromochloromethane	0.091	0.50	ug/L	-	20	69.9-120	20	73-123	20	124-48-1
EPA 8260B	1,2-Dibromoethane (EDB)	0.13	0.50	ug/L	-	20	77.9-122	20	75.3-126	20	106-93-4
EPA 8260B	Dibromomethane	0.14	0.50	ug/L	-	20	80.4-120	20	75.7-126	20	74-95-3
EPA 8260B	1,2-Dichlorobenzene	0.076	0.50	ug/L	-	20	78.5-118	20	80.5-122	20	95-50-1
EPA 8260B	1,4-Dichlorobenzene	0.070	0.50	ug/L	-	20	80.1-117	20	79.7-124	20	106-46-7
EPA 8260B	1,3-Dichlorobenzene	0.096	0.50	ug/L	-	20	81.2-117	20	80.6-121	20	541-73-1

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
EPA 8260B	Dichlorodifluoromethane	0.11	0.50	ug/L	-	20	51.1-155	20	74.3-129	20	75-71-8
EPA 8260B	1,1-Dichloroethane	0.12	0.50	ug/L	-	20	66.1-134	20	72.4-130	20	75-34-3
EPA 8260B	1,2-Dichloroethane	0.078	0.50	ug/L	-	20	61.3-138	20	64.4-143	20	107-06-2
EPA 8260B	trans-1,2-Dichloroethene	0.11	0.50	ug/L	-	20	65.1-129	20	75.8-124	20	156-60-5
EPA 8260B	cis-1,2-Dichloroethene	0.11	0.50	ug/L	-	20	72.3-126	20	76.9-122	20	156-59-2
EPA 8260B	1,1-Dichloroethene	0.14	0.50	ug/L	-	20	67.4-126	20	68.4-137	20	75-35-4
EPA 8260B	2,2-Dichloropropane	0.14	0.50	ug/L	-	20	58.6-129	20	62.3-134	20	590-20-7
EPA 8260B	1,2-Dichloropropane	0.10	0.50	ug/L	-	20	76.2-122	20	74.9-128	20	78-87-5
EPA 8260B	1,3-Dichloropropane	0.11	0.50	ug/L	-	20	71.7-122	20	72.2-124	20	142-28-9
EPA 8260B	cis-1,3-Dichloropropene	0.061	0.50	ug/L	-	20	72.8-118	20	74.1-122	20	10061-01-5
EPA 8260B	trans-1,3-Dichloropropene	0.096	0.50	ug/L	-	20	65.8-123	20	66.4-126	20	10061-02-6
EPA 8260B	1,1-Dichloropropene	0.11	0.50	ug/L	-	20	70.8-124	20	75.2-126	20	563-58-6
EPA 8260B	Diisopropyl Ether	0.15	0.50	ug/L	-	20	70-130	20	68.2-129	20	108-20-3
EPA 8260B	Ethylbenzene	0.054	0.50	ug/L	-	20	74-119	20	80.6-119	20	100-41-4
EPA 8260B	Hexachlorobutadiene	0.13	2.0	ug/L	-	20	75.1-127	20	77.4-130	20	87-68-3
EPA 8260B	n-Hexane	0.21	0.50	ug/L	-	20	70-130	20	62.3-134	20	110-54-3
EPA 8260B	2-Hexanone	0.95	20	ug/L	-	20	48-139	20	54.9-140	20	591-78-6
EPA 8260B	Isopropylbenzene	0.081	0.50	ug/L	-	20	72.7-124	20	79-124	20	98-82-8
EPA 8260B	p-Isopropyltoluene	0.085	0.50	ug/L	-	20	79.9-115	20	76.8-122	20	99-87-6
EPA 8260B	Methylene chloride	0.14	2.0	ug/L	-	20	67.5-128	20	77.1-122	20	75-09-2
EPA 8260B	4-Methyl-2-pentanone	0.77	20	ug/L	-	20	54.8-134	20	55-146	20	108-10-1
EPA 8260B	Methyl t-Butyl Ether	0.14	0.50	ug/L	-	20	70-130	20	64.7-136	20	1634-04-4
EPA 8260B	Naphthalene	0.088	5.0	ug/L	-	20	40.8-124	20	61.6-128	20	91-20-3
EPA 8260B	n-Propyl Benzene	0.10	0.50	ug/L	-	20	71.5-121	20	78.1-122	20	103-65-1
EPA 8260B	Styrene	0.065	0.50	ug/L	-	20	74-115	20	79.3-118	20	100-42-5
EPA 8260B	1,1,1,2-Tetrachloroethane	0.11	0.50	ug/L	-	20	83.2-116	20	83.1-119	20	630-20-6
EPA 8260B	1,1,2,2-Tetrachloroethane	0.099	0.50	ug/L	-	20	62.9-132	20	69.2-127	20	79-34-5
EPA 8260B	Tetrachloroethene	0.081	0.50	ug/L	-	20	76.4-126	20	78.6-126	20	127-18-4
EPA 8260B	Tetrahydrofuran	1.2	10	ug/L	-	20	70-130	20	70-130	20	109-99-9
EPA 8260B	Toluene	0.053	0.50	ug/L	-	20	77-121	20	79.1-127	20	108-88-3
EPA 8260B	1,2,3-Trichlorobenzene	0.045	2.0	ug/L	-	20	73-119	20	73.7-125	20	87-61-6
EPA 8260B	1,2,4-Trichlorobenzene	0.077	2.0	ug/L	-	20	78.1-116	20	73.8-128	20	120-82-1
EPA 8260B	1,1,1-Trichloroethane	0.10	0.50	ug/L	-	20	70.4-128	20	74.3-131	20	71-55-6
EPA 8260B	1,1,2-Trichloroethane	0.10	0.50	ug/L	-	20	74.8-121	20	71-130	20	79-00-5
EPA 8260B	Trichloroethene	0.062	0.50	ug/L	-	20	76.5-121	20	78.5-124	20	79-01-6
EPA 8260B	Trichlorofluoromethane	0.13	0.50	ug/L	-	20	61.3-136	20	72.4-133	20	75-69-4
EPA 8260B	1,2,3-Trichloropropane	0.15	1.0	ug/L	-	20	55-131	20	56.3-132	20	96-18-4
EPA 8260B	1,1,2-Trichlorotrifluoroethane	0.13	0.50	ug/L	-	20	70-130	20	68.9-139	20	76-13-1
EPA 8260B	1,3,5-Trimethylbenzene	0.075	0.50	ug/L	-	20	71.4-122	20	75.8-123	20	108-67-8
EPA 8260B	1,2,4-Trimethylbenzene	0.060	0.50	ug/L	-	20	68.5-120	20	75.3-121	20	95-63-6
EPA 8260B	Vinyl chloride	0.16	0.50	ug/L	-	20	54.1-132	20	60.7-135	20	75-01-4
EPA 8260B	m,p-Xylene	0.057	1.0	ug/L	-	20	72.8-122	20	80.9-121	20	108-38-3/1
EPA 8260B	o-Xylene	0.058	0.50	ug/L	-	20	77.8-114	20	79.6-119	20	95-47-6
EPA 8260B	1,4-Dioxane	70	250	ug/L	-	-	70-130	20	70-130	20	123-91-1
EPA 8260B	Xylenes, total	1.0	1.5	ug/L	-	-	-	-	-	-	1330-20-7
EPA 8260B	Gasoline Range Organics	50	50	ug/L	-	20	70-130	20	70-130	20	NA
EPA 8260B	Dibromofluoromethane	0.19	0.50	Surrogate	87.2-110	20	87.2-110	20	87.2-110	20	1868-53-7
EPA 8260B	Toluene-d8	0.19	0.50	Surrogate	91.7-104	20	91.7-104	20	91.7-104	20	2037-26-5
EPA 8260B	4-Bromofluorobenzene	0.24	0.50	Surrogate	83.8-109	20	83.8-109	20	83.8-109	20	460-00-4
EPA 8260B	Pentafluorobenzene			ug/L	-	-	-	-	-	-	NA
EPA 8260B	1,4-Difluorobenzene			ug/L	-	-	-	-	-	-	540-36-3
EPA 8260B	Chlorobenzene-d5			ug/L	-	-	-	-	-	-	3114-55-4
EPA 8260B	1,4-Dichlorobenzene-d4			ug/L	-	-	-	-	-	-	NA

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Polynuclear Aromatic Compounds by GC/MS with Selected Ion Monitoring in Soil											
EPA 8270	Acenaphthene	1.8	10	ug/kg dry wt	-	-	61.4-132	20	75.3-122	20	83-32-9
EPA 8270	Acenaphthylene	1.6	10	ug/kg dry wt	-	-	32.2-164	20	72.5-123	20	208-96-8
EPA 8270	Anthracene	5.8	10	ug/kg dry wt	-	-	11.8-181	20	78.7-112	20	120-12-7
EPA 8270	Benzo (a) anthracene	2.8	10	ug/kg dry wt	-	-	19.9-183	20	68.1-127	20	56-55-3
EPA 8270	Benzo (a) pyrene	3.7	10	ug/kg dry wt	-	-	18.9-184	20	60.8-135	20	50-32-8
EPA 8270	Benzo (b) fluoranthene	2.4	10	ug/kg dry wt	-	-	24-189	20	65.7-129	20	205-99-2
EPA 8270	Benzo (e) pyrene	1.3	10	ug/kg dry wt	-	-	21.8-170	20	68-128	20	192-97-2
EPA 8270	Benzo (g,h,i) perylene	1.2	10	ug/kg dry wt	-	-	14.3-181	20	68-124	20	191-24-2
EPA 8270	Benzo (k) fluoranthene	3.4	10	ug/kg dry wt	-	-	12.3-176	20	69.9-127	20	207-08-9
EPA 8270	Chrysene	1.0	10	ug/kg dry wt	-	-	12.7-192	20	68.6-129	20	218-01-9
EPA 8270	Dibenz (a,h) anthracene	3.7	10	ug/kg dry wt	-	-	24.5-167	20	67.8-123	20	53-70-3
EPA 8270	Fluoranthene	2.0	10	ug/kg dry wt	-	-	12.2-184	20	67.8-126	20	206-44-0
EPA 8270	Fluorene	2.0	10	ug/kg dry wt	-	-	26.1-165	20	74.9-121	20	86-73-7
EPA 8270	Indeno (1,2,3-cd) pyrene	5.7	10	ug/kg dry wt	-	-	22.7-168	20	65.7-123	20	193-39-5
EPA 8270	Naphthalene	2.2	10	ug/kg dry wt	-	-	60.6-132	20	72.6-125	20	91-20-3
EPA 8270	Phenanthrene	1.7	10	ug/kg dry wt	-	-	23-167	20	72.1-122	20	85-01-8
EPA 8270	Pyrene	2.4	10	ug/kg dry wt	-	-	13.3-200	20	66.8-128	20	129-00-0
EPA 8270	1-Methylnaphthalene	2.8	10	ug/kg dry wt	-	-	64.6-127	20	79.2-112	20	90-12-0
EPA 8270	2-Methylnaphthalene	2.6	10	ug/kg dry wt	-	-	58.7-128	20	73-121	20	91-57-6
EPA 8270	Total PAHs	5.8	10	ug/kg dry wt	-	-	-	-	-	-	NA
EPA 8270	p-Terphenyl-d14	2.6	10	Surrogate	78.2-121	-	78.2-121	20	78.2-121	20	
EPA 8270	Acenaphthene-d10			ug/kg dry wt	-	-	-	-	-	-	NA
EPA 8270	Chrysene-d12			ug/kg dry wt	-	-	-	-	-	-	NA
EPA 8270	Perylene-d12			ug/kg dry wt	-	-	-	-	-	-	NA
Polynuclear Aromatic Compounds by GC/MS with Selected Ion Monitoring in Water											
EPA 8270	Acenaphthene	0.0021	0.010	ug/L	-	-	70-130	20	53.2-102	20	83-32-9
EPA 8270	Acenaphthylene	0.0017	0.010	ug/L	-	-	70-130	20	55.9-102	20	208-96-8
EPA 8270	Anthracene	0.0033	0.010	ug/L	-	-	70-130	20	68.7-101	20	120-12-7
EPA 8270	Benzo (a) anthracene	0.0027	0.010	ug/L	-	-	70-130	20	70.2-113	20	56-55-3
EPA 8270	Benzo (a) pyrene	0.0016	0.010	ug/L	-	-	70-130	20	59.4-116	20	50-32-8
EPA 8270	Benzo (b) fluoranthene	0.0019	0.010	ug/L	-	-	70-130	20	68.3-114	20	205-99-2
EPA 8270	Benzo (e) pyrene	0.0025	0.010	ug/L	-	-	70-130	20	70-130	20	192-97-2
EPA 8270	Benzo (g,h,i) perylene	0.0022	0.010	ug/L	-	-	70-130	20	22.9-113	20	191-24-2
EPA 8270	Benzo (k) fluoranthene	0.0023	0.010	ug/L	-	-	70-130	20	61.5-118	20	207-08-9
EPA 8270	Chrysene	0.0022	0.010	ug/L	-	-	70-130	20	66.8-107	20	218-01-9
EPA 8270	Dibenz (a,h) anthracene	0.0026	0.010	ug/L	-	-	70-130	20	33.9-115	20	53-70-3
EPA 8270	Fluoranthene	0.0014	0.010	ug/L	-	-	70-130	20	76.3-111	20	206-44-0
EPA 8270	Fluorene	0.0025	0.010	ug/L	-	-	70-130	20	62.1-105	20	86-73-7
EPA 8270	Indeno (1,2,3-cd) pyrene	0.0045	0.010	ug/L	-	-	70-130	20	57.5-116	20	193-39-5
EPA 8270	Naphthalene	0.0063	0.050	ug/L	-	-	70-130	20	53.3-98.8	20	91-20-3
EPA 8270	Phenanthrene	0.0039	0.010	ug/L	-	-	70-130	20	71.4-105	20	85-01-8
EPA 8270	Pyrene	0.0019	0.010	ug/L	-	-	70-130	20	71.2-110	20	129-00-0
EPA 8270	1-Methylnaphthalene	0.0034	0.050	ug/L	-	-	75-125	20	47.1-102	20	90-12-0
EPA 8270	2-Methylnaphthalene	0.0035	0.050	ug/L	-	-	75-125	20	43.9-98	20	91-57-6
EPA 8270	Total PAHs	0.0063	0.050	ug/L	-	-	-	-	-	-	NA
EPA 8270	p-Terphenyl-d14	0.0023	0.010	Surrogate	51.9-132	-	51.9-132	20	51.9-132	20	
EPA 8270	Acenaphthene-d10			ug/L	-	-	-	-	-	-	NA
EPA 8270	Chrysene-d12			ug/L	-	-	-	-	-	-	NA

Analytical Method Details - ECCS

					Surr.	DUP	Matrix Spike		Blank Spike		
Method	**Analyte**	**MDL**	**MRL**	**Units**	**%R**	**RPD**	**%R**	**RPD**	**%R**	**RPD**	**CAS #**
EPA 8270	Perylene-d12			ug/L	-	-	-	-	-	-	NA

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Total Organic Carbon by Walkley Black in Soil											
Walkley Black	TOC	183.79	400.0	mg/kg dry wt	-	20	80-120	20	80-120	20	NA

Analytical Method Details - ECCS

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #
Organochlorine Pesticides by EPA Method 8081A in Wipes											
EPA 8081A	Aldrin	-	0.025	ug/Wipe							309-00-02
EPA 8081A	alpha-BHC	-	0.025	ug/Wipe							319-84-6
EPA 8081A	beta-BHC	-	0.025	ug/Wipe							319-85-7
EPA 8081A	delta-BHC	-	0.025	ug/Wipe							319-86-8
EPA 8081A	gamma-BHC (Lindane)	-	0.025	ug/Wipe							58-89-9
EPA 8081A	alpha-Chlordane	-	0.025	ug/Wipe							5103-71-9
EPA 8081A	gamma-Chlordane	-	0.025	ug/Wipe							5103-74-2
EPA 8081A	Chlordane (technical)	-	0.5	ug/Wipe							57-74-9
EPA 8081A	4,4'-DDD	-	0.05	ug/Wipe							72-54-8
EPA 8081A	4,4'-DDE	-	0.05	ug/Wipe							72-55-9
EPA 8081A	4,4'-DDT	-	0.05	ug/Wipe							50-29-3
EPA 8081A	Dieldrin	-	0.05	ug/Wipe							60-57-1
EPA 8081A	Endosulfan I	-	0.025	ug/Wipe							959-98-8
EPA 8081A	Endosulfan II	-	0.05	ug/Wipe							33213-65-9
EPA 8081A	Endosulfan Sulfate	-	0.05	ug/Wipe							1031-07-8
EPA 8081A	Endrin	-	0.05	ug/Wipe							72-20-8
EPA 8081A	Endrin Aldehyde	-	0.05	ug/Wipe							7421-93-4
EPA 8081A	Endrin Ketone	-	0.05	ug/Wipe							53494-70-5
EPA 8081A	Hexachlorobenzene	-	0.01	ug/Wipe							118-74-1
EPA 8081A	Heptachlor	-	0.025	ug/Wipe							76-44-8
EPA 8081A	Heptachlor Epoxide	-	0.025	ug/Wipe							1024-57-3
EPA 8081A	Isodrin	-	0.025	ug/Wipe							465-73-6
EPA 8081A	Methoxychlor	-	0.25	ug/Wipe							72-43-5
EPA 8081A	Toxaphene	-	1.3	ug/Wipe							8001-35-2

Attachment 3
Current Screening Levels

(Excerpts from) Illinois EPA Part 742: Tiered Approach to Corrective Action Objectives Effective Date: February 23, 2007

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE G: WASTE DISPOSAL
CHAPTER I: POLLUTION CONTROL BOARD
SUBCHAPTER f: RISK BASED CLEANUP OBJECTIVES

PART 742
TIERED APPROACH TO CORRECTIVE ACTION OBJECTIVES

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SUBPART D: DETERMINING AREA BACKGROUND

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AUTHORITY: Implementing Sections 22.4, 22.12, Title XVI, and Title XVII and authorized by Sections 27 and 58.5 of the Environmental Protection Act [415 ILCS 5/22.4, 22.12, 27, and 58.5 and Title XVI and Title XVII].

SOURCE: Adopted in R97-12(A) at 21 Ill. Reg. 7942, effective July 1, 1997; amended in R97-12(B) at 21 Ill. Reg. 16391, effective December 8, 1997; amended in R97-12(C) at 22 Ill. Reg. 10847, effective June 8, 1998; amended in R00-19(A) at 25 Ill. Reg. 651, effective January 6, 2001; amended in R00-19(B) at 25 Ill. Reg. 10374, effective August 15, 2001; amended in R00-19(C) at 26 Ill. Reg. 2683, effective February 5, 2002; amended in R06-10 at 31 Ill. Reg. 4063, effective February 23, 2007.

NOTE: Italics indicates statutory language.

SUBPART A: INTRODUCTION

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Section 742.Table B Tier 1 Soil Remediation Objectives[a] for Industrial/Commercial Properties

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
83-32-9	Acenaphthene	120,000[b]	-----[c]	120,000[b]	-----[c]	570[b]	2,900	*
67-64-1	Acetone	----[g]	100,000[d]	----[g]	100,000[d]	25[b]	25	*
15972-60-8	Alachlor[o]	72[e]	-----[c]	1,600[e]	-----[c]	0.04	0.2	NA
116-06-3	Aldicarb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.013	0.07	NA
309-00-2	Aldrin	0.3[e]	6.6[e]	6.1[b]	9.3[e]	0.5[e]	2.5	0.94
120-12-7	Anthracene	610,000[b]	-----[c]	610,000[b]	-----[c]	12,000[b]	59,000	*
1912-24-9	Atrazine[o]	72,000[b]	-----[c]	7,100[b]	-----[c]	0.066	0.33	NA
71-43-2	Benzene	100[e]	1.6[e]	2,300[e]	2.2[e]	0.03	0.17	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
56-55-3	Benzo(*a*)anthracene	8[e]	-----[c]	170[e]	-----[c]	2	8	*
205-99-2	Benzo(*b*)fluoranthene	8[e]	-----[c]	170[e]	-----[c]	5	25	*
207-08-9	Benzo(*k*)fluroanthene	78[e]	-----[c]	1,700[e]	-----[c]	49	250	*
50-32-8	Benzo(*a*)pyrene	0.8[e,x]	-----[c]	17[e]	-----[c]	8	82	*
111-44-4	Bis(2-chloroethyl)ether	5[e]	0.47[e]	75[e]	0.66[e]	0.0004[e,]	0.0004	0.66
117-81-7	Bis(2-ethylhexyl)phthalate	410[e]	31,000[d]	4,100[b]	31,000[d]	3,600	31,000[d]	*
75-27-4	Bromodichloromethane (Dichlorobromomethane)	92[e]	3,000[d]	2,000[e]	3,000[d]	0.6	0.6	*
75-25-2	Bromoform	720[e]	100[e]	16,000[e]	140[e]	0.8	0.8	*
71-36-3	Butanol	200,000[b]	10,000[d]	200,000[b]	10,000[d]	17[b]	17	NA
85-68-7	Butyl benzyl phthalate	410,000[b]	930[d]	410,000[b]	930[d]	930[d]	930[d]	*
86-74-8	Carbazole	290[e]	-----[c]	6,200[e]	-----[c]	0.6[e]	2.8	NA

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1563-66-2	Carbofuran[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.22	1.1	NA
75-15-0	Carbon disulfide	200,000[b]	720[d]	20,000[b]	9.0[b]	32[b]	160	*
56-23-5	Carbon tetrachloride	44[e]	0.64[e]	410[b]	0.90[e]	0.07	0.33	*
57-74-9	Chlordane	16[e]	140[e]	100[b]	22[b]	10	48	*
106-47-8	4 – Chloroaniline (*p*-Chloroaniline)	8,200[b]	-----[c]	820[b]	-----[c]	0.7[b]	0.7	*
108-90-7	Chlorobenzene (Monochlorobenzene)	41,000[b]	210[b]	4,100[b]	1.3[b]	1	6.5	*
124-48-1	Chlorodibromomethane (Dibromochloromethane)	41,000[b]	1,300[d]	41,000[b]	1,300[d]	0.4	0.4	*
67-66-3	Chloroform	940[e]	0.54[e]	2,000[b]	0.76[e]	0.6	2.9	*
218-01-9	Chrysene	780[e]	-----[c]	17,000[e]	-----[e]	160	800	*
94-75-7	2,4-D[o]	20,000[b]	-----[c]	2,000[b]	-----[c]	1.5	7.7	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-99-0	Dalapon[o]	61,000[b]	-----[c]	6,100[b]	-----[c]	0.85	8.5	*
72-54-8	DDD	24[e]	-----[c]	520[e]	-----[c]	16[e]	80	*
72-55-9	DDE	17[e]	-----[c]	370[e]	-----[c]	54[e]	270	*
50-29-3	DDT	17[e]	1,500[e]	100[b]	2,100[e]	32[e]	160	*
53-70-3	Dibenzo(*a*,*h*)anthracene	0.8[e]	-----[c]	17[e]	-----[c]	2	7.6	*
96-12-8	1,2-Dibromo-3-chloropropane	4[e]	17[b]	89[e]	0.11[b]	0.002	0.02	*
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	2.9[e]	0.12[e]	62[e]	0.16[e]	0.0004	0.004	0.005
84-74-2	Di-*n*-butyl phthalate	200,000[b]	2,300[d]	200,000[b]	2,300[d]	2,300[d]	2,300[d]	*
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	180,000[b]	560[d]	18,000[b]	310[b]	17	43	*
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	-----[c]	17,000[b]	-----[c]	340[b]	2	11	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
91-94-1	3,3'-Dichlorobenzidine	13[e]	-----[c]	280[e]	-----[c]	0.007[e,]	0.033	1.3
75-34-3	1,1-Dichloroethane	200,000[b]	1,700[d]	200,000[b]	130[b]	23[b]	110	*
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	63[e]	0.70[e]	1,400[e]	0.99[e]	0.02	0.1	*
75-35-4	1,1-Dichloroethylene	100,000[b]	470[b]	10,000[b]	3.0[b]	0.06	0.3	*
156-59-2	*cis*-1,2-Dichloroethylene	20,000[b]	1,200[d]	20,000[b]	1,200[d]	0.4	1.1	*
156-60-5	*Trans*-1,2-Dichloroethylene	41,000[b]	3,100[d]	41,000[b]	3,100[d]	0.7	3.4	*
78-87-5	1,2-Dichloropropane	84[e]	23[b]	1,800[e]	0.50[b]	0.03	0.15	*
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	57[e]	2.1[e]	1,200[e]	0.39[b]	0.004[e]	0.02	0.005
60-57-1	Dieldrin[n]	0.4[e]	2.2[e]	7.8[e]	3.1[e]	0.004[e]	0.02	0.603
84-66-2	Diethyl phthalate	1,000,000[b]	2,000[d]	1,000,000[b]	2,000[d]	470[b]	470	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
105-67-9	2,4-Dimethylphenol	41,000[b]	-----[c]	41,000[b]	-----[c]	9[b]	9	*
121-14-2	2,4-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0008[e,]	0.0008	0.250
606-20-2	2,6-Dinitrotoluene	8.4[e]	-----[c]	180[e]	-----[c]	0.0007[e,]	0.0007	0.260
117-84-0	Di-*n*-octyl phthalate	41,000[e]	10,000[d]	4,100[b]	10,000[d]	10,000[d]	10,000[d]	*
115-29-7	Endosulfan[o]	12,000[b]	-----[c]	1,200[b]	-----[c]	18[b]	90	*
145-73-3	Endothall[o]	41,000[c]	-----[c]	4,100[b]	-----[c]	0.4	0.4	NA
72-20-8	Endrin	610[b]	-----[c]	61[b]	-----[c]	1	5	*
100-41-4	Ethylbenzene	200,000[b]	400[d]	20,000[b]	58[b]	13	19	*
206-44-0	Fluoranthene	82,000[b]	-----[c]	82,000[b]	-----[c]	4,300[b]	21,000	*
86-73-7	Fluorene	82,000[b]	-----[c]	82,000[b]	-----[c]	560[b]	2,800	*
76-44-8	Heptachlor	1[e]	11[e]	28[e]	16[e]	23	110	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1024-57-3	Heptachlor epoxide	0.6[e]	9.2[e]	2.7[b]	13[e]	0.7	3.3	1.005
118-74-1	Hexachlorobenzene	4[e]	1.8[e]	78[e]	2.6[e]	2	11	*
319-84-6	*Alpha*-HCH (*alpha*-BHC)	0.9[e]	1.5[e]	20[e]	2.1[e]	0.0005[e,]	0.003	0.0074
58-89-9	*Gamma*-HCH (Lindane)[n]	4[e]	-----[c]	96[e]	-----[c]	0.009	0.047	*
77-47-4	Hexachlorocyclopentadiene	14,000[b]	16[b]	14,000[b]	1.1[b]	400	2,200[d]	*
67-72-1	Hexachloroethane	2,000[b]	-----[c]	2,000[b]	-----[c]	0.5[b]	2.6	*
193-39-5	Indeno(1,2,3-*c,d*)pyrene	8[e]	-----[c]	170[e]	-----[c]	14	69	*
78-59-1	Isophorone	410,000[b]	4,600[d]	410,000[b]	4,600[d]	8[b]	8	*
72-43-5	Methoxychlor[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	160	780	*
74-83-9	Methyl bromide (Bromomethane)	2,900[b]	15[b]	1,000[b]	3.9[b]	0.2[b]	1.2	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
1634-04-4	Methyl tertiary-butyl ether	20,000[b]	8,800[d]	2,000[b]	140[b]	0.32	0.32	*
75-09-2	Methylene chloride (Dichloromethane)	760[e]	24[e]	12,000[b]	34[e]	0.02[e]	0.2	*
95-48-7	2-Methylphenol (*o* – Cresol)	100,000[b]	-----[c]	100,000[b]	-----[c]	15[b]	15	*
86-30-6	*N*-Nitrosodiphenylamine	1,200[e]	-----[c]	25,000[e]	-----[c]	1[e]	5.6	*
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.8[e]	-----[c]	18[e]	-----[c]	0.00005[e]	0.00005	0.0018
91-20-3	Naphthalene	41,000[b]	270[b]	4,100[b]	1.8[b]	12[b]	18	*
98-95-3	Nitrobenzene	1,000[b]	140[b]	1,000[b]	9.4[b]	0.1[b]	0.1	0.26
108-95-2	Phenol	610,000[b]	-----[c]	61,000[b]	-----[c]	100[b]	100	*
1918-02-1	Picloram[o]	140,000[b]	-----[c]	14,000[b]	-----[c]	2	20	NA
1336-36-3	Polychlorinated biphenyls (PCBs)[n]	1[h]	-----[c,h]	1[h]	-----[c,h]	-----[h]	-----[h]	*
129-00-0	Pyrene	61,000[b]	-----[c]	61,000[b]	-----[c]	4,200[b]	21,000	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
122-34-9	Simazine[o]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.04	0.37	NA
100-42-5	Styrene	410,000[b]	1,500[d]	41,000[b]	430[b]	4	18	*
127-18-4	Tetrachloroethylene (Perchloroethylene)	110[e]	20[e]	2,400[e]	28[e]	0.06	0.3	*
108-88-3	Toluene	410,000[b]	650[d]	410,000[b]	42[b]	12	29	*
8001-35-2	Toxaphene[n]	5.2[e]	170[e]	110[e]	240[e]	31	150	*
120-82-1	1,2,4-Trichlorobenzene	20,000[b]	3,200[d]	2,000[b]	920[b]	5	53	*
71-55-6	1,1,1-Trichloroethane	-----[c]	1,200[d]	-----[c]	1,200[d]	2	9.6	*
79-00-5	1,1,2-Trichloroethane	8,200[b]	1,800[d]	8,200[b]	1,800[d]	0.02	0.3	*
79-01-6	Trichloroethylene	520[e]	8.9[e]	1,200[b]	12[e]	0.06	0.3	*
108-05-4	Vinyl acetate	1,000,000[b]	1,600[b]	200,000[b]	10[b]	170[b]	170	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
75-01-4	Vinyl chloride	7.9[e]	1.1[e]	170[e]	1.1[b]	0.01	0.07	*
108-38-3	m-Xylene	410,000[b]	420[d]	41,000[b]	6.4[b]	210	210	*
95-47-6	o-Xylene	410,000[b]	410[d]	41,000[b]	6.5[b]	190	190	*
106-42-3	p-Xylene	410,000[b]	460[d]	41,000[b]	5.9[b]	200	200	*
1330-20-7	Xylenes (total)	410,000[b]	320[d]	41,000[b]	5.6[b]	150	150	*
	Ionizable Organics							
65-85-0	Benzoic Acid	1,000,000[b]	-----[c]	820,000[b]	-----[c]	400[b,i]	400[i]	*
95-57-8	2-Chlorophenol	10,000[b]	53,000[d]	10,000[b]	53,000[d]	4[b, i]	20[i]	*
120-83-2	2,4-Dichlorophenol	6,100[b]	-----[c]	610[b]	-----[c]	1[b, i]	1[i]	*
51-28-5	2,4-Dinitrophenol	4,100[b]	-----[c]	410[b]	-----[c]	0.2[b, i]	0.2[i]	3.3
88-85-7	Dinoseb[o]	2,000[b]	-----[c]	200[b]	-----[c]	0.34[b, i]	3.4[i]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/kg)	ClassII (mg/kg)	ADL (mg/kg)
87-86-5	Pentachlorophenol	24[e,j]	-----[c]	520[e,j]	-----[c]	0.03 [i]	0.14[i]	*
93-72-1	2,4,5-TP (Silvex)	16,000[b]	-----[c]	1,600[b]	-----[c]	11[i]	55[i]	*
95-95-4	2,4,5-Trichlorophenol	200,000[b]	-----[c]	200,000[b]	-----[c]	270[b, i]	1,400[i]	*
88-06-2	2,4,6- Trichlorophenol	520[e]	390[e]	11,000[e]	540[e]	0.2[e, i]	0.77[i]	0.66

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
	Inorganics							
7440-36-0	Antimony	820[b]	-----[c]	82[b]	-----[c]	0.006[m]	0.024[m]	*
7440-38-2	Arsenic[l,n]	---[t]	1,200[e]	61[b]	25,000[e]	0.05[m]	0.2[m]	*
7440-39-3	Barium	140,000[b]	910,000[b]	14,000[b]	870,000[b]	2.0[m]	2.0[m]	*
7440-41-7	Beryllium	4,100[b]	2,100[e]	410[b]	44,000[e]	0.004[m]	0.5[m]	*
7440-42-8	Boron	410,000[b]	---[c]	41,000[b]	---[c]	2.0[m]	2.0[m]	*
7440-43-9	Cadmium[l,n]	2,000[b,r]	2,800[e]	200[b,r]	59,000[e]	0.005[m]	0.05[m]	*
7440-70-2	Calcium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
16887-00-6	Chloride	-------[c]	-----[c]	-----[c]	-----[c]	200[m]	200[m]	*
7440-47-3	Chromium, total	6,100[b]	420[e]	4,100[b]	690[b]	0.1[m]	1.0[m]	*
16065-83-1	Chromium, ion, trivalent	1,000,000[b]	-----[c]	310,000[b]	-----[c]	-----[g]	-----[g]	*
18540-29-9	Chromium, ion, hexavalent	6,100[b]	420[e]	4,100[b]	690[b]	-----	-----	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-48-4	Cobalt	120,000[b]	-----[c]	12,000[b]	-----[c]	1.0[m]	1.0[m]	*
7440-50-8	Copper[n]	82,000[b]	-----[c]	8,200[b]	-----[c]	0.65[m]	0.65[m]	*
57-12-5	Cyanide (amenable)	41,000[b]	-----[c]	4,100[b]	-----[c]	0.2[q,m]	0.6[q,m]	*
7782-41-4	Fluoride	120,000[b]	-----[c]	12,000[b]	-----[c]	4.0[m]	4.0[m]	*
15438-31-0	Iron	-----[c]	-----[c]	-----[c]	-----[c]	5.0[m]	5.0[m]	*
7439-92-1	Lead	800[y]	-----[c]	700[y]	-----[c]	0.0075[m]	0.1[m]	*
7439-95-4	Magnesium[n]	---[g]	---[c]	730,000	---[c]	---[c]	---[c]	*
7439-96-5	Manganese	41,000 [b,w]	91,000[b]	4,100 [b,w]	8,700[b]	0.15[m]	10.0[m]	*
7439-97-6	Mercury[l,n,s]	610[b]	16[b]	61[b]	0.1[b]	0.002[m]	0.01[m]	*
7440-02-0	Nickel[l]	41,000[b]	21,000[e]	4,100[b]	440,000[e]	0.1[m]	2.0[m]	*
14797-55-8	Nitrate as N[p]	1,000,000[b]	-----[c]	330,000[b]	-----[c]	10.0[q, m]	100[q]	*
7723-14-0	Phosphorus[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*

		Exposure Route-Specific Values for Soils				Soil Component of the Groundwater Ingestion Exposure Route Values		
		Industrial-Commercial		Construction Worker				
CAS No.	Chemical Name	Ingestion (mg/kg)	Inhalation (mg/kg)	Ingestion (mg/kg)	Inhalation (mg/kg)	Class I (mg/L)	Class II (mg/L)	ADL (mg/kg)
7440-09-7	Potassium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
7782-49-2	Selenium[l,n]	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	0.05[m]	*
7440-22-4	Silver	10,000[b]	-----[c]	1,000[b]	-----[c]	0.05[m]	-----	*
7440-23-5	Sodium[n]	---[g]	---[c]	---[g]	---[c]	---[c]	---[c]	*
14808-79-8	Sulfate	-----[c]	-----[c]	-----[c]	-----[c]	400[m]	400[m]	*
7440-28-0	Thallium	160[b,u]	-----[c]	160[b,u]	-----[c]	0.002[m]	0.02[m]	*
7440-62-2	Vanadium	14,000[b]	-----[c]	1,400[b]	-----[c]	0.049[m]	0.1[m]	*
7440-66-6	Zinc[l]	610,000[b]	-----[c]	61,000[b]	-----[c]	5.0[m]	10[m]	*

"*" indicates that the ADL is less than or equal to the specified remediation objective.

NA means Not Available; no PQL or EQL available in USEPA analytical methods.

Chemical Name and Soil Remediation Objective Notations (2nd, 5th thru 8th Columns)

[a] oil remediation objectives based on human health criteria only.
[b] Calculated values correspond to a target hazard quotient of 1.
[c] No toxicity criteria available for this route of exposure.
[d] Soil saturation concentration ($C_{[sat]}$) = the concentration at which the absorptive limits of the soil particles, the solubility limits of the available soil moisture, and saturation of soil pore air have been reached. Above the soil saturation concentration, the assumptions regarding vapor transport to air and/or dissolved phase transport to groundwater (for chemicals which are liquid at ambient soil temperatures) have been violated, and alternative modeling approaches are required.
[e] Calculated values correspond to a cancer risk level of 1 in 1,000,000.

[g] Chemical-specific properties are such that this route is not of concern at any soil contaminant concentration.
[h] 40 CFR 761 contains applicability requirements and methodologies for the development of PCB remediation objectives. Requests for approval of a Tier 3 evaluation must address the applicability of 40 CFR 761.
[i] Soil remediation objective for pH of 6.8. If soil pH is other than 6.8, refer to Appendix B, Tables C and D in this Part.
[j] Ingestion soil remediation objective adjusted by a factor of 0.5 to account for dermal route.
[l] Potential for soil-plant-human exposure.
[m] The person conducting the remediation has the option to use: (1) TCLP or SPLP test results to compare with the remediation objectives listed in this Table; (2) the total amount of contaminant in the soil sample results to compare with pH specific remediation objectives listed in Appendix B, Table C or D of this Part (see Section 742.510); or (3) the appropriate background value listed in Appendix A, Table G. If the person conducting the remediation wishes to calculate soil remediation objectives based on background concentrations, this should be done in accordance with Subpart D of this Part.
[n] The Agency reserves the right to evaluate the potential for remaining contaminant concentrations to pose significant threats to crops, livestock, or wildlife.
[o] For agrichemical facilities, remediation objectives for surficial soils which are based on field application rates may be more appropriate for currently registered pesticides. Consult the Agency for further information.
[p] For agrichemical facilities, soil remediation objectives based on site-specific background concentrations of Nitrate as N may be more appropriate. Such determinations shall be conducted in accordance with the procedures set forth in Subparts D and I of this Part.
[q] The TCLP extraction must be done using water at a pH of 7.0.
[r] Value based on dietary Reference Dose.
[s] Value for Ingestion based on Reference Dose for Mercuric chloride (CAS No. 7487-94-7); value for Inhalation based on Reference Concentration for elemental Mercury (CAS No. 7439-97-6). Inhalation remediation objective only applies at sites where elemental mercury is a contaminant of concern.
[t] For the ingestion route for arsenic for industrial/commercial, see 742.Appendix A, Table G.
[u] Value based on Reference Dose for Thallium sulfate (CAS No. 7446-18-6).
[w] Value based on Reference Dose adjusted for dietary intake.
[x] For any populated areas as defined in Section 742.200, Appendix A, Table H may be used.
[y] Value based on maintaining fetal blood lead below 10 ug/d1, using the USEPA adults Blood Lead Model.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Section 742.APPENDIX B Tier 1 Illustrations and Tables

Section 742.TABLE E Tier 1 Groundwater Remediation Objectives for the Groundwater Component of the Groundwater Ingestion Route

		Groundwater Remediation Objective	
CAS No.	Chemical Name Organics	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	0.42	2.1
67-64-1	Acetone	6.3	6.3
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	0.014[a]	0.07
120-12-7	Anthracene	2.1	10.5
1912-24-9	Atrazine	0.003[c]	0.015[c]
71-43-2	Benzene	0.005[c]	0.025[c]
56-55-3	Benzo(*a*)anthracene	0.00013[a]	0.00065
205-99-2	Benzo(*b*)fluoranthene	0.00018[a]	0.0009
207-08-9	Benzo(*k*)fluroanthene	0.00017[a]	0.00085
50-32-8	Benzo(*a*)pyrene	0.0002[a,c]	0.002[c]
65-85-0	Benzoic Acid	28	28
111-44-4	Bis(2-chloroethyl)ether	0.01[a]	0.01
117-81-7	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	0.006[c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.0002[a]	0.0002
75-25-2	Bromoform	0.001[a]	0.001
71-36-3	Butanol	0.7	0.7
85-68-7	Butyl benzyl phthalate	1.4	7.0
86-74-8	Carbazole	---	---
1563-66-2	Carbofuran	0.04[c]	0.2[c]
75-15-0	Carbon disulfide	0.7	3.5
56-23-5	Carbon tetrachloride	0.005[c]	0.025[c]
57-74-9	Chlordane	0.002[c]	0.01[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
106-47-8	4-Chloroaniline (ρ-Chloroaniline)	0.028	0.028
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.14	0.14
67-66-3	Chloroform	0.0002[a]	0.001
95-57-8	2-Chlorophenol (pH 4.9-7.3)	0.035	0.175
	2-Chlorophenol (pH 7.4-8.0)	0.035	0.035
218-01-9	Chrysene	0.0015[a]	0.0075
94-75-7	2,4-D	0.07[c]	0.35[c]
75-99-0	Dalapon	0.2[c]	2.0[c]
72-54-8	DDD	0.014[a]	0.07
72-55-9	DDE	0.01[a]	0.05
50-29-3	DDT	0.006[a]	0.03
53-70-3	Dibenzo(*a*,*h*)anthracene	0.0003[a]	0.0015
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.002 [c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[c]	0.0005[c]
84-74-2	Di-*n*-butyl phthalate	0.7	3.5
95-50-1	1,2-Dichlorobenzene (*o* – Dichlorobenzene)	0.6[c]	1.5[c]
106-46-7	1,4-Dichlorobenzene (*p* – Dichlorobenzene)	0.075[c]	0.375[c]
91-94-1	3,3'-Dichlorobenzidine	0.02[a]	0.1
75-34-3	1,1-Dichloroethane	0.7	3.5
107-06-2	1,2-Dichloroethane (Ethylene dichloride)	0.005[c]	0.025[c]
75-35-4	1,1-Dichloroethylene[b]	0.007[c]	0.035[c]
156-59-2	*cis*-1,2-Dichloroethylene	0.07[c]	0.2[c]
156-60-5	*trans*-1,2-Dichloroethylene	0.1[c]	0.5[c]
120-83-2	2,4-Dichlorophenol	0.021	0.021
78-87-5	1,2-Dichloropropane	0.005[c]	0.025[c]
542-75-6	1,3-Dichloropropene (1,3-Dichloropropylene, *cis* + *trans*)	0.001[a]	0.005

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
60-57-1	Dieldrin	0.009[a]	0.045
84-66-2	Diethyl phthalate	5.6	5.6
105-67-9	2,4-Dimethylphenol	0.14	0.14
51-28-5	2,4-Dinitrophenol	0.014	0.014
121-14-2	2,4-Dinitrotoluene	0.00002[a]	0.00002
606-20-2	2,6-Dinitrotoluene	0.00031[a]	0.00031
88-85-7	Dinoseb	0.007[c]	0.07[c]
117-84-0	Di-*n*-octyl phthalate	0.14	0.7
115-29-7	Endosulfan	0.042	0.21
145-73-3	Endothall	0.1[c]	0.1[c]
72-20-8	Endrin	0.002[c]	0.01[c]
100-41-4	Ethylbenzene	0.7[c]	1.0[c]
206-44-0	Fluoranthene	0.28	1.4
86-73-7	Fluorene	0.28	1.4
76-44-8	Heptachlor	0.0004[c]	0.002[c]
1024-57-3	Heptachlor epoxide	0.0002[c]	0.001[c]
118-74-1	Hexachlorobenzene	0.00006[a]	0.0003
319-84-6	*alpha*-HCH (*alpha*-BHC)	0.00011[a]	0.00055
58-89-9	*Gamma*-HCH (Lindane)	0.0002[c]	0.001[c]
77-47-4	Hexachlorocyclopentadiene	0.05[c]	0.5[c]
67-72-1	Hexachloroethane	0.007	0.035
193-39-5	Indeno(1,2,3-*c*,*d*)pyrene	0.00043[a]	0.00215
78-59-1	Isophorone	1.4	1.4
72-43-5	Methoxychlor	0.04[c]	0.2[c]
74-83-9	Methyl bromide (Bromomethane)	0.0098	0.049
1634-04-4	Methyl tertiary-butyl ether	0.07	0.07
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
95-48-7	2-Methylphenol (*o*-Cresol)	0.35	0.35
91-20-3	Naphthalene	0.14	0.22
98-95-3	Nitrobenzene[b]	0.0035	0.0035

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
86-30-6	*N*-Nitrosodiphenylamine	0.0032 [a]	0.016
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.0018 [a]	0.0018
87-86-5	Pentachlorophenol	0.001[c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)	0.0005[c]	0.0025[c]
129-00-0	Pyrene	0.21	1.05
122-34-9	Simazine	0.004[c]	0.04[c]
100-42-5	Styrene	0.1[c]	0.5[c]
93-72-1	2,4,5-TP (Silvex)	0.05[c]	0.25[c]
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.005[c]	0.025[c]
108-88-3	Toluene	1.0[c]	2.5[c]
8001-35-2	Toxaphene	0.003[c]	0.015[c]
120-82-1	1,2,4-Trichlorobenzene	0.07[c]	0.7[c]
71-55-6	1,1,1-Trichloroethane[b]	0.2[c]	1.0[c]
79-00-5	1,1,2-Trichloroethane	0.005[c]	0.05[c]
79-01-6	Trichloroethylene	0.005[c]	0.025[c]
95-95-4	2,4,5-Trichlorophenol (pH 4.9-7.8)	0.7	3.5
	2,4,5-Trichlorophenol (pH 7.9-8.0)	0.7	0.7
88-06-2	2,4,6-Trichlorophenol (pH 4.9-6.8)	0.01[a]	0.05
	2,4,6-Trichlorophenol (pH 6.9-8.0)	0.01	0.01
108-05-4	Vinyl acetate	7.0	7.0
75-01-4	Vinyl chloride	0.002[c]	0.01[c]
1330-20-7	Xylenes (total)	10.0[c]	10.0[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
	Inorganics		
7440-36-0	Antimony	0.006[c]	0.024[c]
7440-38-2	Arsenic	0.05[c]	0.2[c]
7440-39-3	Barium	2.0[c]	2.0[c]
7440-41-7	Beryllium	0.004[c]	0.5[c]
7440-42-8	Boron	2.0[c]	2.0[c]
7440-43-9	Cadmium	0.005[c]	0.05[c]
7440-70-2	Calcium	---[d]	---[d]
16887-00-6	Chloride	200[c]	200[c]
7440-47-3	Chromium, total	0.1[c]	1.0[c]
18540-29-9	Chromium, ion, hexavalent	---	---
7440-48-4	Cobalt	1.0[c]	1.0[c]
7440-50-8	Copper	0.65[c]	0.65[c]
57-12-5	Cyanide	0.2[c]	0.6[c]
7782-41-4	Fluoride	4.0[c]	4.0[c]
15438-31-0	Iron	5.0[c]	5.0[c]
7439-92-1	Lead	0.0075[c]	0.1[c]
7439-95-4	Magnesium	---[d]	---[d]
7439-96-5	Manganese	0.15[c]	10.0[c]
7439-97-6	Mercury	0.002[c]	0.01[c]
7440-02-0	Nickel	0.1[c]	2.0[c]
14797-55-8	Nitrate as N	10.0[c]	100[c]
7723-14-0	Phosphorus	---[d]	---[d]
7440-09-7	Potassium	---[d]	---[d]
7782-49-2	Selenium	0.05[c]	0.05[c]

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
7440-22-4	Silver	0.05[c]	---
7440-23-5	Sodium	---[d]	---[d]
14808-79-8	Sulfate	400[c]	400[c]
7440-28-0	Thallium	0.002[c]	0.02[c]
7440-62-2	Vanadium[b]	0.049	0.1
7440-66-6	Zinc	5.0[c]	10[c]

Chemical Name and Groundwater Remediation Objective Notations

[a] The groundwater remediation objective is equal to the ADL for carcinogens according to the procedures specified in 35 Ill. Adm. Code 620.
[b] Oral Reference Dose and/or Reference Concentration under review by USEPA. Listed values subject to change.
[c] Value listed is also the Groundwater Quality Standard for this chemical pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.
[d] This chemical is included in the Total Dissolved Solids (TDS) Groundwater Quality Standard of 1,200 mg/l pursuant to 35 Ill. Adm. Code 620.410 for Class I Groundwater or 35 Ill. Adm. Code 620.420 for Class II Groundwater.

(Source: Amended at 31 Ill. Reg. 4063, effective February 23, 2007)

Chemicals Not in TACO Tier 1 Tables – Groundwater Objectives
Revision Date: October 30, 2012
Table downloaded from IEPA Website in May 2013

CHEMICAL NAME	CAS No.	CLASS 1 GW	CLASS 2 GW	NOTE		
ACENAPHTHYLENE	208-96-8	0.21	1.05			
ACETALDEHYDE	75-07-0	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
ACETOCHLOR	34256-82-1	0.14	0.7			
ACROLEIN	107-02-8	0.0035	0.0035			
ACRYLIC ACID	79-10-7	3.5	3.5			
ACRYLONITRILE	107-13-1	0.001	0.001	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
ALLYL ALCOHOL	107-18-6	0.035	0.035			
ALUMINUM	7429-90-5	3.5	5			
ANILINE	62-53-3	0.023	0.023	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
BENTAZON	25057-89-0	0.21	0.21			
BENZALDEHYDE	100-52-7	0.7	0.7			
BENZIDINE	92-87-5	0.00000037	0.00000037	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
BENZO(g,h,i,)PERYLENE	191-24-2	0.21	1.05			
BENZYL ALCOHOL	100-51-6	0.7	0.7			
BIDRIN	141-66-2	0.0007	0.0007			
1,1-BIPHENYL	92-52-4	0.35	1.75			
BIS(2-CHLORO-1-METHYLETHYL)ETHER	108-60-1	0.28	0.28			
BROMOBENZENE	108-86-1	0.056	0.28			
BROMOXYNIL	1689-84-5	0.14	0.14			
1,3-BUTADIENE	106-99-0	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
2-BUTANONE	78-93-3	4.2	4.2			
BUTYLATE	2008-41-5	0.35	1.75			
n-BUTYLBENZENE	104-51-8	0.35	1.75			
CAPROLACTAM	105-60-2	3.5	3.5			
CAPTAN	133-06-2	0.91	0.91			
CARBARYL	63-25-2	0.7	0.7			
CARBOXIN	5234-68-4	0.7	0.7			
CHLORAMBEN	133-90-4	0.105	0.105			
CHLORFENVINPHOS	470-90-6	0.0049	0.0245			
1-CHLOROBUTANE	109-69-3	0.28	1.4			
CHLOROETHANE	75-00-3	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
CHLOROMETHANE	74-87-3	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
2-CHLORONAPHTHALENE	91-58-7	0.56	2.8			
o-CHLOROTOLUENE	95-49-8	0.14	0.7			
CHLORPYRIFOS	2921-88-2	0.007	0.035			
CHLORPYRIFOS METHYL	5598-13-0	0.07	0.35			
CYANAZINE	21725-46-2	0.014	0.014			
CYCLOHEXANE	110-82-7	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
CYCLOHEXANONE	108-94-1	35	35			
2,4-DB (pH 4.5 -5.5)	94-82-6	0.056	0.28			
2,4-DB (pH 6.0 - 9.0)	94-82-6	0.056	0.056			
DIAZINON	333-41-5	0.0063	0.0315			
DIBENZOFURAN	132-64-9	0.007	0.035			
DICAMBA	1918-00-9	0.21	0.21			
DICHLORODIFLUOROMETHANE	75-71-8	1.4	7			
1,3-DICHLOROPROPANE	142-28-9	0.14	0.14			
DICHLORVOS	62-73-7	0.008	0.008	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
DICYCLOPENTADIENE	77-73-6	0.056	0.28			
DIETHANOLAMINE	111-42-2	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
DIETHYLENE GLYCOL MONOBUTYL ETHER	112-34-5	0.21	0.21			
DIETHYLENE GLYCOL MONOETHYL ETHER	111-90-0	0.42	0.42			
DIISOPROPYL ETHER	108-20-3	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
DIMETHYL PHTHALATE	131-11-3	not available	not available			
1,3-DINITROBENZENE	75-71-8	0.0007	0.0007			
DINITRO-o-CRESOL, 4,6-	534-52-1	0.00056	0.00056			
p-DIOXANE	123-91-1	0.0077	0.0077			
DIPHENYLAMINE	122-39-4	0.175	0.875			
DISULFOTON	298-04-4	0.00028	0.0014			
EPTC	759-94-4	0.175	0.875			
ETHION	563-12-2	0.0035	0.0175			
ETHOXYETHANOL ACETATE	111-15-9	0.7	0.7			
ETHYL ACETATE	141-78-6	6.3	6.3			
ETHYL ACRYLATE	140-88-5	0.00177	0.00177	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
ETHYLENE GLYCOL	107-21-1	14	14			
ETHYLENE GLYCOL MONBUTYL ETHER	111-76-2	0.7	0.7			
ETHYLENE THIOUREA	96-45-7	0.0019	0.0019	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		

ETHYL ETHER	60-29-7	1.4	1.4			
FONOFOS	944-22-9	0.014	0.07			
FORMALDEHYDE	50-00-0	1.4	1.4			
FURFURAL	98-01-1	0.021	0.021			
GLYPHOSATE (pH 4.5-7.24)	1071-83-6	0.7	3.5			
GLYPHOSATE (pH 7.25-9.0)	1071-83-6	0.7	0.7			
HEXACHLOROBUTADIENE	87-68-3	0.007	0.035			
HEXANE	110-54-3	0.42	2.1			
2-HEXANONE	591-78-6	0.035	0.035			
HMX	2691-41-0	1.4	1.4			
HYDRAZINE	302-01-2	0.000028	0.000028	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
IMAZAQUIN	81335-37-7	1.75	1.75			
IODINE	7553-56-2	0.35	not available			
ISOBUTANOL	78-83-1	2.1	2.1			
ISOPROPYLBENZENE (cumene)	98-82-8	0.7	3.5			
MALATHION	121-75-5	0.14	0.14			
MCPA	94-74-6	0.0035	0.0035			
MCPP	93-65-2	0.007	0.007			
METHANOL	67-56-1	3.5	3.5			
METHYL ACETATE	79-20-9	7	7			
METHYL ACRYLATE	96-33-3	0.21	0.21			
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101-14-4	0.00085	0.0043	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
METHYLENE BROMIDE	74-95-3	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
4,4'-METHYLENEDIANILINE	101-77-9	0.000053	0.000053	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
METHYLISOBUTYLKETONE	108-10-1	0.56	0.56			
1-METHYLNAPHTHALENE	90-12-0	0.49	2.45			
2-METHYLNAPHTHALENE	93-65-2	0.028	0.14			
3-METHYLPHENOL	108-39-4	0.35	0.35			
4-METHYLPHENOL	106-44-5	0.7	0.7			
METOLACHLOR	51218-45-2	1.05	5.25			
METRIBUZIN	21087-64-9	0.175	0.175			
MOLYBDENUM	7439-98-7	0.035	0.035			
2-NITROANILINE	88-74-4	0.105	0.105			
3-NITROANILINE	99-09-2	not available	not available			
4-NITROANILINE	100-01-6	0.028	0.028			
NITROGLYCERINE	55-63-0	0.005	0.005	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
n-NITROSODIMETHYLAMINE	62-75-9	0.0006	0.0006	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
2-NITROTOLUENE	88-72-2	0.00039	0.00039	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
3-NITROTOLUENE	99-08-1	0.0007	0.0007			
4-NITROTOLUENE	99-99-0	0.0085	0.0085	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
PARAQUAT DICHLORIDE	1910-42-5	0.0315	0.0315			
PARATHION-ETHYL	56-38-2	0.168	0.84			
PARATHION-METHYL (pH 4.5-7.24)	298-00-0	0.0018	0.0088			
PARATHION-METHYL (pH 7.25-9.0)	298-00-0	0.0018	0.0018			
PENDIMETHALIN	40487-42-1	0.28	1.4			
PENTACHLORONITROBENZENE	82-68-8	0.021	0.105			
PENTAERYTHRITOL TETRANITRATE (PETN)	78-11-5	0.014	0.014			
PERCHLORATE	14797-73-0	0.0049	0.0049			
PHENANTHRENE	85-01-8	0.21	1.05			
PHORATE	298-02-2	0.0014	0.007			
PROMETON (g)	1610-18-0	0.105	0.105			
n-PROPYLBENZENE	103-65-1	0.7	3.5			
PROPYLENE GLYCOL	57-55-6	140	140			
PROPYLENE GLYCOL DINITRATE	6423-43-4	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
PROPYLENE GLYCOL MONOMETHYL ETHER	107-98-2	4.9	4.9			
PYRIDINE	110-86-1	0.007	0.007			
RDX	121-82-4	0.084	0.084			
STRONTIUM	7440-24-6	4.2	not available			
TEBUTHIURON	34014-18-1	0.49	0.49			
TERBUFOS	13071-79-9	0.00018	0.0009			
1,1,1,2-TETRACHLOROETHANE	630-20-6	0.21	1.05			
1,1,2,2-TETRACHLOROETHANE	79-34-5	0.0043	0.0043	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
TETRACHLOROVINPHOS	961-11-5	0.21	1.05			
THIRAM	137-26-8	0.035	0.035			
TIN	7440-31-5	4.2	not available			
2,4,6-TRIBROMOPHENOL	118-79-6	not available	not available			
1,2,3-TRICHLOROBENZENE	87-61-6	0.0056	0.028			

TRICHLOROFLUOROMETHANE	75-69-4	2.1	10.5			
2,4,5-TRICHLOROPHENOXYACETIC ACID	93-76-5	0.28	1.4			
1,2,3-TRICHLOROPROPANE	96-18-4	0.001	0.001	Mixtures for carcinogens must be evaluated in accordance with 35 IAC 742 Section 742.805(d)		
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	210	1050			
TRIFLURALIN	1582-09-8	0.052	0.26			
1,2,3-TRIMETHYLBENZENE	526-73-8	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
1,2,4-TRIMETHYLBENZENE	95-63-6	not available	not available	Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact		
1,3,5-TRIMETHYLBENZENE	108-67-8	0.07	0.35			
1,3,5-TRINITROBENZENE	99-35-4	0.84	0.84			
2,4,6-TRINITROTOLUENE	118-96-7	0.014	0.014			
TRINITROPHENYLMETHYLNITRAMINE, 2,4,6- (TETRYL)	479-45-8	0.11	0.11			
NOTE: ALL CONCENTRATIONS IN MG/L						
REVISION DATE: 10/30/12						

Chemicals Not in TACO Tier 1 Tables – Soil Objectives
Revision Date: October 30, 2012
Table downloaded from IEPA Website in May 2013

CHEMICAL NAME	CAS No.	RESIDENTIAL INGESTION	RESIDENTIAL INHALATION	I/C INGESTION	I/C INHALATION	CONST. WORKER INGESTION	CONST. WORKER INHALATION	MIGRATION TO CLASS 1 GW	MIGRATION TO CLASS 2 GW		
ACENAPHTHYLENE	208-96-8	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	85(a)	420		
ACETALDEHYDE (e)	75-07-0	(c)	9.9(b,i)	(c)	19(b)	(c)	8.6(a)	(c,h)	(c,h)		
ACETOCHLOR (e,g)	34256-82-1	1600(a)	(c)	41000(a)	(c)	4100(a)	(c)	5.9(a)	30		
ACROLEIN (e)	107-02-8	39(a)	0.17(a,i)	1000(a)	0.26(a)	820(a)	0.008(a)	0.014(a)	0.014		
ACRYLIC ACID (e)	79-10-7	39000(a)	140(a,i)	1000000(a)	230(a)	41000(a)	0.3(a)	14(a)	14		
ACRYLONITRILE (e)	107-13-1	1.2(b)	0.29(b,i)	11(b)	0.56(b)	230(b)	0.17(a)	0.0006(b)	0.0006		
ALLYL ALCOHOL (e)	107-18-6	390(a)	3.6(a,i)	10000(a)	5.8(a)	820(a)	0.37(a)	0.14(a)	0.14		
ALUMINUM	7429-90-5	78000(a)	1000000(a,i)	1000000(a)	1000000(a)	200000(a)	870000(a)	3.5 mg/l (TCLP or SPLP)	5.0 mg/l (TCLP or SPLP)		
ANILINE (e)	62-53-3	110(b)	83(a,i)	1000(b)	130(a)	1400(a)	8.6(a)	0.064(b)	0.064		
BENTAZON (g)	25057-89-0	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	2.5(a)	2.5		
BENZALDEHYDE (e)	100-52-7	7800(a)	(c)	200000(a)	(c)	200000(a)	(c)	3.3(a)	3.3		
BENZIDINE	92-87-5	0.003(b)	0.009(b,i)	0.02(b)	0.02(b)	0.54(b)	0.02(b)	0.000002(b)	0.000002		
BENZO(g,h,i,)PERYLENE	191-24-2	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	27000(a)	130000		
BENZYL ALCOHOL (e)	100-51-6	7800(a)	(c)	200000(a)	(c)	61000(a)	(c)	3(a)	3		
BIDRIN (e,g)	141-66-2	7.8(a)	(c)	200(a)	(c)	20(a)	(c)	0.0028(a)	0.0028		
1,1-BIPHENYL	92-52-4	3900(a)	(c)	100000(a)	(c)	20000(a)	(c)	150(a)	740		
BIS(2-CHLORO-1-METHYLETHYL)ETHER (e)	108-60-1	3100(a)	(c)	82000(a)	(c)	200(a)	(c)	2.4(a)	2.4		
BROMOBENZENE (e)	108-86-1	630(a)	630(a,i)	16000(a)	810(d)	4100(a)	22(a)	0.86(a)	4.3		
BROMOXYNIL (g)	1689-84-5	1600(a)	(c)	41000(a)	(c)	4100(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
1,3-BUTADIENE (e)	106-99-0	(c)	0.05(b,i)	(c)	0.09(b)	(c)	0.01(a)	(c,h)	(c,h)		
2-BUTANONE (MEK) (e)	78-93-3	47000(a)	25000(d,i)	1000000(a)	25000(d,i)	120000(a)	730(a)	17(a)	17		
BUTYLATE (e,g)	2008-41-5	3900(a)	(c)	100000(a)	(c)	10000(a)	(c)	170(a)	850		
n-BUTYLBENZENE (e)	104-51-8	3900(a)	(c)	100000(a)	(c)	20000(a)	(c)	52(a)	87(d)		
CAPROLACTAM	105-60-2	39000(a)	(c)	1000000(a)	(c)	100000(a)	(c)	14(a)	14		
CAPTAN (g)	133-06-2	10000(a)	(c)	270000(a)	(c)	27000(a)	(c)	11(a)	11		
CARBARYL (g)	63-25-2	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	8.7(a)	8.7		
CARBOXIN (g)	5234-68-4	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	6.3(a)	6.3		
CHLORAMBEN (g)	133-90-4	1200(a)	(c)	31000(a)	(c)	3100(a)	(c)	0.47(a)	0.47		
CHLORFENVINPHOS (e)	470-90-6	55(a)	(c)	1400(a)	(c)	410(a)	(c)	1.1(a)	5.6		
1-CHLOROBUTANE (e)	109-69-3	3100(a)	(c)	82000(a)	(c)	14000(a)	(c)	3.1(a)	16		
CHLOROETHANE (e)	75-00-3	(c)	1500(d,i)	(c)	1500(d)	20000(a)	39(a)	(c,h)	(c,h)		
CHLOROMETHANE (e)	74-87-3	(c)	110(a,i)	(c)	180(a)	(c)	5(a)	(c,h)	(c,h)		
2-CHLORONAPHTHALENE	91-58-7	6300(a)	(c)	160000(a)	(c)	41000(a)	(c)	49(a)	240		
o-CHLOROTOLUENE (e)	95-49-8	1600(a)	(c)	41000(a)	(c)	4100(a)	150(a)	4(a)	20		
CHLORPYRIFOS (g)	2921-88-2	78(a)	(c)	2000(a)	(c)	610(a)	(c)	29(a)	150		
CHLORPYRIFOS METHYL (g)	5598-13-0	780(a)	(c)	20000(a)	(c)	2000(a)	(c)	49(a)	240		
CYANAZINE (g)	21725-46-2	160(a)	(c)	4100(a)	(c)	410(a)	(c)	0.14(a)	0.14		
CYCLOHEXANE (e)	110-82-7	(c)	280(d,i)	(c)	280(d)	(c)	280(d)	(c,h)	(c,h)		
CYCLOHEXANONE (e)	108-94-1	390000(a)	660(d,i)	1000000(a)	660(d)	410000(a)	660(d)	150(a)	150		
2,4-DB (g)	94-82-6	630(a)	(c)	16,000(a)	(c)	16,000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
DIAZINON (g)	333-41-5	55(a)	(c)	1400(a)	(c)	410(a)	400(a)	1.4(a)	7.2		
DIBENZOFURAN	132-64-9	78(a)	(c)	2000(a)	(c)	820(a)	(c)	3(a)	15(a)		
DICAMBA	1918-00-9	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	0.86(a)	0.86		
DICHLORODIFLUOROMETHANE (e)	75-71-8	16000(a)	200(a,i)	410000(a)	310(a)	180000(a)	20(a)	43(a)	220		
1,3-DICHLOROPROPANE (e)	142-28-9	1600(a)	(c)	41000(a)	(c)	41000(a)	(c)	0.83(a)	0.83		
DICHLORVOS (e)	62-73-7	2.2(b)	0.18(b,i)	20(b)	0.34(b)	430(b)	0.2(b)	0.0014(b)	0.0014		
DICYCLOPENTADIENE (e)	77-73-6	630(a)	18(a,i)	16000(a)	29(a)	16000(a)	0.53(a)	1.3(a)	6.6		
DIETHANOLAMINE (e)	111-42-2	(c)	490(a,i)	(c)	790(a)	(c)	15(a)	(c)	(c)		
DIETHYLENE GLYCOL MONOBUTYL ETHER (e)	112-34-5	2300(a)	23(a,i)	61000(a)	37(a)	61000(a)	2.4(a)	0.91(a)	0.91		
DIETHYLENE GLYCOL MONOETHYL ETHER (e)	111-90-0	4700(a)	56(a,i)	120000(a)	89(a)	120000(a)	5.8(a)	1.7(a)	1.7		
DIISOPROPYL ETHER (e)	108-20-3	(c)	470(d,i)	(c)	470(d)	(c)	21(a)	(c,h)	(c,h)		
DIMETHYL PHTHALATE (e)	131-11-3	(c)	(c)	(c)	(c)	20000(a)	(c)	(c)	(c)		
1,3-DINITROBENZENE	75-71-8	7.8(a)	(c)	200(a)	(c)	200(a)	(c)	0.0037(a)	0.0037		
4,6-DINITRO-o-CRESOL	534-52-1	6.3(a)	(c)	160(a)	(c)	160(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
p-DIOXANE (e)	123-91-1	58(b)	8.2(b,i)	520(b)	16(b)	11000(b)	22(b)	0.031(b)	0.031		
DIPHENYLAMINE	122-39-4	2000(a)	(c)	51000(a)	(c)	4100(a)	(c)	20(a)	100		
DISULFOTON (e,g)	298-04-4	3.1(a)	(c)	82(a)	(c)	18(a)	3.9(a)	0.09(a)	0.45		
EPTC (e,g)	759-94-4	2000(a)	(c)	51000(a)	(c)	5100(a)	(c)	3.6(a)	18		
ETHION (e,g)	563-12-2	39(a)	(c)	1000(a)	(c)	410(a)	(c)	13(a)	67		
ETHOXYETHANOL ACETATE (e)	111-15-9	7800(a)	4500(a,i)	200000(a)	7300(a)	200000(a)	47(a)	2.9(a)	2.9		
ETHYL ACETATE (e)	141-78-6	70000(a)	(c)	1000000(a)	(c)	1000000(a)	(c)	26(a)	26		
ETHYL ACRYLATE (e)	140-88-5	13(b)	(c)	120(b)	(c)	2600(b)	(c)	0.0081(b)	0.0081		
ETHYLENE GLYCOL (e)	107-21-1	160000(a)	54000(a,i)	1000000(a)	86000(a)	160000(a)	5600(a)	56(a)	56		
ETHYLENE GLYCOL MONBUTYL ETHER (e)	111-76-2	7800(a)	130000(d,i)	200000(a)	130000(d)	20000(a)	2800(a)	2.9(a)	2.9		
ETHYLENE THIOUREA	96-45-7	6.3(a)	27(b,i)	130(b)	51(b)	16(a)	72(b)	0.0076(b)	0.0076		
ETHYL ETHER (e)	60-29-7	16000(a)	(c)	410000(a)	(c)	100000(a)	110(a)	6.1(a)	6.1		
FONOFOS (e,g)	944-22-9	160(a)	(c)	4100(a)	(c)	410(a)	(c)	4.2(a)	21		
FORMALDEHYDE (e)	50-00-0	16000(a)	16(b,i)	410000(a)	30(b)	61000(a)	33(a)	5.7(a)	5.7		
FURFURAL (e)	98-01-1	230(a)	2700(a,i)	6100(a)	4200(a)	6100(a)	270(a)	0.086(a)	0.086		
GLYPHOSATE (g)	1071-83-6	7800(a)	(c)	200000(a)	(c)	20000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
HEXACHLOROBUTADIENE (e)	87-68-3	78(a)	(c)	2000(a)	(c)	200(a)	(c)	2.2(a)	11		
HEXANE (e)	110-54-3	4700(a)	290(d,i)	120000(a)	290(d)	61000(a)	16(a)	82(a)	120(d)		
2-HEXANONE (e)	591-78-6	390(a)	450(a,i)	10000(a)	720(a)	1000(a)	47(a)	0.16(a)	0.16		
HMX	2691-41-0	3900(a)	(c)	100000(a)	(c)	100000(a)	(c)	5.7(a)	5.7		
HYDRAZINE (e)	302-01-2	0.21(b)	0.033(b,i)	1.9(b)	0.064(b)	41(b)	0.065(a)	0.0001(b)	0.0001		

IMAZAQUIN (g)	81335-37-7	20000(a)	(c)	510000(a)	(c)	51000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
IODINE	7553-56-2	780(a)	(c)	20000(a)	(c)	2000(a)	(c)	0.35 mg/l (TCLP or SPLP)	not available		
ISOBUTANOL (e)	78-83-1	23000(a)	(c)	610000(a)	(c)	610000(a)	(c)	8.8(a)	8.8		
ISOPROPYBENZENE (cumene)(e)	98-82-8	7800(a)	500(a,i)	200000(a)	800(a)	82000(a)	52(a)	91(a)	400(d)		
MALATHION (e,g)	121-75-5	1600(a)	(c)	41000(a)	(c)	4100(a)	170(a)	1.7(a)	1.7		
MCPA	94-74-6	39(a)	(c)	1000(a)	(c)	100(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
MCPP	93-65-2	78(a)	(c)	2000(a)	(c)	2000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
METHANOL (e)	67-56-1	39000(a)	100000(d,i)	1000000(a)	100000(d)	1000000(a)	3400(a)	14(a)	14		
METHYL ACETATE (e)	79-20-9	78000(a)	(c)	1000000(a)	(c)	1000000(a)	9.2(a)	28(a)	28		
METHYL ACRYLATE (e)	96-33-3	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	0.88(a)	0.88		
4,4'-METHYLENEBIS(2-CHLOROANILINE)	101-14-4	6.4(b)	(c)	57(b)	(c)	410(a)	(c)	0.25(b)	1.3		
METHYLENE BROMIDE (e)	74-95-3	(c)	28(a,i)	(c)	44(a)	1800(a)	2.8(a)	(c)	(c)		
4,4'-METHYLENEDIANILINE	101-77-9	0.4(b)	1.5(b,i)	3.6(b)	2.9(b)	78(b)	4.0(b)	0.00026(b)	0.00026		
METHYLISOBUTYLKETONE (e)	108-10-1	6300(a)	3100(d,i)	160000(a)	3100(d)	160000(a)	340(a)	2.5(a)	2.5		
1-METHYLNAPHTHALENE (e)	90-12-0	5500(a)	(c)	140000(a)	(c)	14000(a)	(c)	130(a)	330(d)		
2-METHYLNAPHTHALENE	93-65-2	310(a)	(c)	8200(a)	(c)	820(a)	(c)	1.9(a)	9.5		
3-METHYLPHENOL (e)	108-39-4	3900(a)	8100(d,i)	100000(a)	8100(d)	20000(a)	3200(a)	2(a)	2		
4-METHYLPHENOL	106-44-5	7800(a)	100000(a,i)	200000(a)	170000(a)	4100(a)	3300(a)	3.9(a)	3.9		
METOLACHLOR (e,g)	51218-45-2	12000(a)	(c)	310000(a)	(c)	31000(a)	(c)	55(a)	270		
METRIBUZIN(g)	21087-64-9	2000(a)	(c)	51000(a)	(c)	5100(b)	(c)	1(b)	1		
MOLYBDENUM	7439-98-7	390(a)	(c)	10000(a)	(c)	1000(a)	(c)	0.035 mg/l (TCLP or SPLP)	0.035 mg/l (TCLP or SPLP)		
2-NITROANILINE	88-74-4	1200(a)	18(a,i)	31000(a)	28(a)	31000(a)	1.5(a)	0.7(a)	0.7		
3-NITROANILINE	99-09-2	(c)	(c)	(c)	(c)	200(a)	(c)	(c)	(c)		
4-NITROANILINE	100-01-6	310(a)	1500(a,i)	8200(a)	2400(a)	2000(a)	52(a)	0.14(a)	0.14		
NITROGLYCERINE (e)	55-63-0	7.8(a)	(c)	200(a)	(c)	20(a)	(c)	0.028(b)	0.028		
n-NITROSODIMETHYLAMINE (e)	62-75-9	0.013(b)	0.012(b,i)	0.11(b)	0.023(b)	1.6(a)	2	0.000007(b)	0.000007		
2-NITROTOLUENE (e)	88-72-2	2.9(b)	(c)	26(b)	(c)	560(b)	(c)	0.0028(b)	0.0028		
3-NITROTOLUENE (e)	99-08-1	7.8(a)	(c)	200(a)	(c)	200(a)	(c)	0.0057(a)	0.0057		
4-NITROTOLUENE	99-99-0	40(b)	(c)	360(b)	(c)	820(a)	(c)	0.067(b)	0.067		
PARAQUAT DICHLORIDE (g)	1910-42-5	350(a)	(c)	9200(a)	(c)	920(a)	(c)	0.13(a)	0.13		
PARATHION-ETHYL (e,g)	56-38-2	470(a)	(c)	12000(a)	(c)	1200(a)	(c)	40(a)	78(d)		
PARATHION-METHYL (g)	298-00-0	20(a)	(c)	510(a)	(c)	140(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
PENDIMETHALIN (g)	40487-42-1	3100(a)	(c)	82000(a)	(c)	8200(a)	(c)	1400(a)	6900		
PENTACHLORONITROBENZENE	82-68-8	230(a)	(c)	6100(a)	(c)	610(a)	(c)	31(a)	150		
PENTAERYTHRITOL TETRANITRATE (PETN)	78-11-5	160(a)	(c)	4000(a)	(c)	410(a)	(c)	0.18(a)	0.18(a)		
PERCHLORATE	14797-73-0	55(a)	(c)	1400(a)	(c)	140(a)		0.0049 mg/l(TCLP or SPLP)	0.0049 mg/l(TCLP or SPLP)		
PHENANTHRENE	85-01-8	2300(a)	(c)	61000(a)	(c)	61000(a)	(c)	210(a)	1100		
PHORATE (e,g)	298-02-2	16(a)	(c)	410(a)	(c)	41(a)	(c)	0.11(a)	0.55		
PROMETON (g)	1610-18-0	1200(a)	(c)	31000(a)	(c)	31000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
n-PROPYLBENZENE (e)	103-65-1	7800(a)	300(d,i)	200000(a)	300(d)	20000(a)	91(a)	31(a)	120(d)		
PROPYLENE GLYCOL (e)	57-55-6	1000000(a)	(c)	1000000(a)	(c)	1000000(a)	49(a)	560(a)	560		
PROPYLENE GLYCOL DINITRATE	6423-43-4	(c)	54(a,i)	(c)	87(a)	(c)	0.56(a)	(c)	(c)		
PROPYLENE GLYCOL MONOMETHYL ETHER (e)	107-98-2	55000(a)	100000(d,i)	1000000(a)	100000(d)	1000000(a)	34000(a)	20(a)	20		
PYRIDINE (e)	110-86-1	78(a)	(c)	2000(a)	(c)	2000(a)	(c)	see pH-specific worksheet	see pH-specific worksheet		
RDX	121-82-4	230(a)	(c)	6100(a)	(c)	610(a)	(c)	0.36(a)	0.36		
STRONTIUM	7440-24-6	47000(a)	(c)	1000000(a)	(c)	410000(a)	(c)	4.2 mg/l (TCLP or SPLP)	not available		
TEBUTHIURON (g)	34014-18-1	5500(a)	(c)	140000(a)	(c)	14000(a)	(c)	3.1(a)	3.1		
TERBUFOS (e,g)	13071-79-9	2(a)	(c)	51(a)	(c)	5.1(a)	(c)	0.031(a)	0.15		
1,1,1,2-TETRACHLOROETHANE (e)	630-20-6	2300(a)	(c)	61000(a)	(c)	18000(a)	(c)	3.4(a)	17		
1,1,2,2-TETRACHLOROETHANE (e)	79-34-5	3.2(b)	0.62(b,i)	27(b)	1.2(b)	620(b)	1.7(b)	0.0035(b)	0.0035		
TETRACHLOROVINPHOS	961-11-5	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	26(a)	130		
THIRAM (g)	137-26-8	390(a)	(c)	10000(a)	(c)	1200(a)	(c)	0.21(a)	0.21		
TIN	7440-31-5	47000(a)	(c)	1000000(a)	(c)	61000(a)	(c)	4.2 mg/l (TCLP or SPLP)	not available		
2,4,6-TRIBROMOPHENOL	118-79-6	(c)	(c)	(c)	(c)	18000(a)	(c)	(c)	(c)		
1,2,3-TRICHLOROBENZENE	87-61-6	63(a)	(c)	1600(a)	(c)	1600(a)	(c)	0.46(a)	2.3		
TRICHLOROFLUOROMETHANE (e)	75-69-4	23000(a)	870(a,i)	610000(a)	1400(a)	140000(a)	13(a)	34(a)	170		
2,4,5-TRICHLOROPHENOXYACETIC ACID (g)	93-76-5	780(a)	(c)	20000(a)	(c)	20000(a)	(c)	5.2 (a)	26		
1,2,3-TRICHLOROPROPANE (e)	96-18-4	0.021(b)	3.2(a,i)	0.19(b)	5.0(a)	4.1(b)	0.32(a)	0.000017(b)	0.000017		
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (e)	76-13-1	1000000(a)	1000(d,i)	1000000(a)	1000(d)	610000(a)	350(a)	450(d)	450(d)		
TRIFLURALIN (g)	1582-09-8	590(a)	(c)	15000(a)	(c)	1500(a)	(c)	420(a)	2100		
1,2,3-TRIMETHYLBENZENE (e)	526-73-8	(c)	66(a,i)	(c)	110(a)	(c)	6.9(a)	(c)	(c)		
1,2,4-TRIMETHYLBENZENE (e)	95-63-6	(c)	87(a,i)	(c)	140(a)	(c)	8.9(a)	(c,h)	(c,h)		
1,3,5-TRIMETHYLBENZENE (e)	108-67-8	780(a)	(c)	20000(a)	(c)	20000(a)	0.79(a)	2.0(a)	10		
1,3,5-TRINITROBENZENE	99-35-4	2300(a)	(c)	61000(a)	(c)	6100(a)	(c)	3.9	3.9		
2,4,6-TRINITROTOLUENE	118-96-7	39(a)	(c)	1000(a)	(c)	310(a)	(c)	0.077	0.077		
2,4,6-TRINITROPHENYLMETHYLNITRAMINE (TETRYL)	479-45-8	310(a)	(c)	8200(a)	(c)	2000(a)	(c)	0.62(a)	0.62		

NOTE: ALL CONCENTRATIONS IN MG/KG

(a) Calculated using a target hazard quotient of 1
(b) Calculated using a cancer risk level of 1 in 1,000,000
(c) No toxicity criteria for this route of exposure
(d) Soil Saturation Concentration

(e) See workbook page for soil saturation concentration											
(f) For soils contaminated with secondary explosives where no chunks of aggregated or precipitated material are present											
(g) For agrichemical facilities, surface soil objectives based on field application rates may be more appropriate for currently registered pesticides.											
(h) Although lacking a health-based groundwater ingestion objective, the inhalation RfC or URF indicates that this chemical could represent a potential threat through volatilization during indoor groundwater use. Contact the Toxicity Assessment Unit for assistance in evaluating this pathway.											
(i) The remediation objectives for this receptor must also include the Construction Worker inhalation objective.											
REVISION DATE: 10/30/12											

Office of Solid Waste and Emergency Response (OSWER)
Vapor Intrusion Assessment
Vapor Intrusion Screening Level (VISL) Calculator
Version 3.1, June 2013 RSLs

OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.1, June 2013 RSLs

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (^{0}C)	Tgw	25	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25^{0}C	Groundwater Vapor Conc.	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1
			Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Cvp	Chc	Tgw or 25	LEL		IUR		RfC		i	Cia,c	Cia,nc
			Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	(ug/m^3)	(ug/m^3)	C	(% by vol)		(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)
	83-32-9	Acenaphthene	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.78E+04	2.93E+04	25	0.6	M							
	75-07-0	Acetaldehyde	Yes	Yes	5.6E+00	C	5.6E+01	2.0E+03	--	2.14E+09	2.73E+09	25	4	E	2.20E-06	I	9.00E-03	I		5.6E+00	3.9E+01
	67-64-1	Acetone	Yes	Yes	1.4E+05	NC	1.4E+06	9.5E+07	--	7.25E+08	1.43E+09	25	2.6	E			3.10E+01	A			1.4E+05
	75-86-5	Acetone Cyanohydrin	Yes	Yes	8.8E+00	NC	8.8E+01	1.6E+04	--	1.56E+06	5.31E+08	25					2.00E-03	X			8.8E+00
	75-05-8	Acetonitrile	Yes	Yes	2.6E+02	NC	2.6E+03	1.9E+05	--	1.96E+08	1.41E+09	25	3	N			6.00E-02	I			2.6E+02
	98-86-2	Acetophenone	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.57E+06	2.61E+06	25	1.1	M							
	107-02-8	Acrolein	Yes	Yes	8.8E-02	NC	8.8E-01	1.8E+01	--	8.27E+08	1.06E+09	25	2.8	N			2.00E-05	I			8.8E-02
	107-13-1	Acrylonitrile	Yes	Yes	1.8E-01	C	1.8E+00	3.2E+01	--	3.11E+08	4.20E+08	25	3	N	6.80E-05	I	2.00E-03	I		1.8E-01	8.8E+00
	107-05-1	Allyl Chloride	Yes	Yes	2.0E+00	C	2.0E+01	4.5E+00	--	1.52E+09	1.52E+09	25			6.00E-06	CA	1.00E-03	I		2.0E+00	4.4E+00
	120-12-7	Anthracene	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	6.26E+01	9.86E+01	25	0.6	M							
	11104-28-2	Aroclor 1221	Yes	Yes	2.2E-02	C	2.2E-01	7.2E-01	--	6.80E+04	4.51E+05	25			5.70E-04	S				2.2E-02	
	11141-16-5	Aroclor 1232	Yes	Yes	2.2E-02	C	2.2E-01	7.2E-01	--	4.12E+04	4.36E+04	25			5.70E-04	S				2.2E-02	
	103-33-3	Azobenzene	Yes	Yes	4.0E-01	C	4.0E+00	7.2E+02	--	3.54E+03	3.53E+03	25			3.10E-05	I				4.0E-01	
	100-52-7	Benzaldehyde	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	7.25E+06	7.58E+06	25	1.4	M							
x	71-43-2	Benzene	Yes	Yes	1.6E+00	C	1.6E+01	6.9E+00	No (5)	3.98E+08	4.06E+08	25	1.2	N	7.80E-06	I	3.00E-02	I		1.6E+00	1.3E+02
	108-98-5	Benzenethiol	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.14E+07	1.14E+07	25									
	98-07-7	Benzotrichloride	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.35E+06	5.63E+05	25									
	100-44-7	Benzyl Chloride	Yes	Yes	2.5E-01	C	2.5E+00	1.5E+01	--	8.38E+06	8.84E+06	25	1.1	N	4.90E-05	CA	1.00E-03	P		2.5E-01	4.4E+00
	92-52-4	Biphenyl, 1,1'-	Yes	Yes	1.8E+00	NC	1.8E+01	1.4E+02	--	7.41E+04	8.74E+04	25	0.6	N			4.00E-04	X			1.8E+00
	108-60-1	Bis(2-chloro-1-methylethyl) ether	Yes	Yes	1.2E+00	C	1.2E+01	4.0E+02	--	5.15E+06	5.16E+06	25			1.00E-05	H				1.2E+00	
	111-44-4	Bis(2-chloroethyl)ether	Yes	Yes	3.7E-02	C	3.7E-01	5.3E+01	--	1.19E+07	1.20E+07	25	2.7	N	3.30E-04	I				3.7E-02	
	542-88-1	Bis(chloromethyl)ether	Yes	Yes	2.0E-04	C	2.0E-03	1.1E-03	--	1.82E+08	3.92E+09	25			6.20E-02	I				2.0E-04	
	107-04-0	Bromo-2-chloroethane, 1-	Yes	Yes	2.0E-02	C	2.0E-01	5.5E-01	--	2.55E+08	2.56E+08	25			6.00E-04	X				2.0E-02	
	108-86-1	Bromobenzene	Yes	Yes	2.6E+02	NC	2.6E+03	2.6E+03	--	3.53E+07	4.50E+07	25					6.00E-02	I			2.6E+02
	74-97-5	Bromochloromethane	Yes	Yes	1.8E+02	NC	1.8E+03	2.9E+03	--	9.96E+08	9.97E+08	25					4.00E-02	X			1.8E+02
	75-27-4	Bromodichloromethane	Yes	Yes	3.3E-01	C	3.3E+00	3.8E+00	Yes (80)	5.22E+08	2.63E+08	25			3.70E-05	CA				3.3E-01	
	74-83-9	Bromomethane	Yes	Yes	2.2E+01	NC	2.2E+02	7.3E+01	--	8.28E+09	4.56E+09	25	10	N			5.00E-03	I			2.2E+01
	106-99-0	Butadiene, 1,3-	Yes	Yes	4.1E-01	C	4.1E+00	1.4E-01	--	6.14E+09	2.21E+09	25	2	N	3.00E-05	I	2.00E-03	I		4.1E-01	8.8E+00
	104-51-8	Butylbenzene, n-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	7.66E+06	7.67E+06	25									
	135-98-8	Butylbenzene, sec-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.26E+07	1.27E+07	25									
	98-06-6	Butylbenzene, tert-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.59E+07	1.59E+07	25									
x	75-15-0	Carbon Disulfide	Yes	Yes	3.1E+03	NC	3.1E+04	5.2E+03	--	1.47E+09	1.27E+09	25	1.3	N			7.00E-01	I			3.1E+03
	56-23-5	Carbon Tetrachloride	Yes	Yes	2.0E+00	C	2.0E+01	1.8E+00	Yes (5)	9.52E+08	8.95E+08	25			6.00E-06	I	1.00E-01	I		2.0E+00	4.4E+02
	75-68-3	Chloro-1,1-difluoroethane, 1-	Yes	Yes	2.2E+05	NC	2.2E+06	9.1E+04	--	1.37E+10	3.36E+09	25					5.00E+01	I			2.2E+05
	126-99-8	Chloro-1,3-butadiene, 2-	Yes	Yes	4.1E-02	C	4.1E-01	1.8E-02	--	1.03E+09	1.92E+09	25	1.9	N	3.00E-04	I	2.00E-02	I		4.1E-02	8.8E+01
	107-20-0	Chloroacetaldehyde, 2-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.72E+08	1.97E+08	25									
	108-90-7	Chlorobenzene	Yes	Yes	2.2E+02	NC	2.2E+03	1.7E+03	No (100)	7.27E+07	6.33E+07	25	1.3	N			5.00E-02	P			2.2E+02
	98-56-6	Chlorobenzotrifluoride, 4-	Yes	Yes	1.3E+03	NC	1.3E+04	9.3E+02	--	7.41E+07	1.66E+07	25					3.00E-01	P			1.3E+03
	109-69-3	Chlorobutane, 1-	No Inhal. Tox. Info	No Inhal. Tox. Info		--			--	5.03E+08	7.51E+08	25	1.8	M							
	75-45-6	Chlorodifluoromethane	Yes	Yes	2.2E+05	NC	2.2E+06	1.3E+05	--	3.37E+10	4.60E+09	25					5.00E+01	I			2.2E+05
	67-66-3	Chloroform	Yes	Yes	5.3E-01	C	5.3E+00	3.6E+00	Yes (80)	1.27E+09	1.19E+09	25			2.30E-05	I	9.80E-02	A		5.3E-01	4.3E+02
x	74-87-3	Chloromethane	Yes	Yes	3.9E+02	NC	3.9E+03	1.1E+03	--	1.17E+10	1.92E+09	25	8.1	N			9.00E-02	I			3.9E+02
	107-30-2	Chloromethyl Methyl Ether	Yes	Yes	1.8E-02	C	1.8E-01	1.4E+00	--	1.30E+08	2.39E+09	25			6.90E-04	CA				1.8E-02	
	91-58-7	Chloronaphthalene, Beta-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.07E+05	1.53E+05	25									
	95-57-8	Chlorophenol, 2-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.75E+07	5.17E+06	25									
	76-06-2	Chloropicrin	Yes	Yes	1.8E+00	NC	1.8E+01	2.1E+01	--	2.11E+08	1.36E+08	25					4.00E-04	CA			1.8E+00
	95-49-8	Chlorotoluene, o-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.34E+07	5.46E+07	25									
	106-43-4	Chlorotoluene, p-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.83E+07	1.90E+07	25									
	123-73-9	Crotonaldehyde, trans-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.13E+08	1.19E+08	25	2.1	N							
	98-82-8	Cumene	Yes	Yes	1.8E+03	NC	1.8E+04	3.7E+03	--	2.91E+07	2.88E+07	25	0.9	N			4.00E-01	I			1.8E+03
	57-12-5	Cyanide (CN-)	Yes	Yes	3.5E+00	NC	3.5E+01	6.4E+02	No (200)	4.48E+08	5.44E+09	25					8.00E-04	S			3.5E+00
	460-19-5	Cyanogen	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.20E+10	2.09E+09	25									
	506-68-3	Cyanogen Bromide	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	6.95E+08	1.51E+11	25									
	506-77-4	Cyanogen Chloride	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.07E+09	2.38E+09	25									
	110-82-7	Cyclohexane	Yes	Yes	2.6E+04	NC	2.6E+05	4.3E+03	--	4.39E+08	3.37E+08	25					6.00E+00	I			2.6E+04
	110-83-8	Cyclohexene	Yes	Yes	4.4E+03	NC	4.4E+04	2.4E+03	--	3.93E+08	3.96E+08	25					1.00E+00	X			4.4E+03
	132-64-9	Dibenzofuran	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.24E+04	2.70E+04	25									
	96-12-8	Dibromo-3-chloropropane, 1,2-	Yes	Yes	2.0E-03	C	2.0E-02	3.4E-01	No (0.2)	7.38E+06	7.39E+06	25			6.00E-03	P	2.00E-04	I	Mut	2.0E-03	8.8E-01
	124-48-1	Dibromochloromethane	Yes	Yes	4.5E-01	C	4.5E+00	1.4E+01	Yes (80)	1.68E+08	8.64E+07	25			2.70E-05	CA				4.5E-01	
	106-93-4	Dibromoethane, 1,2-	Yes	Yes	2.0E-02	C	2.0E-01	7.7E-01	No (0.05)	1.13E+08	1.04E+08	25			6.00E-04	I	9.00E-03	I		2.0E-02	3.9E+01
	74-95-3	Dibromomethane (Methylene Bromide)	Yes	Yes	1.8E+01	NC	1.8E+02	5.2E+02	--	4.15E+08	4.00E+08	25					4.00E-03	X			1.8E+01
	764-41-0	Dichloro-2-butene, 1,4-	Yes	Yes	2.9E-03	C	2.9E-02	1.1E-01	--	2.02E+07	1.57E+07	25			4.20E-03	P				2.9E-03	
	1476-11-5	Dichloro-2-butene, cis-1,4-	Yes	Yes	2.9E-03	C	2.9E-02	1.1E-01	--	2.75E+07	1.57E+07	25			4.20E-03	P				2.9E-03	
	110-57-6	Dichloro-2-butene, trans-1,4-	Yes	Yes	2.9E-03	C	2.9E-02	1.1E-01	--	2.31E+07	2.31E+07	25			4.20E-03	P				2.9E-03	
	95-50-1	Dichlorobenzene, 1,2-	Yes	Yes	8.8E+02	NC	8.8E+03	1.1E+04	No (600)	1.16E+07	1.22E+07	25	2.2	N			2.00E-01	H			8.8E+02
x	106-46-7	Dichlorobenzene, 1,4-	Yes	Yes	1.1E+00	C	1.1E+01	1.1E+01	Yes (75)	1.38E+07	8.01E+06	25	2.5	N	1.10E-05	CA	8.00E-01	I		1.1E+00	3.5E+03
x	75-71-8	Dichlorodifluoromethane	Yes	Yes	4.4E+02	NC	4.4E+03	3.1E+01	--	3.16E+10	3.93E+09	25					1.00E-01	X			4.4E+02
x	75-34-3	Dichloroethane, 1,1-	Yes	Yes	7.7E+00	C	7.7E+01	3.3E+01	--	1.45E+09	1.16E+09	25	5.4	N	1.60E-06	CA				7.7E+00	
	107-06-2	Dichloroethane, 1,2-	Yes	Yes	4.7E-01	C	4.7E+00	9.8E+00	No (5)	4.20E+08	4.15E+08	25	6.2	N	2.60E-05	I	7.00E-03	P		4.7E-01	3.1E+01
x	75-35-4	Dichloroethylene, 1,1-	Yes	Yes	8.8E+02	NC	8.8E+03	8.2E+02	No (7)	3.31E+09	2.58E+09	25	6.5	N			2.00E-01	I			8.8E+02
x	540-59-0	Dichloroethylene, 1,2- (Mixed Isomers)	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.05E+09	5.84E+08	25									
	156-59-2	Dichloroethylene, 1,2-cis-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	No (70)	1.05E+09	1.07E+09	25	9.7	M							

OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.1, June 2013 RSLs

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (^{o}C)	Tgw	25	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25°C	Groundwater Vapor Conc.	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1
			Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Cvp	Chc	Tgw or 25	LEL		IUR		RfC		i	Cia,c	Cia,nc
			Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	(ug/m^3)	(ug/m^3)	C	(% by vol)		(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)
	156-60-5	Dichloroethylene, 1,2-trans-	Yes	Yes	2.6E+02	NC	2.6E+03	1.6E+03	No (100)	1.05E+09	7.54E+08	25	9.7	M			6.00E-02	P			2.6E+02
	78-87-5	Dichloropropane, 1,2-	Yes	Yes	1.2E+00	C	1.2E+01	1.1E+01	No (5)	3.24E+08	3.23E+08	25	3.4	N	1.00E-05	CA	4.00E-03	I		1.2E+00	1.8E+01
	142-28-9	Dichloropropane, 1,3-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.11E+08	1.10E+08	25									
	542-75-6	Dichloropropene, 1,3-	Yes	Yes	3.1E+00	C	3.1E+01	2.1E+01	--	2.03E+08	4.06E+08	25	5.3	N	4.00E-06	I	2.00E-02	I		3.1E+00	8.8E+01
	77-73-6	Dicyclopentadiene	Yes	Yes	3.1E+01	NC	3.1E+02	1.2E+01	--	1.63E+07	3.50E+07	25					7.00E-03	P			3.1E+01
	75-37-6	Difluoroethane, 1,1-	Yes	Yes	1.8E+05	NC	1.8E+06	2.1E+05	--	1.62E+10	2.66E+09	25					4.00E+01	I			1.8E+05
	94-58-6	Dihydrosafrole	Yes	Yes	9.4E-01	C	9.4E+00	1.4E-01	--	4.95E+05	3.89E+07	25			1.30E-05	CA				9.4E-01	
	108-20-3	Diisopropyl Ether	Yes	Yes	3.1E+03	NC	3.1E+04	2.9E+04	--	8.19E+08	9.21E+08	25					7.00E-01	P			3.1E+03
	1445-75-6	Diisopropyl Methylphosphonate	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.69E+06	2.69E+06	25									
	121-69-7	Dimethylaniline, N,N-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.56E+06	3.37E+06	25									
	120-61-6	Dimethylterephthalate	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.04E+05	1.04E+05	25									
	513-37-1	Dimethylvinylchloride	Yes	Yes	9.4E-01	C	9.4E+00	2.8E-01	--	7.74E+08	3.31E+09	25			1.30E-05	CA				9.4E-01	
	505-29-3	Dithiane, 1,4-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--			--	5.18E+06	5.15E+06	25									
	106-89-8	Epichlorohydrin	Yes	Yes	4.4E+00	NC	4.4E+01	3.5E+03	--	8.17E+07	8.19E+07	25	3.8	N	1.20E-06	I	1.00E-03	I		1.0E+01	4.4E+00
	106-88-7	Epoxybutane, 1,2-	Yes	Yes	8.8E+01	NC	8.8E+02	1.2E+04	--	6.98E+08	6.99E+08	25					2.00E-02	I			8.8E+01
	759-94-4	EPTC	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.44E+05	2.44E+05	25									
	141-78-6	Ethyl Acetate	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.42E+08	4.38E+08	25	2	N							
x	140-88-5	Ethyl Acrylate	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.08E+08	2.08E+08	25									
	75-00-3	Ethyl Chloride	Yes	Yes	4.4E+04	NC	4.4E+05	9.7E+04	--	3.51E+09	3.04E+09	25	3.8	N			1.00E+01	I			4.4E+04
	60-29-7	Ethyl Ether	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.15E+09	3.04E+09	25	1.9	N							
	97-63-2	Ethyl Methacrylate	Yes	Yes	1.3E+03	NC	1.3E+04	5.6E+04	--	1.27E+08	1.26E+08	25	1.8	M			3.00E-01	P			1.3E+03
	100-41-4	Ethylbenzene	Yes	Yes	4.9E+00	C	4.9E+01	1.5E+01	Yes (700)	5.48E+07	5.44E+07	25	0.8	N	2.50E-06	CA	1.00E+00	I		4.9E+00	4.4E+03
	75-21-8	Ethylene Oxide	Yes	Yes	1.4E-01	C	1.4E+00	2.3E+01	--	3.11E+09	6.05E+09	25	3	N	8.80E-05	CA	3.00E-02	CA		1.4E-01	1.3E+02
	151-56-4	Ethyleneimine	Yes	Yes	6.5E-04	C	6.5E-03	1.3E+00	--	4.94E+08	4.95E+08	25	3.3	N	1.90E-02	CA				6.5E-04	
	86-73-7	Fluorene	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	5.37E+03	6.65E+03	25									
	110-00-9	Furan	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.20E+09	2.21E+09	25	2.3	M							
	822-06-0	Hexamethylene Diisocyanate, 1,6-	Yes	Yes	4.4E-02	NC	4.4E-01	2.2E+01	--	2.72E+05	3.51E+05	25					1.00E-05	I			4.4E-02
	110-54-3	Hexane, N-	Yes	Yes	3.1E+03	NC	3.1E+04	4.2E+01	--	7.00E+08	6.99E+08	25	1.1	N			7.00E-01	I			3.1E+03
	591-78-6	Hexanone, 2-	Yes	Yes	1.3E+02	NC	1.3E+03	3.4E+04	--	6.25E+07	6.55E+07	25					3.00E-02	I			1.3E+02
	74-90-8	Hydrogen Cyanide	Yes	Yes	3.5E+00	NC	3.5E+01	6.4E+02	--	1.08E+09	5.44E+09	25	5.6	N			8.00E-04	I			3.5E+00
	NA (JP-7)	JP-7	No VP	No VP	No VP	NC	No VP	No VP	--	No VP	No HLC	25					3.00E-01	A			1.3E+03
	7439-97-6	Mercury (elemental)	Yes	Yes	1.3E+00	NC	1.3E+01	2.8E+00	No (2)	2.11E+04	2.80E+04	25					3.00E-04	I			1.3E+00
	126-98-7	Methacrylonitrile	Yes	Yes	1.3E+02	NC	1.3E+03	1.3E+04	--	2.57E+08	2.56E+08	25	2	N			3.00E-02	P			1.3E+02
	79-20-9	Methyl Acetate	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	8.61E+08	1.14E+09	25	3.1	N							
	96-33-3	Methyl Acrylate	Yes	Yes	8.8E+01	NC	8.8E+02	1.1E+04	--	4.01E+08	4.02E+08	25	2.8	N			2.00E-02	P			8.8E+01
	78-93-3	Methyl Ethyl Ketone (2-Butanone)	Yes	Yes	2.2E+04	NC	2.2E+05	9.4E+06	--	3.52E+08	5.19E+08	25	1.4	N			5.00E+00	I			2.2E+04
	108-10-1	Methyl Isobutyl Ketone (4-methyl-2-pentan	Yes	Yes	1.3E+04	NC	1.3E+05	2.3E+06	--	1.07E+08	1.07E+08	25	1.2	N			3.00E+00	I			1.3E+04
	624-83-9	Methyl Isocyanate	Yes	Yes	4.4E+00	NC	4.4E+01	1.2E+02	--	1.07E+09	1.83E+09	25	5.3	N			1.00E-03	CA			4.4E+00
	80-62-6	Methyl Methacrylate	Yes	Yes	3.1E+03	NC	3.1E+04	2.4E+05	--	2.07E+08	1.96E+08	25	1.7	N			7.00E-01	I			3.1E+03
	25013-15-4	Methyl Styrene (Mixed Isomers)	Yes	Yes	1.8E+02	NC	1.8E+03	1.4E+03	--	9.54E+06	1.09E+07	25					4.00E-02	H			1.8E+02
	1634-04-4	Methyl tert-Butyl Ether (MTBE)	Yes	Yes	4.7E+01	C	4.7E+02	2.0E+03	--	1.19E+09	1.22E+09	25	1.6	M	2.60E-07	CA	3.00E+00	I		4.7E+01	1.3E+04
	75-09-2	Methylene Chloride	Yes	Yes	1.2E+03	C	1.2E+04	9.2E+03	No (5)	1.99E+09	1.73E+09	25	13	N	1.00E-08	I	6.00E-01	I	Mut	1.2E+03	2.6E+03
	90-12-0	Methylnaphthalene, 1-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	5.13E+05	5.42E+05	25									
	91-57-6	Methylnaphthalene, 2-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.21E+05	5.21E+05	25									
	98-83-9	Methylstyrene, Alpha-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.21E+07	1.21E+07	25									
	8012-95-1	Mineral oils	No VP	No VP	No VP	--	No VP	No VP	--	No VP	1.24E+06	25									
	64724-95-6	Naphtha, High Flash Aromatic (HFAN)	No MW	No MW	No MW	NC	No MW	No MW	--	No MW	No HLC	25					1.00E-01	P			4.4E+02
	91-20-3	Naphthalene	Yes	Yes	3.6E-01	C	3.6E+00	2.0E+01	--	5.86E+05	5.58E+05	25	0.9	N	3.40E-05	CA	3.00E-03	I		3.6E-01	1.3E+01
	98-95-3	Nitrobenzene	Yes	Yes	3.1E-01	C	3.1E+00	3.1E+02	--	1.62E+06	2.05E+06	25	1.8	N	4.00E-05	I	9.00E-03	I		3.1E-01	3.9E+01
	75-52-5	Nitromethane	Yes	Yes	1.4E+00	C	1.4E+01	1.2E+03	--	1.18E+08	1.30E+08	25			9.00E-06	P	2.00E-02	P		1.4E+00	8.8E+01
	79-46-9	Nitropropane, 2-	Yes	Yes	4.5E-03	C	4.5E-02	9.3E-01	--	8.25E+07	8.27E+07	25	2.6	N	2.70E-03	H	2.00E-02	I		4.5E-03	8.8E+01
	924-16-3	Nitroso-di-N-butylamine, N-	Yes	Yes	7.7E-03	C	7.7E-02	1.4E+01	--	3.99E+05	6.85E+05	25			1.60E-03	I				7.7E-03	
	88-72-2	Nitrotoluene, o-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.39E+06	3.32E+05	25	2.2	N							
	111-84-2	Nonane, n-	Yes	Yes	8.8E+02	NC	8.8E+03	6.3E+00	--	3.07E+07	3.06E+07	25					2.00E-01	P			8.8E+02
	109-66-0	Pentane, n-	Yes	Yes	4.4E+03	NC	4.4E+04	8.6E+01	--	2.00E+09	1.94E+09	25					1.00E+00	P			4.4E+03
	75-44-5	Phosgene	Yes	Yes	1.3E+00	NC	1.3E+01	1.9E+00	--	7.56E+09	4.66E+09	25					3.00E-04	I			1.3E+00
	123-38-6	Propionaldehyde	Yes	Yes	3.5E+01	NC	3.5E+02	1.2E+04	--	9.91E+08	9.18E+08	25					8.00E-03	I			3.5E+01
	103-65-1	Propyl benzene	Yes	Yes	4.4E+03	NC	4.4E+04	1.0E+04	--	2.21E+07	2.24E+07	25	0.8	M			1.00E+00	X			4.4E+03
	115-07-1	Propylene	Yes	Yes	1.3E+04	NC	1.3E+05	1.6E+03	--	1.97E+10	1.60E+09	25	2	E			3.00E+00	CA			1.3E+04
	75-56-9	Propylene Oxide	Yes	Yes	3.3E+00	C	3.3E+01	1.2E+03	--	1.68E+09	1.68E+09	25			3.70E-06	I	3.00E-02	I		3.3E+00	1.3E+02
	129-00-0	Pyrene	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	4.90E+01	6.57E+01	25									
	110-86-1	Pyridine	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	8.85E+07	4.50E+08	25	1.8	N							
	100-42-5	Styrene	Yes	Yes	4.4E+03	NC	4.4E+04	3.9E+04	No (100)	3.59E+07	3.48E+07	25	1.1	E			1.00E+00	I			4.4E+03
	630-20-6	Tetrachloroethane, 1,1,1,2-	Yes	Yes	1.7E+00	C	1.7E+01	1.6E+01	--	1.08E+08	1.09E+08	25			7.40E-06	I				1.7E+00	
x	79-34-5	Tetrachloroethane, 1,1,2,2-	Yes	Yes	2.1E-01	C	2.1E+00	1.4E+01	--	1.20E+08	4.25E+07	25			5.80E-05	CA				2.1E-01	
x	127-18-4	Tetrachloroethylene	Yes	Yes	4.7E+01	C	4.7E+02	6.5E+01	No (5)	1.65E+08	1.49E+08	25			2.60E-07	I	4.00E-02	I		4.7E+01	1.8E+02
	811-97-2	Tetrafluoroethane, 1,1,1,2-	Yes	Yes	3.5E+05	NC	3.5E+06	1.7E+05	--	2.60E+10	2.23E+09	25					8.00E+01	I			3.5E+05
	109-99-9	Tetrahydrofuran	Yes	Yes	8.8E+03	NC	8.8E+04	3.0E+06	--	6.29E+08	2.88E+09	25	2	N			2.00E+00	I			8.8E+03
x	108-88-3	Toluene	Yes	Yes	2.2E+04	NC	2.2E+05	8.1E+04	No (1000)	1.41E+08	1.43E+08	25	1.1	N			5.00E+00	I			2.2E+04
	76-13-1	Trichloro-1,2,2-trifluoroethane, 1,1,2-	Yes	Yes	1.3E+05	NC	1.3E+06	6.1E+03	--	3.66E+09	3.65E+09	25					3.00E+01	H			1.3E+05
	87-61-6	Trichlorobenzene, 1,2,3-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.05E+06	9.20E+05	25									
	120-82-1	Trichlorobenzene, 1,2,4-	Yes	Yes	8.8E+00	NC	8.8E+01	1.5E+02	No (70)	4.49E+06	2.84E+06	25	2.5	N			2.00E-03	P			8.8E+00

OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.1, June 2013 RSLs

Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (^{o}C)	Tgw	25	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25°C	Groundwater Vapor Conc.	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source
			Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Cvp	Chc	Tgw or 25	LEL	
			Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	(ug/m^3)	(ug/m^3)	C	(% by vol)	
x	71-55-6	Trichloroethane, 1,1,1-	Yes	Yes	2.2E+04	NC	2.2E+05	3.1E+04	No (200)	8.90E+08	9.07E+08	25	7.5	N
x	79-00-5	Trichloroethane, 1,1,2-	Yes	Yes	7.7E-01	C	7.7E+00	2.3E+01	No (5)	1.65E+08	1.55E+08	25	6	N
x	79-01-6	Trichloroethylene	Yes	Yes	3.0E+00	C	3.0E+01	7.4E+00	No (5)	4.88E+08	5.15E+08	25	8	N
	75-69-4	Trichlorofluoromethane	Yes	Yes	3.1E+03	NC	3.1E+04	7.7E+02	--	5.94E+09	4.36E+09	25		
	598-77-6	Trichloropropane, 1,1,2-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	2.46E+07	2.46E+07	25		
	96-18-4	Trichloropropane, 1,2,3-	Yes	Yes	1.3E+00	NC	1.3E+01	9.4E+01	--	2.93E+07	2.45E+07	25	3.2	N
	96-19-5	Trichloropropene, 1,2,3-	Yes	Yes	1.3E+00	NC	1.3E+01	1.8E+00	--	3.44E+07	3.48E+08	25		
	121-44-8	Triethylamine	Yes	Yes	3.1E+01	NC	3.1E+02	5.0E+03	--	3.11E+08	4.18E+08	25		
	526-73-8	Trimethylbenzene, 1,2,3-	Yes	Yes	2.2E+01	NC	2.2E+02	1.2E+02	--	1.09E+07	1.34E+07	25		
	95-63-6	Trimethylbenzene, 1,2,4-	Yes	Yes	3.1E+01	NC	3.1E+02	1.2E+02	--	1.36E+07	1.44E+07	25	0.9	N
	108-67-8	Trimethylbenzene, 1,3,5-	No Inhal. Tox. Info	No Inhal. Tox. Info	--	--	--	--	--	1.36E+07	1.73E+07	25		
	108-05-4	Vinyl Acetate	Yes	Yes	8.8E+02	NC	8.8E+03	4.2E+04	--	4.18E+08	4.18E+08	25	2.6	N
	593-60-2	Vinyl Bromide	Yes	Yes	3.8E-01	C	3.8E+00	7.6E-01	--	5.93E+09	5.21E+09	25		
x	75-01-4	Vinyl Chloride	Yes	Yes	2.8E+00	C	2.8E+01	2.5E+00	No (2)	1.00E+10	1.00E+10	25	3.6	N
	108-38-3	Xylene, m-	Yes	Yes	4.4E+02	NC	4.4E+03	1.5E+03	--	4.74E+07	4.72E+07	25	1.1	N
x	95-47-6	Xylene, o-	Yes	Yes	4.4E+02	NC	4.4E+03	2.1E+03	--	4.56E+07	3.77E+07	25	0.9	N
x	106-42-3	Xylene, P-	Yes	Yes	4.4E+02	NC	4.4E+03	1.6E+03	--	5.05E+07	4.57E+07	25	1	N
x	1330-20-7	Xylenes	Yes	Yes	4.4E+02	NC	4.4E+03	2.1E+03	Yes (10000)	4.78E+07	2.24E+07	25		

CAS	Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1
	IUR		RfC		i	Cia,c	Cia,nc
	(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)
71-55-6			5.00E+00	I			2.2E+04
79-00-5	1.60E-05	I	2.00E-04	X		7.7E-01	8.8E-01
79-01-6	see note	I	2.00E-03	I	TCE	3.0E+00	8.8E+00
75-69-4			7.00E-01	H			3.1E+03
598-77-6							
96-18-4			3.00E-04	I	Mut		1.3E+00
96-19-5			3.00E-04	P			1.3E+00
121-44-8			7.00E-03	I			3.1E+01
526-73-8			5.00E-03	P			2.2E+01
95-63-6			7.00E-03	P			3.1E+01
108-67-8							
108-05-4			2.00E-01	I			8.8E+02
593-60-2	3.20E-05	H	3.00E-03	I		3.8E-01	1.3E+01
75-01-4	4.40E-06	I	1.00E-01	I	VC	2.8E+00	4.4E+02
108-38-3			1.00E-01	S			4.4E+02
95-47-6			1.00E-01	S			4.4E+02
106-42-3			1.00E-01	S			4.4E+02
1330-20-7			1.00E-01	I			4.4E+02

Notes:

(1) **Inhalation Pathway Exposure Parameters (RME):**

Exposure Scenario	Units	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E5) Symbol	Selected Value
Averaging time for carcinogens	(yrs)	ATc_R	70	ATc_C	70	ATc	70
Averaging time for non-carcinogens	(yrs)	ATnc_R	30	ATnc_C	25	ATnc	25
Exposure duration	(yrs)	ED_R	30	ED_C	25	ED	25
Exposure frequency	(days/yr)	EF_R	350	EF_C	250	EF	250
Exposure time	(hr/day)	ET_R	24	ET_C	8	ET	8

(2) **Generic Attenuation Factors:**

Source Medium of Vapors		Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E5) Symbol	Selected Value
Groundwater	(-)	AFgw_R	0.001	AFgw_C	0.001	AFgw	0.001
Sub-Slab and Exterior Soil Gas	(-)	AFss_R	0.1	AFss_C	0.1	AFss	0.1

(3) **Formulas**

Cia, target = MIN(Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hrs/day) / (ED x EF x ET x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 hrs/day) x RfC x (1000 ug/mg) / (ED x EF x ET)

(4) **Special Case Chemicals**

Trichloroethylene	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario in cell E5) Symbol	Selected Value
	mIURTCE_R	1.00E-06	mIURTCE_C	0.00E+00	mIURTCE	0.00E+00
	IURTCE_R	3.10E-06	IURTCE_C	4.10E-06	IURTCE	4.10E-06

Mutagenic Chemicals — The exposure durations and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Note: This section applies to trichloroethylene and other mutagenic chemicals, but not to vinyl chloride.

Age Cohort	Exposure Duration (years)	Age-dependent adjustment factor
0 - 2 years	2	10
2 - 6 years	4	3
6 - 16 years	10	3
16 - 30 years	14	1

Mutagenic-mode-of-action (MMOA) adjustment factor 25 This factor is used in the equations for mutagenic chemicals.

Vinyl Chloride — See the Navigation Guide equation for Cia,c for vinyl chloride.

Notation:
NVT = Not sufficiently volatile and/or toxic to pose inhalation risk in selected exposure scenario for the indicated medium
C = Carcinogenic
NC = Non-carcinogenic
I = IRIS: EPA Integrated Risk Information System (IRIS). Available online at: http://www.epa.gov/iris/subst/index.html
P = PPRTV. EPA Provisional Peer Reviewed Toxicity Values (PPRTVs). Available online at: http://hhpprtv.ornl.gov/pprtv.shtml
A = Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Levels (MRLs). Available online at: http://www.atsdr.cdc.gov/mrls/index.html
CA = California Environmental Protection Agency/Office of Environmental Health Hazard Assessment assessments. Available online at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp
H = HEAST. EPA Superfund Health Effects Assessment Summary Tables (HEAST) database. Available online at: http://epa-heast.ornl.gov/heast.shtml
S = See RSL User Guide, Section 5
X = PPRTV Appendix
E = The Engineering ToolBox. Available online at http://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html
N = Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. Available online at: http://www.cdc.gov/niosh/npg/default.html http://www.cdc.gov/niosh/npg/default.html
M = Chemical-specific MSDS
Mut = Chemical acts according to the mutagenic-mode-of-action, special exposure parameters apply (see footnote (4) above).
VC = Special exposure equation for vinyl chloride applies (see Navigation Guide for equation).

OSWER VAPOR INTRUSION ASSESSMENT
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Parameter	Symbol	Value	Instructions
Exposure Scenario	Scenario	Commercial	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	TCR	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	THQ	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (^{o}C)	Tgw	25	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target concentrations

CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Soil Source?	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Pure Phase Vapor Conc. @ 25°C	Groundwater Vapor Conc.	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source
		Cvp > Cia,target?	Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Cvp	Chc	Tgw or 25	LEL	
		Yes/No	Yes/No	(ug/m^3)	C/NC	(ug/m^3)	(ug/L)	Yes/No (MCL ug/L)	(ug/m^3)	(ug/m^3)	C	(% by vol)	

Inhalation Unit Risk	IUR Source*	Reference Concentration	RFC Source*	Mutagenic Indicator	Target Indoor Air Conc. for Carcinogens @ TCR = 1E-06	Target Indoor Air Conc. for Non-Carcinogens @ THQ = 1
IUR		RfC		i	Cia,c	Cia,nc
(ug/m^3)$^{-1}$		(mg/m^3)			(ug/m^3)	(ug/m^3)

TCE = Special mutagenic and non-mutagenic IURs for trichloroethylene apply (see footnote (4) above).
Yellow highlighting indicates site-specific parameters that may be edited by the user.
Blue highlighting indicates exposure factors that are based on Risk Assessment Guidance for Superfund (RAGS) or EPA vapor intrusion guidance, which generally should not be changed.
**Lower explosive limit is the minimum concentration of the compound in air (% by volume) that is needed for the gas to ignite and explode.

USEPA National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCLs)
EPA 816-F-09-004 May 2009

National Primary Drinking Water Regulations

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Acrylamide	TT[4]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[5]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[4]	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
M	Fecal coliform and *E. coli*	MCL[6]	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	zero[6]
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[7]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT5; Action Level=0.015	Infants and children: Delays in physical or or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT7	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms	5.0 percent[8]	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and *E. coli*	Naturally present in the environment	zero
DBP	Total Trihalomethanes (TTHMs)	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.2
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
M	Turbidity	TT[7]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30µg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 Health effects are from long-term exposure unless specified as short-term exposure.

4 Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

5 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

6 A routine sample that is fecal coliform-positive or *E. coli*-positive triggers repeat samples--if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or *E. coli*-negative triggers repeat samples--if any repeat sample is fecal coliform-positive or *E. coli*-positive, the system has an acute MCL violation. See also Total Coliforms.

7 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*: 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- Giardia lamblia: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- Turbidity: For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelolometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment; Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Long Term 2 Enhanced Surface Water Treatment; This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

8 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* or fecal coliforms, system has an acute MCL violation.

9 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

National Secondary Drinking Water Regulation

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, some states may choose to adopt them as enforceable standards.

Contaminant	Secondary Maximum Contaminant Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

For More Information

EPA's Safe Drinking Water Web site:
http://www.epa.gov/safewater/

EPA's Safe Drinking Water Hotline:
(800) 426-4791

To order additional posters or other ground water and drinking water publications, please contact the National Service Center for Environmental Publications at :
(800) 490-9198, or
email: nscep@bps-lmit.com.

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TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE F: PUBLIC WATER SUPPLIES
CHAPTER I: POLLUTION CONTROL BOARD

PART 620
GROUNDWATER QUALITY

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620.APPENDIX D Confirmation of an Adequate Corrective Action Pursuant to 35 Ill. Adm. Code 620.250(a)(2)

AUTHORITY: Implementing and authorized by Section 8 of the Illinois Groundwater Protection Act [415 ILCS 55/8] and authorized by Section 27 of the Illinois Environmental Protection Act [415 ILCS 5/27].

SOURCE: Adopted in R89-14(B) at 15 Ill. Reg. 17614, effective November 25, 1991; amended in R89-14(C) at 16 Ill. Reg. 14667, effective September 11, 1992; amended at 18 Ill. Reg. 14084, effective August 24, 1994; amended in R93-27 at 18 Ill. Reg. 14084, effective August 24, 1994; amended in R96-18 at 21 Ill. Reg. 6518, effective May 8, 1997; amended in R97-11 at 21 Ill. Reg. 7869, effective July 1, 1997; amended

in R01-14 at 26 Ill. Reg. 2662, effective February 5, 2002; amended in R08-18 at 36 Ill. Reg. 15206, effective October 5, 2012.

SUBPART A: GENERAL

Section 620.105 Purpose

This Part prescribes various aspects of groundwater quality, including method of classification of groundwaters, nondegradation provisions, standards for quality of groundwaters, and various procedures and protocols for the management and protection of groundwaters.

Section 620.110 Definitions

The definitions of the Environmental Protection Act [415 ILCS 5] and the Groundwater Protection Act [415 ILCS 55] apply to this Part. The following definitions also apply to this Part.

"Act" means the Environmental Protection Act [415 ILCS 5].

"Agency" means the Illinois Environmental Protection Agency.

"Aquifer" means saturated (with groundwater) soils and geologic materials which are sufficiently permeable to readily yield economically useful quantities of water to wells, springs, or streams under ordinary hydraulic gradients. [415 ILCS 55/3(b)]

"BETX" means the sum of the concentrations of benzene, ethylbenzene, toluene, and xylenes.

"Board" means the Illinois Pollution Control Board.

"Carcinogen" means a contaminant that is classified as a Category A1 or A2 Carcinogen by the American Conference of Governmental Industrial Hygienists; or a Category 1 or 2A/2B carcinogen by the World Health Organization's International Agency for Research on Cancer; or a "Human carcinogen" or "Anticipated Human Carcinogen" by the United States Department of Health and Human Service National Toxicological Program; or a Category A or B1/B2 Carcinogen by the United States Environmental Protection Agency in Integrated Risk Information System or a Final Rule issued in a Federal Register notice by the USEPA. [415 ILCS 5/58.2]

"Community water supply" means a public supply which serves or is

c) After completion of preventive response pursuant to authority of an appropriate regulatory agency, the concentration of a contaminant listed in subsection (a)(3)(A) in groundwater may exceed 50 percent of the applicable numerical standard in Subpart D only if the following conditions are met:

1) The exceedence has been minimized to the extent practicable;

2) Beneficial use, as appropriate for the class of groundwater, has been assured; and

3) Any threat to public health or the environment has been minimized.

d) Nothing in this Section shall in any way limit the authority of the State or of the United States to require or perform any corrective action process.

(Source: Amended at 36 Ill. Reg. 15206, effective October 5, 2012)

SUBPART D: GROUNDWATER QUALITY STANDARDS

Section 620.401 Applicability

Groundwaters must meet the standards appropriate to the groundwater's class as specified in this Subpart and the nondegradation provisions of Subpart C.

Section 620.405 General Prohibitions Against Violations of Groundwater Quality Standards

No person shall cause, threaten or allow the release of any contaminant to groundwater so as to cause a groundwater quality standard set forth in this Subpart to be exceeded.

Section 620.410 Groundwater Quality Standards for Class I: Potable Resource Groundwater

a) Inorganic Chemical Constituents
Except due to natural causes or as provided in Section 620.450, concentrations of the following chemical constituents must not be exceeded in Class I groundwater:

Constituent	Units	Standard
Antimony	mg/L	0.006

Arsenic*	mg/L	0.010
Barium	mg/L	2.0
Beryllium	mg/L	0.004
Boron	mg/L	2.0
Cadmium	mg/L	0.005
Chloride	mg/L	200.0
Chromium	mg/L	0.1
Cobalt	mg/L	1.0
Copper	mg/L	0.65
Cyanide	mg/L	0.2
Fluoride	mg/L	4.0
Iron	mg/L	5.0
Lead	mg/L	0.0075
Manganese	mg/L	0.15
Mercury	mg/L	0.002
Nickel	mg/L	0.1
Nitrate as N	mg/L	10.0
Perchlorate	mg/L	0.0049
Radium-226	pCi/l	20.0
Radium-228	pCi/l	20.0
Selenium	mg/L	0.05
Silver	mg/L	0.05
Sulfate	mg/L	400.0
Thallium	mg/L	0.002
Total Dissolved Solids (TDS)	mg/L	1,200
Vanadium	mg/L	0.049
Zinc	mg/L	5.0

* Denotes a carcinogen.

b) Organic Chemical Constituents

Except due to natural causes or as provided in Section 620.450 or subsection (d), concentrations of the following organic chemical constituents shall not be exceeded in Class I groundwater:

Constituent	Standard (mg/L)
Acenaphthene	0.42
Acetone	6.3
Alachlor*	0.002
Aldicarb	0.003
Anthracene	2.1
Atrazine	0.003
Benzene*	0.005

Benzo(a)anthracene*	0.00013
Benzo(b)fluoranthene*	0.00018
Benzo(k)fluoranthene*	0.00017
Benzo(a)pyrene*	0.0002
Benzoic acid	28.0
2-Butanone (MEK)	4.2
Carbofuran	0.04
Carbon Disulfide	0.7
Carbon Tetrachloride*	0.005
Chlordane*	0.002
Chloroform*	0.07
Chrysene*	0.012
Dalapon	0.2
Dibenzo(a,h)anthracene*	0.0003
Dicamba	0.21
Dichlorodifluoromethane	1.4
1,1-Dichloroethane	1.4
Dichloromethane*	0.005
Di(2-ethylhexyl)phthalate*	0.006
Diethyl Phthalate	5.6
Di-n-butyl Phthalate	0.7
Dinoseb	0.007
Endothall	0.1
Endrin	0.002
Ethylene Dibromide*	0.00005
Fluoranthene	0.28
Fluorene	0.28
Heptachlor*	0.0004
Heptachlor Epoxide*	0.0002
Hexachlorocyclopentadiene	0.05
Indeno(1,2,3-cd)pyrene*	0.00043
Isopropylbenzene (Cumene)	0.7
Lindane (Gamma-Hexachlorocyclohexane)	0.0002
2,4-D	0.07
ortho-Dichlorobenzene	0.6
para-Dichlorobenzene	0.075
1,2-Dibromo-3-Chloropropane*	0.0002
1,2-Dichloroethane*	0.005
1,1-Dichloroethylene	0.007
cis-1,2-Dichloroethylene	0.07
trans-1,2-Dichloroethylene	0.1
1,2-Dichloropropane*	0.005
Ethylbenzene	0.7
MCPP (Mecoprop)	0.007

Methoxychlor	0.04
2-Methylnaphthalene	0.028
2-Methylphenol	0.35
Methyl Tertiary-Butyl Ether (MTBE)	0.07
Monochlorobenzene	0.1
Naphthalene	0.14
P-Dioxane*	0.0077
Pentachlorophenol*	0.001
Phenols	0.1
Picloram	0.5
Pyrene	0.21
Polychlorinated Biphenyls (PCBs) (as decachloro-biphenyl)*	0.0005
alpha-BHC (alpha-Benzene hexachloride)*	0.00011
Simazine	0.004
Styrene	0.1
2,4,5-TP (Silvex)	0.05
Tetrachloroethylene*	0.005
Toluene	1.0
Toxaphene*	0.003
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethane	0.005
1,2,4-Trichlorobenzene	0.07
Trichloroethylene*	0.005
Trichlorofluoromethane	2.1
Vinyl Chloride*	0.002
Xylenes	10.0

* Denotes a carcinogen.

c) Explosive Constituents

Concentrations of the following explosive constituents must not exceed the Class I groundwater standard:

Constituent	Standard (mg/L)
1,3-Dinitrobenzene	0.0007
2,4-Dinitrotoluene*	0.0001
2,6-Dinitrotoluene*	0.00031
HMX (High Melting Explosive, Octogen)	1.4
Nitrobenzene	0.014

RDX (Royal Demolition Explosive, Cyclonite)	0.084
1,3,5-Trinitrobenzene	0.84
2,4,6-Trinitrotoluene (TNT)	0.014

* Denotes a carcinogen.

d) Complex Organic Chemical Mixtures

Concentrations of the following chemical constituents of gasoline, diesel fuel, or heating fuel must not be exceeded in Class I groundwater:

Constituent	Standard (mg/L)
Benzene*	0.005
BETX	11.705

* Denotes a carcinogen.

e) pH
Except due to natural causes, a pH range of 6.5 - 9.0 units must not be exceeded in Class I groundwater.

f) Beta Particle and Photon Radioactivity

1) Except due to natural causes, the average annual concentration of beta particle and photon radioactivity from man-made radionuclides shall not exceed a dose equivalent to the total body organ greater than 4 mrem/year in Class I groundwater. If two or more radionuclides are present, the sum of their dose equivalent to the total body, or to any internal organ shall not exceed 4 mrem/year in Class I groundwater except due to natural causes.

2) Except for the radionuclides listed in subsection (f)(3), the concentration of man-made radionuclides causing 4 mrem total body or organ dose equivalent must be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data in accordance with the procedure set forth in NCRP Report Number 22, incorporated by reference at Section 620.125(a).

3) Except due to natural causes, the average annual concentration assumed to produce a total body or organ dose of 4 mrem/year of the following chemical constituents shall not be exceeded in Class I groundwater:

Constituent	Critical Organ	Standard (pCi/L)
Tritium	Total body	20,000.0
Strontium-90	Bone marrow	8.0

(Source: Amended at 36 Ill. Reg. 15206, effective October 5, 2012)

Section 620.420 Groundwater Quality Standards for Class II: General Resource Groundwater

a) Inorganic Chemical Constituents

1) Except due to natural causes or as provided in Section 620.450 or subsection (a)(3) or (e) of this Section, concentrations of the following chemical constituents must not be exceeded in Class II groundwater:

Constituent	Standard (mg/L)
Antimony	0.024
Arsenic*	0.2
Barium	2.0
Beryllium	0.5
Cadmium	0.05
Chromium	1.0
Cobalt	1.0
Cyanide	0.6
Fluoride	4.0
Lead	0.1
Mercury	0.01
Nitrate as N	100.0
Perchlorate	0.0049
Thallium	0.02
Vanadium	0.1

* Denotes a carcinogen.

2) Except as provided in Section 620.450 or subsection (a)(3) or (e) of this Section, concentrations of the following chemical constituents must not be exceeded in Class II groundwater:

Constituent	Standard (mg/L)

Boron	2.0
Chloride	200.0
Copper	0.65
Iron	5.0
Manganese	10.0
Nickel	2.0
Selenium	0.05
Total Dissolved Solids (TDS)	1,200.0
Sulfate	400.0
Zinc	10.0

3) The standard for any inorganic chemical constituent listed in subsection (a)(2) of this Section, for barium, or for pH does not apply to groundwater within fill material or within the upper 10 feet of parent material under such fill material on a site not within the rural property class for which:

A) Prior to November 25, 1991, surficial characteristics have been altered by the placement of such fill material so as to impact the concentration of the parameters listed in subsection (a)(3) of this Section, and any on-site groundwater monitoring of such parameters is available for review by the Agency.

B) On November 25, 1991, surficial characteristics are in the process of being altered by the placement of such fill material, that proceeds in a reasonably continuous manner to completion, so as to impact the concentration of the parameters listed in subsection (a)(3) of this Section, and any on-site groundwater monitoring of such parameters is available for review by the Agency.

4) For purposes of subsection (a)(3) of this Section, the term "fill material" means clean earthen materials, slag, ash, clean demolition debris, or other similar materials.

b) Organic Chemical Constituents

1) Except due to natural causes or as provided in Section 620.450 or subsection (b)(2) or (e) of this Section, concentrations of the following organic chemical constituents must not be exceeded in Class II groundwater:

Constituent	Standard (mg/L)
Acenaphthene	2.1
Acetone	6.3
Alachlor*	0.010
Aldicarb	0.015
Anthracene	10.5
Atrazine	0.015
Benzene*	0.025
Benzo(a)anthracene*	0.00065
Benzo(b)fluoranthene*	0.0009
Benzo(k)fluoranthene*	0.006
Benzo(a)pyrene*	0.002
Benzoic acid	28.0
2-Butanone (MEK)	4.2
Carbon Disulfide	3.5
Carbofuran	0.2
Carbon Tetrachloride*	0.025
Chlordane*	0.01
Chloroform*	0.35
Chrysene*	0.06
Dalapon	2.0
Dibenzo(a,h)anthracene	0.0015
Dicamba	0.21
Dichlorodifluoromethane	7.0
1,1-Dichloroethane	7.0
Dichloromethane*	0.05
Di(2-ethylhexyl)phthalate*	0.06
Diethyl Phthalate	5.6
Di-n-butyl Phthalate	3.5
Dinoseb	0.07
Endothall	0.1
Endrin	0.01
Ethylene Dibromide*	0.0005
Fluoranthene	1.4
Fluorene	1.4
Heptachlor*	0.002
Heptachlor Epoxide*	0.001
Hexachlorocyclopentadiene	0.5
Indeno(1,2,3-cd)pyrene*	0.0022
Isopropylbenzene (Cumene)	3.5
Lindane (Gamma-Hexachloro cyclophexane)	0.001
2,4-D	0.35

Ortho-Dichlorobenze	1.5
Para-Dichlorobenzene	0.375
1,2-Dibromo-3-Chloropropane*	0.002
1,2-Dichloroethane*	0.025
1,1-Dichloroethylene	0.035
cis-1,2-Dichloroethylene	0.2
Trans-1,2-Dichloroethylene	0.5
1,2-Dichloropropane*	0.025
Ehylbenzene	1.0
MCPP (Mecoprop)	0.007
Methoxychlor	0.2
2-Methylnaphthalene	0.14
2-Methylphenol	0.35
Methyl Tertiary-Butyl Ether (MTBE)	0.07
Monochlorobenzene	0.5
Naphthalene	0.22
P-Dioxane*	0.0077
Pentachlorophenol*	0.005
Phenols	0.1
Picloram	5.0
Pyrene	1.05
Polychlorinated Biphenyls (PCBs) (as decachloro-biphenyl)*	0.0025
alpha-BHC (alpha-Benzene hexachloride)*	0.00055
Simazine	0.04
Styrene	0.5
2,4,5-TP	0.25
Tetrachloroethylene*	0.025
Toluene	2.5
Toxaphene*	0.015
1,1,1-Trichloroethane	1.0
1,2,4-Trichlorobenzene	0.7
1,1,2-Trichloroethane	0.025
Trichlorofluoromethane	10.5
Vinyl Chloride*	0.01
Xylenes	10.0

* Denotes a carcinogen.

2) The standards for pesticide chemical constituents listed in subsection (b)(1) of this Section do not apply to groundwater within 10 feet of the land surface, provided that the concentrations of such constituents result from the application of pesticides in a manner consistent with the requirements of the

Federal Insecticide, Fungicide and Rodenticide Act (7 USC 136 et seq.) and the Illinois Pesticide Act [415 ILCS 60].

c) Explosive Constituents
Concentrations of the following explosive constituents must not exceed the Class II groundwater standard:

Constituent	Standard (mg/L)
1,3-Dinitrobenzene	0.0007
2,4-Dinitrotoluene*	0.0001
2,6-Dinitrotoluene*	0.00031
HMX (High Melting Explosive, Octogen)	1.4
Nitrobenzene	0.014
RDX (Royal Demolition Explosive, Cyclonite)	0.084
1,3,5-Trinitrobenzene	0.84
2,4,6-Trinitrotoluene (TNT)	0.014

*Denotes a carcinogen.

d) Complex Organic Chemical Mixtures
Concentrations of the following organic chemical constituents of gasoline, diesel fuel, or heating fuel must not be exceeded in Class II groundwater:

Constituent	Standard (mg/L)
Benzene*	0.025
BETX	13.525

*Denotes a carcinogen

e) pH
Except due to natural causes, a pH range of 6.5 - 9.0 units must not be exceeded in Class II groundwater that is within 5 feet of the land surface.

(Source: Amended at 36 Ill. Reg. 15206, effective October 5, 2012)

IEPA Derived Water Quality Criteria for General Use Waters
IAC302.210 Subpart F
Updated April 2013
Table downloaded from IEPA Website in May 2013

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
acenaphthene	83-32-9	GU	120	62	µg/L	990200	--	--			Y
acenaphthylene	208-96-8	GU	(190)	(15)	µg/L	980300	--	--			Y
acetochlor	34256-82-1	GU	150	12	µg/L	070926	590	--	µg/L	070926	
acetone	67-64-1	GU	1.5	0.12	g/L	930525	--	--			Y
acetonitrile	75-05-8	GU	380	30	mg/L	931122	14 20 (G)	-- --	mg/L mg/L	931122 070123	Y
acrolein	107-02-8	GU	2.7	0.22	µg/L	990200	--	--			Y
acrylamide; 2-propenamide	79-06-1	GU	30	2.4	mg/L	950515	--	--			
acrylonitrile	107-13-1	GU	910	73	µg/L	990200	--	0.21	µg/L	990200	Y
alachlor	15972-60-8	GU	1100	(~100)	µg/L	920323	--	5.6	µg/L	920323	
aldrin	309-00-2	GU	[~3]	--	µg/L	990200	--	0.046	ng/L	990200	
2-amino-4,6-dinitrophenol	96-91-3	GU	(4.6)	(0.4)	mg/L	970400	--	--			
2-amino-4,6-dinitrotoluene	35572-78-2	GU	98	7.9	µg/L	920317	--	--			
4-amino-2,6-dinitrotoluene	19406-51-0	GU	180	14	µg/L	022904	--	--			
1-(2-aminoethyl)piperazine	140-31-8	GU	(220)	(18)	mg/L	921216	--	--			
aniline	62-53-3	GU	120	15	µg/L	980724	--	--			
anthracene	120-12-7	GU	0.66	0.53	µg/L	070530	35	--	mg/L	990200	Y
antimony	7440-36-0	GU	1,200	320	µg/L	080929	12,000 (G) 1,200 6 (PWS)	-- -- --	µg/L µg/L µg/L	080929 080929 080929	
Antimycin A	1397-94-0	GU	(~0.02)	--	µg/L	950200	--	--			
atrazine	1912-24-9	GU	82	9.0	µg/L	050205	--	--			
benzaldehyde	100-52-7	GU	180	14	mg/L	920615	--	--			
benzene (2-bromo-2-nitroethenyl)	7166-19-0	GU	(1.1)	(0.86)	mg/L	980908	--	--			
benzidine	92-87-5	GU	--	--			--	0.17	ng/L	990200	
benzo (a) anthracene	56-55-3	GU	--	--			--	0.16	µg/L	990200	Y
benzo (a) pyrene	50-32-8	GU	--	--			--	0.016	µg/L	990200	Y
benzo (b) fluoranthene	205-99-2	GU	--	--			--	0.16	µg/L	990200	Y
benzo (k) fluoranthene	207-08-9	GU	--	--			--	1.6	µg/L	990200	Y
benzoic acid	65-85-0	GU	(18)	(1.4)	mg/L	931108	--	--			
benzyl alcohol	100-51-6	GU	1000	80	µg/L	920615	--	--			
BHC = hexachlorocyclohexane	608-73-1	GU	5	0.4	µg/L	980622	--	--			
alpha	319-84-6	GU	31	2.5	µg/L	990200	--	0.0042	µg/L	990200	
beta	319-85-7	GU	--	--			--	15	ng/L	990200	
gamma = lindane											
delta	319-86-8	GU	--	--			--	[41.4]	ng/L	990200	
bis (2-chloro-1-methylethyl) ether	39638-32-9	GU	--	--			46	--	mg/L	990200	

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
bis (2-ethylhexyl) phthalate	117-81-7	GU	(400)	(380)	µg/L	990200	--	1.9	µg/L	990200	
bis (2-ethylhexyl) phthalate	117-81-7	LM	76	17	µg/L	060620	67	3.2	µg/L	060620	Y
							60 (PWS)	2.8 (PWS)	µg/L	060620	
bisphenol A	80-05-7	GU	470	37	µg/L	940800	--	--			
bromacil	314-40-9	GU	(18)	(1.0)	mg/L	960200	--	--			
bromodichloromethane	75-27-4	GU	(10)	(1)	µg/L	990200	--	13.3	µg/L	130328	
							--	14.9 (G)	µg/L	130328	
							--	0.54 (PWS)	µg/L	130328	
bromoform	75-25-2	GU	--	--			--	50	µg/L	990200	
4-bromophenylphenyl ether	101-55-3	GU	36	2.9	µg/L	911115	--	--			
2-butanone=methyl ethyl ketone											
butylate	2008-41-5	GU	(550)	(50)	µg/L	920110	75	--	µg/L	920110	
n-butylbenzene	104-51-8	GU	(39)	(3.1)	µg/L	980713	--	--			
sec -butylbenzene	135-98-8	GU	(82)	(6.6)	µg/L	980713	--	--			
tert -butylbenzene	98-06-6	GU	(96)	(7.7)	µg/L	980713	--	--			
butyl benzyl phthalate	85-68-7	GU	170	23	µg/L	990200	1.7	--	mg/L	990200	
butylphenol, t-	98-54-4	GU	390	31	µg/L	960108	--	--			
butyraldehyde	123-72-8	GU	1800	140	µg/L	960108	--	--			
carbazole	86-74-8	GU	93	7.4	µg/L	920207	--	--			
carbofuran	1563-66-2	GU	4.1	0.3	µg/L	980622	--	--			
carbon disulfide	75-15-0	GU	0.2	0.02	mg/L	930105	--	--			
carbon tetrachloride	56-23-5	GU	3.5	0.28	mg/L	990200	--	1.4	µg/L	990200	Y
chlordane	57-74-9	GU	[~2.4]	[~0.0043]	µg/L	990200	--	0.72	ng/L	990200	
4-chloroaniline	106-47-8	GU	2.4	(0.2)	µg/L	920226	--	--			
2-chloroaniline	95-51-2	GU	75	6	µg/L	090415	--	--			
chlorobenzene	108-90-7	GU	990	79	µg/L	990200	4.5	--	mg/L	990200	Y
chlorodibromomethane	124-48-1	GU	--	--			--	9.8	µg/L	130328	
							--	11.0 (G)	µg/L	130328	
							--	0.40 (PWS)	µg/L	130328	
4-chloro-2,6-dinitrophenol	88-87-9	GU	3.5	0.28	mg/L	980100	--	--			
chloroethane	75-00-3	GU	(13)	(1)	mg/L	990200	--	--			
2-chloroethylvinyl ether	110-75-8	GU	(35)	(3)	mg/L	911113	--	--			
chloroform	67-66-3	GU	1900	150	µg/L	990200	--	130	µg/L	990200	Y
chloromethane	74-87-3	GU	(16)	(1.3)	mg/L	990200	--	--			
2-chloronaphthalene	91-58-7	GU	(370)	(30)	µg/L	990200	--	--			
1-chloro-2-nitrobenzene	88-73-3	GU	(880)	(70)	µg/L	960500	--	--			
2-chlorophenol	95-57-8	GU	510	41	µg/L	990200	--	--			

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
4-chloro-2-(phenylmethyl) phenol	120-32-1	GU	33	2.6	µg/L	980715	--	--			
2-chlorotoluene	95-49-8	GU	(670)	(55)	µg/L	920213	--	--			
chlorpyrifos	2921-88-2	GU	0.11	--	µg/L	920000	--	--			
chrysene	218-01-9	GU	--	--			--	16	µg/L	990200	Y
m-cresol=3-methyl phenol											
cyanazine	21725-45-2	GU	370	30	µg/L	920203	--	--			
cyclohexylamine	108-91-8	GU	(6.1)	(0.49)	mg/L	970130	--	--			
p-cymene = *p*-isopropyltoluene											
2,4-D	94-75-7	GU	100	8	µg/L	930701	--	--			
4,4'-DDD	72-54-8	GU	--	--			--	0.27	ng/L	990200	
4,4'-DDE	72-55-9	GU	--	--			--	0.19	ng/L	990200	
4,4'-DDT	50-29-3	GU	[~1.1]	[~0.001]	ng/L	990200	--	0.19	ng/L	990200	
demeton	8065-48-3	GU	--	[0.1]	µg/L	990200	--	--			
diazinon	333-41-5	GU	[~0.05]	--	µg/L	920410	--	--			
dibenz[a,h]anthracene	53-70-3	GU	--	--			--	0.016	µg/L	990200	Y
dibenzofuran	132-64-9	GU	190	15	µg/L	980727	--	--			
dicamba	1918-00-9	GU	1500	150	µg/L	930118	--	--			
dibromochloromethane=chlorodibromomethane											
1,2-dibromo-3-chloropropane	96-12-8	GU	(2.4)	(0.19)	mg/L	980713	--	--			
1,2-dichlorobenzene	95-50-1	GU	210	170	µg/L	990200	--	--			Y
1,3-dichlorobenzene	541-73-1	GU	500	200	µg/L	990200	--	--			Y
1,4-dichlorobenzene	106-46-7	GU	1.8	0.62	mg/L	990200	--	--			
3,3'-dichlorobenzidine	91-94-1	GU	--	--			--	25	ng/L	990200	
dichlorobromomethane=bromodichloromethane											
2,2'-dichlorodiethyl ether	111-44-4	GU	24	1.9	mg/L	990200	--	0.42	µg/L	990200	
1,1-dichloroethane	75-34-3	GU	(20)	(2)	mg/L	970618	--	--			Y
1,2-dichloroethane	107-06-2	GU	25	4.5	mg/L	990200	--	0.023	mg/L	990200	Y
1,1-dichloroethene=1,1-dichloroethylene											
1,2-dichloroethene=1,2-dichloroethylene											
1,1-dichloroethylene	75-35-4	GU	3000	240	µg/L	990300	-- -- --	110 120 (G) 6.6 (PWS)	µg/L µg/L µg/L	090504 090504 090505	Y
1,2-dichloroethylene	540-59-0	GU	14	1.1	mg/L	081118	--	--			Y
1,2-dichloroethylene	540-59-0	LM	8.8	0.98	mg/L	081118	--	--			
trans-1,2-dichloroethylene	156-60-5	GU	--	--			34	--	mg/L	990200	
2,4-dichlorophenol	120-83-2	GU	630	83	µg/L	990200	--	--			Y
1,2-dichloropropane	78-87-5	GU	4.8	0.38	mg/L	990200	5.7	--	µg/L	990200	Y

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
2,2-dichloropropane	540-20-7	GU	(1.9)	(0.15)	mg/L	980713	--	--			
1,1-dichloropropylene	563-58-6	GU	(530)	(42)	µg/L	911113	--	--			
1,1-dichloropropylene=1,1-dichloropropene											
1,3-dichloropropylene	542-75-6	GU	99	7.9	µg/L	911113	--	--			Y
1,3-dichloropropylene=1,3-dichloropropene											
dieldrin	60-57-1	GU	[0.24]	[~0.056]	µg/L	990200	--	0.046	ng/L	990200	
diethylaminoethanol	100-37-8	GU	(140)	(11)	mg/L	970130	--	--			
di-2-ethylhexyl phthalate (DEHP)=bis-2-ethylhexyl phthalate											
di-ethylphthalate	84-66-2	GU	3.2	0.25	mg/L	990200	--	--			
dimethylformamide, N,N-	68-12-2	GU	1500	120	mg/L	980622	--	--			
2,4-dimethylphenol	105-67-9	GU	740	220	µg/L	990200	--	--			Y
dimethylphthalate	131-11-3	GU	3.3	0.26	mg/L	990200	--	--			
1,3-dinitrobenzene	99-65-0	GU	140	4	µg/L	991019	4.7	--	µg/L	991019	
4,6-dinitro-o-cresol=2-methyl-4,6-dinitrophenol											
di-n-butylphthalate	84-74-2	GU	170	48	µg/L	990200	--	--			
2,4-dinitrophenol	51-28-5	GU	85	4.1	µg/L	990200	--	--			Y
2,4-dinitrotoluene	121-14-2	GU	5000	320	µg/L	990200	2.6	--	µg/L	990200	
2,6-dinitrotoluene	606-20-2	GU	1900	150	µg/L	990200	--	0.4	µg/L	990200	y
dioctylphthalate	117-84-0	GU	NT	NT	µg/L	990200	--	--			
dioxane	123-91-1	GU	(440)	(36)	mg/L	940200	--	--			
1,2-diphenylhydrazine	122-66-7	GU	25	2	µg/L	990200	--	0.17	µg/L	990200	
diquat	85-00-7	GU	990	80	µg/L	960100	--	--			Y
diquat=diquat bromide											
EDTA	64-02-8	GU	100	8.2	mg/L	960206	--	--			
α-endosulfan	959-98-8	GU	30.8	5.6	ng/L	990200	--	--			
β-endosulfan	33213-65-9	GU	30.8	5.6	ng/L	990200	--	--			
endosulfan sulfate	1031-07-8	GU	30.8	5.6	ng/L	990200	--	--			
endothall	145-73-3	GU	(~10)	(~1)	mg/L	980200	--	--			
endrin	72-20-8	GU	160	33	ng/L	990200	--	--			
ethalfluralin	55283-68-6	GU	3.2	(0.3)	µg/L	920114	--	--			
ethane,1,1'-oxybis 2-methoxy	111-96-6	GU	(340)	(28)	mg/L	981120	--	--			
ether, bis chloromethyl	542-88-1	GU	--	--			0.25	--	ng/L	990200	
ethanolamine	141-43-5	GU	5.5	0.44	mg/L	980806	--	--			
ethyl alcohol	64-17-5	GU	(1.1)	(0.085)	g/L	910307	--	--			
ethylene glycol	107-21-1	GU	1.6	0.13	mg/L	921216	--	--			
ethylene glycol dimethyl ether	110-71-4	GU	(260)	(21)	mg/L	981001	--	--			
ethylene thirourea	96-45-7	GU	(2.6)	(0.21)	mg/L	970400	--	--			

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3]		Units[4]	Date Derived[5]	Human Health Criteria[6]		Units[4]	Date Derived[5]	NPDES Permit[7]
			Acute	Chronic		(yymmdd)	HTC	HNC		(yymmdd)	
2-ethylhexyl glycidyl ether	2461-15-6	GU	(1400)	(140)	µg/L	960700	--	--			
ethyl mercaptan	75-08-1	GU	17	2	µg/L	020408	--	--			Y
fluoranthene	206-44-0	GU	4.3	1.8	µg/L	070606	120	--	µg/L	990200	Y
fluorene	86-73-7	GU	59	16	µg/L	070606	4.5	--	mg/L	990200	Y
fonofos	944-22-9	GU	0.66	(0.028)	µg/L	920121	--	--			
formaldehyde	50-00-0	GU	4.9	0.39	mg/L	930119	--	--			Y
furfural	98-01-1	GU	1.3	0.10	mg/L	930700	--	--			
furfuryl alcohol	98-00-0	GU	(20)	(2)	mg/L	960700	--	--			
glyphosate	1071-83-6	GU	1.5	0.12	mg/L	931005	--	--			
guthion	86-50-0	GU	--	[0.01]	µg/L	990200	--	--			
heptachlor	76-44-8	GU	[520]	[3.8]	ng/L	990200	--	0.068	ng/L	990200	
heptachlor epoxide	1024-57-3	GU	[520]	[3.8]	ng/L	990200	--	0.036	ng/L	990200	
heptane	142-82-5	GU	(8.3)	(0.66)	mg/L	921100	--	--			
hexachlorobenzene	118-74-1	GU	--	--			--	0.25	ng/L	990200	Y
hexachlorobutadiene	87-68-3	GU	35	2.8	µg/L	990200	--	--			Y
hexachlorocyclohexane=BHC											
hexachlorocyclopentadiene	77-47-4	GU	(1)	(0.1)	µg/L	990200	--	--			
hexachloroethane	67-72-1	GU	380	31	µg/L	990200	--	2.9	µg/L	990200	Y
n-hexane	110-54-3	GU	250	20	µg/L	020408	--	--			Y
2-hexanone	591-78-6	GU	(12)	(0.95)	mg/L	980713	--	--			
HMX	2691-41-0	GU	3.2	0.26	mg/L	970400	--	--			
hyamine 3500	8001-54-5	GU	(~10)	(~1)	µg/L	960100	--	--			
hydrazine	302-01-2	GU	19	1.5	µg/L	970300	--	2.3	µg/L	900913	Y
hydroquinone	123-31-9	GU	10	0.8	µg/L	920413	--	--			
4-hydroxy-4-methyl-2-pentanone	123-42-2	GU	42	3.4	mg/L	921216	--	--			
indene	95-13-6	GU	1.4	0.11	mg/L	920428	--	--			
indeno [1,2,3-cd] pyrene	193-39-5	GU	--	--			--	0.16	µg/L	990200	Y
iodine	7553-56-2	GU	(61)	(4.9)	µg/L	980622	--	--			
isobutyl alcohol=2-methyl-1-propanol											
isodrin	465-73-6	GU	(1)	(0.1)	µg/L	980300	--	--			
isophorone	78-59-1	GU	12	0.96	mg/L	990200	--	0.76	mg/L		
isopropyl acetate	108-21-4	GU	(200)	(20)	mg/L	930514	--	--			
p -isopropyltoluene	99-87-6	GU	(85)	(6.8)	µg/L	980713	--	--			
lindane	58-89-9	GU	[~0.95]	--	µg/L	990200	--	0.02	µg/L	990200	
malathion	121-75-5	GU	[0.4]	[0.04]	µg/L	980729	--	--			
methanol	67-56-1	GU	5.5	0.44	g/L	930600	--	--			
methoxychlor	72-43-5	GU	(0.25)	(0.02)	µg/L	921104	--	--			

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
methoxyethanol, 2-	109-86-4	GU	(800)	(60)	mg/L	980622	--	--			
methyl acrylate	96-33-3	GU	(500)	(50)	µg/L	920316	--	--			
methyl tert butyl ether	1634-04-4	GU	(67)	(5.4)	mg/L	970918	--	--			Y
3-methyl-4-chlorophenol	59-50-7	GU	310	25	µg/L	990300	--	--			
2-methyl-4,6-dinitrophenol	534-52-1	GU	29	2.3	µg/L	990200	--	--			Y
methylene bis (thiocyanate)	6317-18-6	GU	(~7)	(~3)	µg/L	950105	--	--			
methylene chloride	75-09-2	GU	17	1.4	mg/L	990200	-- -- --	330 490 (G) 4.6 (PWS)	µg/L µg/L µg/L	081125 081125 081125	Y
methylene chloride	75-09-2	LM	10.8	1.2	mg/L	060620	Standard at 302.504				Y
methyl ethyl ketone	78-93-3	GU	320	26	mg/L	920701	--	--			Y
methyl methacrylate	80-62-6	GU	19	1.5	mg/L	911217	--	--			
methyl naphthalene	1321-94-4	GU	150	12	µg/L	921026	--	--			
4-methyl-2-pentanol	108-11-2	GU	(~9)	(~0.9)	mg/L	970600	--	--			
4-methyl-2-pentanone	108-10-1	GU	46	1.4	mg/L	920113	--	--			Y
4-methylphenol	106-44-5	GU	670	120	µg/L	921026	--	--			Y
3-methyl phenol	108-39-4	GU	1.6	0.13	mg/L	930700	--	--			
2-methylphenol	95-48-7	GU	4.7	0.37	mg/L	931108	--	--			Y
2-methyl-1-propanol	78-83-1	GU	430	35	mg/L	920213	--	--			Y
metolachlor	51218-45-2	GU	380	30.4	µg/L	071001	--	--			
metribuzin	21087-64-9	GU	8.4	--	mg/L	920316	8.3	--	mg/L	920316	
mirex	23-85-5	GU	--	[1]	ng/L	990200	--	--			
morpholine	110-71-8	GU	11	0.85	mg/L	951000	--	--			
MTBE=methyl tert butyl ether											
naphthalene	91-20-3	GU	510	68	µg/L	990200	--	--			Y
2-nitroaniline	88-74-4	GU	(2)	(0.2)	mg/L	950700	--	--			
4-nitroaniline	100-01-6	GU	(1.5)	(0.12)	mg/L	960500	--	--			Y
nitrobenzene	98-95-3	GU	15	8.5	mg/L	990200	0.53	--	mg/L	990200	Y
2-nitrophenol	88-75-5	GU	6.7	0.54	mg/L	990300	--	--			
4-nitrophenol	100-02-7	GU	3.2	1.9	mg/L	990300	--	--			
2-nitrotoluene	88-72-2	GU	770	62	µg/L	970400	--	--			
N-methylpyrrolidone	872-50-4	GU	(680)	(54)	mg/L	980908	--	--			
nonylphenol	25154-52-3	GU	(~5)	(~0.5)	µg/L	980900	--	--			
PCBs	1336-36-3	GU	--	--				0.056 0.056 (G) 0.056 (PWS)	ng/L ng/L ng/L	111206 111206 111206	
parathion	56-38-2	GU	[65]	[13]	ng/L	990200	--	--			

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
pendimethalin	40487-42-1	GU	(350)	(30)	µg/L	920114	--	--			
pentachlorobenzene	608-93-5	GU	25	2	µg/L	990200	1.3	--	µg/L	990200	
pentachlorophenol	87-86-5	GU	[20] pH	[13] pH	µg/L	990200	--	2.5	µg/L	990200	Y
pentane	109-66-0	GU	(130)	(11)	µg/L	980622	--	--			
perchloroethylene=tetrachloroethylene											
permethrin	52645-53-1	GU	0.15	0.024	µg/L	931012	--	--			
phenanthrene	85-01-8	GU	46	3.7	µg/L	990200	--	--			Y
p-phenyl phenol	92-69-3	GU	230	19	µg/L	920930	--	--			
o-phenyl phenol	90-43-7	GU	230	19	µg/L	920930	--	--			
1-phenyl-3-pyrazolidinone	92-43-3	GU	(320)	(25)	µg/L	920413	--	--			
n-propylbenzene	103-65-1	GU	(130)	(10)	µg/L	980713	--	--			
propylene	115-07-1	GU	(4)	(0.4)	mg/L	020408	--	--			Y
propylene glycol	57-55-6	GU	71	5.7	mg/L	970400	--	--			
pseudocumene=trimethylbenzene											
pyrene	129-00-0	GU	--	--			3.5	--	mg/L	990200	Y
RDX	121-82-4	GU	2	0.5	mg/L	930105	--	--			
rotenone	83-79-4	GU	4.5	0.32	µg/L	920728	--	--			
simazine	123-34-9	GU	(~1)	(~0.05)	mg/L	980400	--	--			
sodium azide	266-22-8	GU	70	(5.6)	µg/L	910408	2	--	µg/L	910408	
sodium molybdate	7631-95-0	GU	(6.6)	(0.52)	mg/L	950500	--	--			
styrene	100-42-5	GU	2.5	0.2	mg/L	921026	--	--			
2,3,7,8-TCDD	1746-01-6	GU	--	--			--	4.6	fg/L	990300	
terbufos	13071-79-9	GU	0.024	(0.002)	µg/L	920121	--	--			
1,2,4,5-tetrachlorobenzene	95-94-3	GU	160	13	µg/L	990200	0.93	--	µg/L	990200	
tetrachlorodibenzofuran, 2378	51207-31-9	GU	--	(<0.5)	ng/L	980622	--	--			
1,1,2,2-tetrachloroethane	79-34-5	GU	1800	140	µg/L	990300	--	3.2	µg/L	990300	
tetrachloroethylene	127-18-4	GU	1.2	0.15	mg/L	990300	--	--			Y
tetrahydrofuran	109-99-9	GU	220	17	mg/L	920316	--	--			Y
thallium	7440-28-0	GU	86	11	µg/L	081118	3.0	--	µg/L	081118	Y
							3.0 (G)	--	µg/L	081118	
							1.2 (PWS)	--	µg/L	081118	
thallium	7440-28-0	LM	54	15	µg/L	081118	3.7	--	µg/L	081118	
							1.3 (PWS)	--	µg/L	081118	
TNT=2,4,6-trinitrotoluene											
toluene diisocyanate	584-84-9	GU	(16)	(1.3)	mg/L	920811	--	--			
toxaphene	8001-35-2	GU	[~730]	[~0.2]	ng/L	990200	--	0.24	ng/L	990200	
trichlorfon	52-68-6	GU	(0.1)	(0.01)	µg/L	920108	--	--			

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3] Acute	Aquatic Life Criteria[3] Chronic	Units[4]	Date Derived[5] (yymmdd)	Human Health Criteria[6] HTC	Human Health Criteria[6] HNC	Units[4]	Date Derived[5] (yymmdd)	NPDES Permit[7]
1,2,3-trichlorobenzene	87-61-6	GU	(35)	(2.8)	µg/L	970103	--	--			
1,2,4-trichlorobenzene	120-82-1	GU	370	72	µg/L	990200	--	--			Y
1,3,5-trichlorobenzene	108-70-3	GU	(330)	(30)	µg/L	980700	--	--			
1,1,1-trichloroethane	71-55-6	GU	4900	390	µg/L	990300	--	--			Y
1,1,2-trichloroethane	79-00-5	GU	19	4.4	mg/L	990200	--	12	µg/L	990200	Y
trichloroethene = trichloroethylene											
trichloroethylene	79-01-6	GU	12	0.94	mg/L	990200	--	25	µg/L	990200	Y
							--	26 (G)	µg/L	081118	
							--	2.5 (PWS)	µg/L	081118	
trichlorofluoromethane	75-69-4	GU	--	--			(250)	--	mg/L	940200	
trichlorophenols	25167-82-2	GU	120	9.5	µg/L	960100	--	--			
2,4,5-trichlorophenol	95-95-4	GU	--	--			3.2	--	mg/L	990200	
2,4,6-trichlorophenol	88-06-2	GU	41	6.3	µg/L	920224	--	2.1	µg/L	990200	
trifluralin	1582-09-8	GU	26	1.1	µg/L	920322	--	--			
1,3,5-trimethyl benzene	108-67-8	GU	(140)	(11)	µg/L	980713	--	--			
1,2,4-trimethyl benzene	95-63-6	GU	360	29	µg/L	980715	--	--			
1,3,5-trinitrobenzene	99-35-4	GU	38	15	µg/L	970400	0.58	--	µg/L	970400	
2,4,6-trinitrophenol	88-89-1	GU	8.8	0.7	mg/L	970400	--	--			
2,4,6-trinitrotoluene	118-96-8	GU	930	75	µg/L	960800	220	--	µg/L	960800	
uranine	518-47-8	GU	(230)	(23)	mg/L	960100	--	--			
vinyl acetate	108-05-4	GU	1800	140	µg/L	911217	--	--			
vinyl chloride	75-01-4	GU	22	1.7	mg/L	081117	--	1.5	µg/L	081117	Y
							--	2.0 (G)	µg/L	081117	
							--	0.025 (PWS)	µg/L	081117	
vinyl chloride	75-01-4	LM	8.4	0.93	mg/L	060620	4860	14.4	µg/L	060620	Y
							83 (PWS)	0.25 (PWS)	µg/L	060620	

[1] CAS# = Chemical Abstracts Service Number.

[2] GU = General Use (Section 303.201); LM = Lake Michigan (Section 303.443).

[3] "Aquatic Life" means native populations of fish and other aquatic life (Section 301.220). Acute criteria are not to be exceeded at any time, chronic criteria are not to be exceeded by the arithmetic average of at least four consecutive samples collected over a period of at least four days. Values enclosed by "( )" were not calculated according to the regulations due to limited data, these values should only be used for advisory purposes such as establishing "reasonable potential". Values enclosed by "[ ]" are national criteria and should be used for advisory purposes only.

[4] g/L = grams per liter; mg/L = 10^{-3} g/L; µg/L = 10^{-6} g/L; ng/L = 10^{-9} g/L; pg/L = 10^{-12} g/L; fg/L = 10^{-15} g/L.

Substance	CAS#[1]	Use[2]	Aquatic Life Criteria[3]		Units[4]	Date Derived[5]	Human Health Criteria[6]		Units[4]	Date Derived[5]	NPDES Permit[7]
			Acute	Chronic		(yymmdd)	HTC	HNC		(yymmdd)	

[5] Date of most recent derivation or revision is listed, older criteria will be updated as new data becomes available.

[6] HTC = Human Threshold Criterion (Section 302.642); HNC = Human Nonthreshold Criterion (Section 302.651). HTC are based on noncancerous effects; HNC are based on cancerous effects. Criteria are based on fish consumption and incidental exposure through contact or ingestion of small volumes of water while swimming or during other recreational activities for areas which are determined to be public access areas pursuant to Section 302.102(b)(3). All criteria are initially derived for protection of primary contact uses, values followed by "(G)" are criteria applicable to General Use waters whose physical configurations are not supportive of primary contact uses (302.202). Values followed by "(PWS)" are applicable to surface waters near a point of intake for public or food processing water supply (303.202). Human health criteria have been calculated for many more substances than are listed, but, since the values are much higher than those for Aquatic Life, they are not included.

[7] These criteria have been used to derived Water Quality Based Effluent Limits at some time.

**** List last revised on 04/04/2013****

USEPA National Recommended Water Quality Criteria for the Protection of Aquatic Life and Human Health Section 304(a) of the Clean Water Act (CWA) Last Updated: January 8, 2013

Water: Current Water Quality Criteria

National Recommended Water Quality Criteria

EPA's compilation of national recommended water quality criteria is presented as a summary table containing recommended water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality standards.

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

- Previous versions of National Recommended Water Quality Criteria Table
- Chemical-specific criteria documents from the 1980s
- Water quality standards
- Human Health Criteria Calculation Matrix (PDF) (23 pp, 445K)

Aquatic Life Criteria Table
Human Health Criteria Table
Organoleptic Effects (e.g., taste and odor)
Additional Notes

- **Appendix A**—Conversion Factors for Dissolved Metals
- **Appendix B**—Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent
- **Appendix C**—Calculation of Freshwater Ammonia Criterion
- **Gold & Red Books**

Aquatic Life Criteria Table

			Freshwater		Saltwater		
Pollutant	**CAS Number**	**P/NP***	**CMC[1] (acute) (µg/L)**	**CCC[1] (chronic) (µg/L)**	**CMC[1] (acute) (µg/L)**	**CCC[1] (chronic) (µg/L)**	**Publication Year**
Acrolein	107028	P	3ug/L	3ug/L			2009
Aesthetic Qualities	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986
Aldrin	309002	P	3.0 G		1.3 G		1980
Alkalinity	—	NP		20000 C			1986
alpha-Endosulfan	959988	P	0.22 G,Y	0.056 G,Y	0.034 G,Y	0.0087 G,Y	1980
Aluminum pH 6.5 – 9.0	7429905	NP	750 I	87 I,S			1988

Ammonia	7664417	NP	FRESHWATER CRITERIA ARE pH, Temperature and Life-stage DEPENDENT SALTWATER CRITERIA ARE pH AND TEMPERATURE DEPENDENT				1999
Arsenic	7440382	P	340 A,D	150 A,D	69 A,D	36 A,D	1995
Bacteria	—	NP	FOR PRIMARY RECREATION AND SHELLFISH USES—SEE DOCUMENT				1986
beta-Endosulfan	33213659	P	0.22 G,Y	0.056 G,Y	0.034 G,Y	0.0087 G,Y	1980
Boron	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986
Carbaryl	63252	NP	2.1	2.1	1.6		2012
Cadmium	7440439	P	2.0 D,E	0.25 D,E	40 D	8.8 D	2001
Chlordane	57749	P	2.4 G	0.0043 G	0.09 G	0.004 G	1980
Chloride	16887006	NP	860000	230000			1986
Chlorine	7782505	NP	19	11	13	7.5	1986
Chloropyrifos	2921882	NP	0.083	0.041	0.011	0.0056	1986
Chromium (III)	16065831	P	570 D,E	74 D,E			1995
Chromium (VI)	18540299	P	16 D	11 D	1,100 D	50 D	1995
Color	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986
Copper	7440508	P	Freshwater criteria calculated using the BLM mm - See Document		4.8 D,cc	3.1 D,cc	2007
Cyanide	57125	P	22 Q	5.2 Q	1 Q	1 Q	1985
Demeton	8065483	NP		0.1 C		0.1 C	1985
Diazinon	333415	NP	0.17ug/L	0.17ug/L	0.82ug/L	0.82ug/L	2005
Dieldrin	60571	P	0.24	0.056 O	0.71 G	0.0019 G	1995
Endrin	72208	P	0.086	0.036 O	0.037 G	0.0023 G	1995
gamma-BHC (Lindane)	58899	P	0.95		0.16 G		1995
Gases, Total Dissolved	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT C				1986
Guthion	86500	NP		0.01 C		0.01 C	1986
Hardness	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986
Heptachlor	76448	P	0.52 G	0.0038 G	0.053 G	0.0036 G	1980

Heptachlor Epoxide	1024573	P	0.52 G,V	0.0038 G,V	0.053 G,V	0.0036 G,V	1981
Iron	7439896	NP		1000 C			1986
Lead	7439921	P	65 D,E	2.5 D,E	210 D	8.1 D	1980
Malathion	121755	NP		0.1 C		0.1 C	1986
Mercury Methylmercury	7439976 22967926	P	1.4 D,hh	0.77 D,hh	1.8 D,ee,hh	0.94 D,ee,hh	1995
Methoxychlor	72435	NP		0.03 C		0.03 C	1986
Mirex	2385855	NP		0.001 C		0.001 C	1986
Nickel	7440020	P	470 D,E	52 D,E	74 D	8.2 D	1995
Nonylphenol	84852153	NP	28ug/L	6.6ug/L	7ug/L	1.7ug/L	2005
Nutrients	—	NP	See EPA's Ecoregional criteria for Total Phosphorus, Total Nitrogen, Chlorophyll *a* and Water Clarity (Secchi depth for lakes; turbidity for streams and rivers) (& Level III Ecoregional criteria)				
Oil and Grease	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT C				1986
Oxygen, Dissolved Freshwater Oxygen, Dissolved Saltwater	7782447	NP	WARMWATER AND COLDWATER MATRIX—SEE DOCUMENT SALTWATER—SEE DOCUMENT				1986
Parathion	56382	NP	0.065 I	0.013 I			1995
Pentachlorophenol	87865	P	19 F	15 F	13	7.9	1995
pH	—	NP		6.5 – 9 C		6.5 – 8.5 C,P	1986
Phosphorus Elemental	7723140	NP					1986
Polychlorinated Biphenyls (PCBs)		P		0.014 N		0.03 N	
Selenium	7782492	P	L	5.0	290 D, dd	71 D, dd	1995
Silver	7440224	P	3.2 D,E		1.9 D		1980
Solids Suspended and Turbidity	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT C				1986
Sulfide-Hydrogen Sulfide	7783064	NP		2.0 C		2.0 C	1986
Tainting Substances	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986

Temperature	—	NP	SPECIES DEPENDENT CRITERIA—SEE DOCUMENT M				1986
Toxaphene	8001352	P	0.73	0.0002	0.21	0.0002	1986
Tributyltin (TBT)	—	NP	0.46	0.072	0.42	0.0074	2004
Zinc	7440666	P	120 D,E	120 D,E	90 D	81 D	1995
4,4'-DDT	50293	P	1.1 G,ii	0.001 G, ii	0.13 G,ii	0.001 G, ii	1980

***P/NP** – Indicates either a Priority Pollutant (P) or a Non Priority Pollutant (NP).

Footnotes

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive. Please consult the criteria document for details.

C The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976). The CCC of 20mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25% of the natural level.

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria (PDF)," (49 pp, 3MB) October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available on NSCEP's web site and 40CFR§131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 100 mg/L. Criteria values for other hardness may be calculated per the equation presented in the criteria document.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH. Values displayed in table correspond to a pH of 7.8.

G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (PDF) (153 pp, 7.3MB) (EPA 440/5-80-019), Chlordane (PDF) (68 pp, 3.1MB) (EPA 440/5-80-027), DDT (PDF) (175 pp, 8.3MB) (EPA 440/5-80-038), Endosulfan (PDF) (155 pp, 7.3MB) (EPA 440/5-80-046), Endrin (PDF) (103 pp, 4.6MB) (EPA 440/5-80-047), Heptachlor (PDF) (114 pp, 5.4MB) (EPA 440/5-80-052), Hexachlorocyclohexane (PDF) (109 pp, 4.8MB) (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines (PDF) (104 pp, 3.3MB). If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

I This value for aluminum is expressed in terms of total recoverable metal in the water column.

J This value was derived using the GLI Guidelines (60 FR 15393-15399, March 23, 1995; 40CFR132 Appendix A); the differences between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. No decision concerning this criterion was affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 ug/l and 12.82 ug/l, respectively.

M U.S. EPA. 1973. Water Quality Criteria 1972. EPA-R3-73-033. National Technical Information Service, Springfield, VA.; U.S. EPA. 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures. EPA 600/3-77-061. National Technical Information Service, Springfield, VA.

N This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

O The derivation of the CCC for this pollutant (Endrin) did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

P According to page 181 of the Red Book:

For open ocean waters where the depth is substantially greater than the euphotic zone, the pH should not be changed more than 0.2 units from the naturally occurring variation or any case outside the range of 6.5 to 8.5. For shallow, highly productive coastal and estuarine areas where naturally occurring pH variations approach the lethal limits of some species, changes in pH should be avoided but in any case should not exceed the limits established for fresh water, i.e., 6.5-9.0.

Q This recommended water quality criterion is expressed as ug free cyanide (as CN)/L.

S There are three major reasons why the use of Water-Effect Ratios might be appropriate.

1. The value of 87 µg/l is based on a toxicity test with the striped bass in water with pH = 6.5–6.6 and hardness <10 mg/L. Data in "Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia" (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time.
2. In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide.
3. EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 g aluminum/L, when either total recoverable or dissolved is measured.

V This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water -Effect Ratios might be appropriate.

dd The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 µg/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (PDF) (144 pp, 6.4MB) (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60 FR 15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

ii This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).

mm The available toxicity data, when evaluated using the procedures described in the “Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses” indicate that freshwater aquatic life should be protected if the 24-hour average and four-day average concentrations do not respectively exceed the acute and chronic criteria concentrations calculated by the Biotic Ligand Model.

Human Health Criteria Table

			Human Health for the consumption of		
Pollutant	**CAS Number**	**P/NP***	**Water + Organism (µg/L)**	**Organism Only (µg/L)**	**Publication Year**
Acenaphthene	83329	P	670 B,U	990 B,U	2002
Acrolein	107028	P	6 ll	9 ll	2009
Acrylonitrile	107131	P	0.051 B,C	0.25 B,C	2002
Aldrin	309002	P	0.000049 B,C	0.000050 B,C	2002
alpha-BHC	319846	P	0.0026 B,C	0.0049 B,C	2002
alpha-Endosulfan	959988	P	62 B	89 B	2002
Anthracene	120127	P	8,300 B	40,000 B	2002
Antimony	7440360	P	5.6 B	640 B	2002
Arsenic	7440382	P	0.018 C,M,S	0.14 C,M,S	1992
Asbestos	1332214	P	7 million fibers/L I		1991
Barium	7440393	NP	1,000 A		1986
Benzene	71432	P	2.2 B,C	51 B,C	2002
Benzidine	92875	P	0.000086 B,C	0.00020 B,C	2002

Benzo(a) Anthracene	56553	P	0.0038 B,C	0.018 B,C	2002
Benzo(a) Pyrene	50328	P	0.0038 B,C	0.018 B,C	2002
Benzo(b) Fluoranthene	205992	P	0.0038 B,C	0.018 B,C	2002
Benzo(k) Fluoranthene	207089	P	0.0038 B,C	0.018 B,C	2002
Beryllium	7440417	P	Z		
beta-BHC	319857	P	0.0091 B,C	0.017 B,C	2002
beta-Endosulfan	33213659	P	62 B	89 B	2002
Bis(2-Chloroethyl) Ether	111444	P	0.030 B,C	0.53 B,C	2002
Bis(2-Chloroisopropyl) Ether	108601	P	1,400 B	65,000 B	2002
Bis(2-Ethylhexyl) Phthalate[x]	117817	P	1.2 B,C	2.2 B,C	2002
Bromoform	75252	P	4.3 B,C	140 B,C	2002
Butylbenzyl Phthalate[w]	85687	P	1,500 B	1,900 B	2002
Cadmium	7440439	P	Z		
Carbon Tetrachloride	56235	P	0.23 B,C	1.6 B,C	2002
Chlordane	57749	P	0.00080 B,C	0.00081 B,C	2002
Chlorobenzene	108907	P	130 Z,U	1,600 U	2003
Chlorodibromomethane	124481	P	0.40 B,C	13 B,C	2002
Chloroform	67663	P	5.7 C,P	470 C,P	2002
Chlorophenoxy Herbicide (2,4-D)	94757	NP	100 Z		1986
Chromium (III)	16065831	P	Z Total		
Chromium (VI)	18540299	P	Z Total		
Chrysene	218019	P	0.0038 B,C	0.018 B,C	2002
Copper	7440508	P	1,300 U		1992
Cyanide	57125	P	140 jj	140 jj	2003
Dibenzo(a,h)Anthracene	53703	P	0.0038 B,C	0.018 B,C	2002
Dichlorobromomethane	75274	P	0.55 B,C	17 B,C	2002
Dieldrin	60571	P	0.000052 B,C	0.000054 B,C	2002
Diethyl Phthalate[w]	84662	P	17,000 B	44,000 B	2002
Dimethyl Phthalate[w]	131113	P	270,000	1,100,000	2002
Di-n-Butyl Phthalate[w]	84742	P	2,000 B	4,500 B	2002

Dinitrophenols	25550587	NP	69	5300	2002
Endosulfan Sulfate	1031078	P	62 B	89 B	2002
Endrin	72208	P	0.059	0.060	2003
Endrin Aldehyde	7421934	P	0.29 B	0.30 B,H	2002
Ether, Bis(Chloromethyl)	542881	NP	0.00010 C	0.00029 C	2002
Ethylbenzene	100414	P	530	2,100	2003
Fluoranthene	206440	P	130 B	140 B	2002
Fluorene	86737	P	1,100 B	5,300 B	2002
gamma-BHC (Lindane)	58899	P	0.98	1.8	2003
Heptachlor	76448	P	0.000079 B,C	0.000079 B,C	2002
Heptachlor Epoxide	1024573	P	0.000039 B,C	0.000039 B,C	2002
Hexachlorobenzene	118741	P	0.00028 B,C	0.00029 B,C	2002
Hexachlorobutadiene	87683	P	0.44 B,C	18 B,C	2002
Hexachlorocyclo-hexane-Technical	608731		0.0123 H	0.0414H	
Hexachlorocyclopentadiene	77474	P	40 U	1,100 U	2003
Hexachloroethane	67721	P	1.4 B,C	3.3 B,C	2002
Ideno(1,2,3-cd)Pyrene	193395	P	0.0038 B,C	0.018 B,C	2002
Isophorone	78591	P	35 B,C	960 B,C	2002
Manganese	7439965	NP	50 O	100 A	
Methylmercury	22967926	P		0.3 mg/kg J	2001
Methoxychlor	72435	NP	100 A,Z		1986
Methyl Bromide	74839	P	47 B	1,500 B	2002
Methylene Chloride	75092	P	4.6 B,C	590 B,C	2002
Nickel	7440020	P	610 B	4,600 B	1998
Nitrates	14797558	NP	10,000 A		1986
Nitrobenzene	98953	P	17 B	690 B,H,U	2002
Nitrosamines	—	NP	0.0008	1.24	1980
Nitrosodibutylamine, N	924163	NP	0.0063 C	0.22 C	2002
Nitrosodiethylamine, N	55185	NP	0.0008 C	1.24 C	2002
Nitrosopyrrolidine, N	930552	NP	0.016 C	34 C	2002

N-Nitrosodimethylamine	62759	P	0.00069 B,C	3.0 B,C	2002
N-Nitrosodi-n-Propylamine	621647	P	0.0050 B,C	0.51 B,C	2002
N-Nitrosodiphenylamine	86306	P	3.3 B,C	6.0 B,C	2002
Nutrients	—	NP	See EPA's Ecoregional criteria for Total Phosphorus, Total Nitrogen, Chlorophyll *a* and Water Clarity (Secchi depth for lakes; turbidity for streams and rivers) (& Level III Ecoregional criteria)		
Pentachlorobenzene	608935	NP	1.4 E	1.5 E	2002
Pentachlorophenol	87865	P	0.27 B,C	3.0 B,C,H	2002
pH	—	NP	5 – 9		1986
Phenol	108952	P	10,000 ll,U	860,000 ll,U	2009
Polychlorinated Biphenyls (PCBs)		P	0.000064 B,C,N	0.000064 B,C,N	2002
Pyrene	129000	P	830 B	4,000 B	2002
Selenium	7782492	P	170 Z	4200	2002
Solids Dissolved and Salinity	—	NP	250,000 A		1986
Tetrachlorobenzene,1,2,4,5-	95943	NP	0.97 B	1.1 B	2002
Tetrachloroethylene	127184	P	0.69 C	3.3 C	2002
Thallium	7440280	P	0.24	0.47	2003
Toluene	108883	P	1,300 Z	15,000	2003
Toxaphene	8001352	P	0.00028 B,C	0.00028 B,C	2002
Trichloroethylene	79016	P	2.5 C	30 C	2002
Trichlorophenol,2,4,5-	95954	NP	1,800 B	3,600 B	2002
Vinyl Chloride	75014	P	0.025 C,kk	2.4 C,kk	2003
Zinc	7440666	P	7,400 U	26,000 U	2002
1,1,1-Trichloroethane	71556	P	Z		
1,1,2,2-Tetrachloroethane	79345	P	0.17 B,C	4.0 B,C	2002
1,1,2-Trichloroethane	79005	P	0.59 B,C	16 B,C	2002
1,1-Dichloroethylene	75354	P	330	7,100	2003
1,2,4-Trichlorobenzene	120821	P	35	70	2003
1,2-Dichlorobenzene	95501	P	420	1,300	2003
1,2-Dichloroethane	107062	P	0.38 B,C	37 B,C	2002

1,2-Dichloropropane	78875	P	0.50 B,C	15 B,C	2002
1,2-Diphenylhydrazine	122667	P	0.036 B,C	0.20 B,C	2002
1,2-Trans-Dichloroethylene	156605	P	140 Z	10,000	2003
1,3-Dichlorobenzene	541731	P	320	960	2002
1,3-Dichloropropene	542756	P	0.34 C	21 C	2003
1,4-Dichlorobenzene	106467	P	63	190	2003
2,3,7,8-TCDD (Dioxin)	1746016	P	5.0E-9 C	5.1E-9 C	2002
2,4,6-Trichlorophenol	88062	P	1.4 B,C	2.4 B,C,U	2002
2,4-Dichlorophenol	120832	P	77 B,U	290 B,U	2002
2,4-Dimethylphenol	105679	P	380 B	850 B,U	2002
2,4-Dinitrophenol	51285	P	69 B	5,300 B	2002
2,4-Dinitrotoluene	121142	P	0.11 C	3.4 C	2002
2-Chloronaphthalene	91587	P	1,000 B	1,600 B	2002
2-Chlorophenol	95578	P	81 B,U	150 B,U	2002
2-Methyl-4,6-Dinitrophenol	534521	P	13	280	2002
3,3'-Dichlorobenzidine	91941	P	0.021 B,C	0.028 B,C	2002
3-Methyl-4-Chlorophenol	59507	P	U	U	
4,4'-DDD	72548	P	0.00031 B,C	0.00031 B,C	2002
4,4'-DDE	72559	P	0.00022 B,C	0.00022 B,C	2002
4,4'-DDT	50293	P	0.00022 B,C	0.00022 B,C	2002

***P/NP** – Indicates either a Priority Pollutant (P) or a Non Priority Pollutant (NP).

Footnotes

A This human health criterion is the same as originally published in the Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value is now published in the Gold Book.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document used to derive the original criterion was retained in each case.

C This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).

D According to the procedures described in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, except possibly where a very sensitive species is important at a

site, freshwater aquatic life should be protected if both conditions specified in Appendix C to the Preamble- Calculation of Freshwater Ammonia Criterion are satisfied.

F The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976).

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).

J This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day.

M EPA is currently reassessing the criteria for arsenic.

N This criterion applies to total pcbs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

O This criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages.

P Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.

R U.S. EPA. 1973. Water Quality Criteria 1972. EPA-R3-73-033. National Technical Information Service, Springfield, VA.; U.S. EPA. 1977. Temperature Criteria for Freshwater Fish: Protocol and Procedures. EPA 600/3-77-061. National Technical Information Service, Springfield, VA.

S This recommended water quality criterion for arsenic refers to the inorganic form only.

T U.S. EPA. 1986. Ambient Water Quality Criteria for Dissolved Oxygen. EPA 440/5-86-003. National Technical Information Service, Springfield, VA.

U The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.

Z A more stringent Maximum Contaminant Level (MCL) has been issued by EPA under the Safe Drinking Water Act. Refer to drinking water regulations 40CFR141 or Safe Drinking Water Hotline (1-800-426-4791) for values.

jj This recommended water quality criterion is expressed as total cyanide, even though the IRIS RFD we used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their differing abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g., $Fe_4[Fe(CN)_6]_3$), this criterion may be over conservative.

kk This recommended water quality criterion was derived using the cancer slope factor of 1.4 (LMS exposure from birth).

II This criterion has been revised to reflect the Environmental Protection Agency's cancer slope factor (CSF) or reference dose (RfD), as contained in the Integrated Risk Information System (IRIS) as of (date of publication of Final FR Notice). The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

Organoleptic Effects (e.g., taste and odor)

Pollutant	CAS Number	Organoleptic Effect Criteria (µg/L)	FR Cite/ Source
Acenaphthene	83329	20	Gold Book
Color		NP	Gold Book
Iron	7439896	NP	Gold Book
Monochlorobenzene	108907	20	Gold Book
Tainting Substance		NP	Gold Book
3-Chlorophenol	—	0.1	Gold Book
4-Chlorophenol	106489	0.1	Gold Book
2,3-Dichlorophenol	—	0.04	Gold Book
2,5-Dichlorophenol	—	0.5	Gold Book
2,6-Dichlorophenol	—	0.2	Gold Book
3,4-Dichlorophenol	—	0.3	Gold Book
2,4,5-Trichlorophenol	95954	1	Gold Book
2,4,6-Trichlorophenol	88062	2	Gold Book
2,3,4,6-Tetrachlorophenol	—	1	Gold Book
2-Methyl-4-Chlorophenol	—	1800	Gold Book
3-Methyl-4-Chlorophenol	59507	3000	Gold Book
3-Methyl-6-Chlorophenol	—	20	Gold Book
2-Chlorophenol	95578	0.1	Gold Book
Copper	7440508	1000	Gold Book
2,4-Dichlorophenol	120832	0.3	Gold Book
2,4-Dimethylphenol	105679	400	Gold Book
Hexachlorocyclopentadiene	77474	1	Gold Book
Manganese	7439965		
Nitrobenzene	98953	30	Gold Book

Pentachlorophenol	87865	30	Gold Book
Phenol	108952	300	Gold Book
Zinc	7440666	5000	45 FR79341

Notes:

1. These criteria are based on organoleptic (taste and odor) effects. Because of variations in chemical nomenclature systems, this listing of pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

Additional Notes

1. **Criteria Maximum Concentration and Criterion Continuous Concentration**

   The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two of the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedence. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States.

2. **Criteria Recommendations for Priority Pollutants, Non Priority Pollutants and Organoleptic Effects**

   This compilation lists all priority toxic pollutants and some non priority toxic pollutants, and both human health effect and organoleptic effect criteria issued pursuant to CWA §304(a). Blank spaces indicate that EPA has no CWA §304(a) criteria recommendations. For a number of non-priority toxic pollutants not listed, CWA §304(a) "water + organism" human health criteria are not available, but EPA has published MCLs under the SDWA that may be used in establishing water quality standards to protect water supply designated uses. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service CAS registry numbers, which provide a unique identification for each chemical.

3. **Human Health Risk**

   The human health criteria for the priority and non priority pollutants are based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).

4. **Water Quality Criteria published pursuant to Section 304(a) or Section 303(c) of the CWA**

   Many of the values in the compilation were published in the California Toxics Rule. Although such values were published pursuant to Section 303(c) of the CWA, they represent the Agency's most recent calculation of water quality criteria and are thus the Agency's 304(a) criteria.

5. **Calculation of Dissolved Metals Criteria**

The 304(a) criteria for metals, shown as dissolved metals, are calculated in one of two ways. For freshwater metals criteria that are hardness-dependent, the dissolved metal criteria were calculated using a hardness of 100 mg/l as $CaCO_3$ for illustrative purposes only. Saltwater and freshwater metals' criteria that are not hardness-dependent are calculated by multiplying the total recoverable criteria before rounding by the appropriate conversion factors. The final dissolved metals' criteria in the table are rounded to two significant figures. Information regarding the calculation of hardness dependent conversion factors are included in the footnotes.

6. **Maximum Contaminant Levels**

The compilation includes footnotes for pollutants with Maximum Contaminant Levels (MCLs) more stringent than the recommended water quality criteria in the compilation. MCLs for these pollutants are not included in the compilation, but can be found in the appropriate drinking water regulations (40 CFR 141.11-16 and 141.60-63), or can be accessed through the Safe Drinking Water Hotline (800-426-4791) or online.

7. **Organoleptic Effects**

The compilation contains 304(a) criteria for pollutants with toxicity-based criteria as well as non-toxicity based criteria. The basis for the non-toxicity based criteria are organoleptic effects (e.g., taste and odor) which would make water and edible aquatic life unpalatable but not toxic to humans. The table includes criteria for organoleptic effects for 23 pollutants. Pollutants with organoleptic effect criteria more stringent than the criteria based on toxicity (e.g., included in both the priority and non-priority pollutant tables) are footnoted as such.

8. **Gold Book**

The "Gold Book" is Quality Criteria for Water: 1986. EPA 440/5-86-001.

9. **Correction of Chemical Abstract Services Number**

The Chemical Abstract Services number (CAS) for Bis(2-Chlorisoprpyl) Ether, has been revised in IRIS and in the table. The correct CAS number for this chemical is 108-60-1. The previous CAS number for this pollutant was 39638-32-9.

10. **Contaminants with Blanks**

EPA has not calculated criteria for contaminants with blanks. However, permit authorities should address these contaminants in NPDES permit actions using the States' existing narrative criteria for toxics.

11. **Specific Chemical Calculations**

Selenium—Aquatic Life
This compilation contains aquatic life criteria for selenium that are the same as those published in the proposed CTR. In the CTR, EPA proposed an acute criterion for selenium based on the criterion proposed for selenium in the Water Quality Guidance for the Great Lakes System (61 FR 58444). The GLI and CTR proposals take into account data showing that selenium's two prevalent oxidation states in water, selenite and selenate, present differing potentials for aquatic toxicity, as well as new data indicating that various forms of selenium are additive. The new approach produces a different selenium acute criterion concentration, or

CMC, depending upon the relative proportions of selenite, selenate, and other forms of selenium that are present.

EPA is currently undertaking a reassessment of selenium, and expects the 304(a) criteria for selenium will be revised based on the final reassessment (63 FR 26186). However, until such time as revised water quality criteria for selenium are published by the Agency, the recommended water quality criteria in this compilation are EPA's current 304(a) criteria.

Appendix A—Conversion Factors for Dissolved Metals

Metal	Conversion Factor			
	freshwater CMC	freshwater CCC	saltwater CMC	saltwater CCC[1]
Arsenic	1.000	1.000	1.000	1.000
Cadmium	1.136672-[(ln hardness)(0.041838)]	1.101672-[(ln hardness)(0.041838)]	0.994	0.994
Chromium III	0.316	0.860	—	—
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	1.46203-[(ln hardness)(0.145712)]	1.46203-[(ln hardness)(0.145712)]	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	—	—	0.998	0.998
Silver	0.85	—	0.85	—
Zinc	0.978	0.986	0.946	0.946

Appendix B—Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	m_A	b_A	m_C	b_C	Freshwater Conversion Factors (CF)	
					CMC	CCC
Cadmium	1.0166	-3.924	0.7409	-4.719	1.136672-[(*ln*hardness)(0.041838)]	1.101672-[(*ln*hardness)(0.041838)]
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960

Chemical	m_A	b_A	m_C	b_C	Freshwater Conversion Factors (CF)	
					CMC	CCC
Lead	1.273	-1.460	1.273	-4.705	1.46203-[(*ln*hardness)(0.145712)]	1.46203-[(*ln*hardness)(0.145712)]
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.59	—	—	0.85	—
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Hardness-dependant metals' criteria may be calculated from the following:

CMC (dissolved) = $\exp\{m_A [ln(\text{hardness})] + b_A\}$ (CF)

CCC (dissolved) = $\exp\{m_C [ln(\text{hardness})] + b_C\}$ (CF)

Appendix C - Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC (acute criterion) calculated using the following equations:
   - Where salmonid fish are present:
     - CMC = $(0.275/(1 + 10^{7.204-pH})) + (39.0/(1 + 10^{pH-7.204}))$
   - Or where salmonid fish are not present:
     - CMC = $(0.411/(1 + 10^{7.204-pH})) + (58.4/(1 + 10^{pH-7.204}))$
2.
   A. The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on theaverage, the CCC (chronic criterion) calculated using the following equations:
      - When fish early life stages are present:
        - CCC = $((0.0577/(1 + 10^{7.688-pH})) + (2.487/(1 + 10^{pH-7.688}))) \times \text{MIN}(2.85, 1.45 \cdot 10^{0.028 \cdot (25-T)})$
      - When fish early life stages are absent:
        - CCC = $((0.0577/(1 + 10^{7.688-pH})) + (2.487/(1 + 10^{pH-7.688}))) \times 1.45 \cdot 10^{0.028 \cdot (25-\text{MAX}(T,7))}$

   B. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

The Gold Book

Quality Criteria for Water, 1986 (PDF) (477 pp., 4.6 MB) May 1986

The Red Book

Quality Criteria for Water, 1976 (PDF) (534 pp., 6.2 MB) July 1976

Chemical Specific Criteria Documents from the 1980s

Last updated on Tuesday, January 08, 2013

USEPA Regional Screening Level (RSL) Summary Table
November 2012

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
1.8E-02	C	5.1E-06	C	1.5E-01	I					1	0.1		ALAR	1596-84-5	2.7E+01	c	9.6E+01	c	4.8E-01	c	2.4E+00	c	3.7E+00	c		8.2E-04	
8.7E-03	I			4.0E-03	I					1	0.1		Acephate	30560-19-1	5.6E+01	c**	2.0E+02	c*					7.7E+00	c**		1.7E-03	
		2.2E-06	I			9.0E-03	I	V		1		1.1E+05	Acetaldehyde	75-07-0	1.0E+01	c**	5.2E+01	c**	1.1E+00	c**	5.6E+00	c**	2.2E+00	c**		4.5E-04	
				2.0E-02	I					1	0.1		Acetochlor	34256-82-1	1.2E+03	n	1.2E+04	n					2.7E+02	n		2.2E-01	
				9.0E-01	I	3.1E+01	A	V		1		1.1E+05	Acetone	67-64-1	6.1E+04	n	6.3E+05	nms	3.2E+04	n	1.4E+05	n	1.2E+04	n		2.4E+00	
						2.0E-03	X	V		1		1.1E+05	Acetone Cyanohydrin	75-86-5	5.3E+01	n	2.2E+02	n	2.1E+00	n	8.8E+00	n	4.2E+00	n		8.4E-04	
						6.0E-02	I	V		1		1.3E+05	Acetonitrile	75-05-8	8.7E+02	n	3.7E+03	n	6.3E+01	n	2.6E+02	n	1.3E+02	n		2.6E-02	
				1.0E-01	I			V		1		2.5E+03	Acetophenone	98-86-2	7.8E+03	ns	1.0E+05	nms					1.5E+03	n		4.5E-01	
3.8E+00	C	1.3E-03	C							1	0.1		Acetylaminofluorene, 2-	53-96-3	1.3E-01	c	4.5E-01	c	1.9E-03	c	9.4E-03	c	1.3E-02	c		6.2E-05	
				5.0E-04	I	2.0E-05	I	V		1		2.3E+04	Acrolein	107-02-8	1.5E-01	n	6.5E-01	n	2.1E-02	n	8.8E-02	n	4.1E-02	n		8.4E-06	
5.0E-01	I	1.0E-04	I	2.0E-03	I	6.0E-03	I		M	1	0.1		Acrylamide	79-06-1	2.3E-01	c	3.4E+00	c	9.6E-03	c	1.2E-01	c	4.3E-02	c		9.1E-06	
				5.0E-01	I	1.0E-03	I			1	0.1		Acrylic Acid	79-10-7	3.0E+04	n	2.9E+05	nm	1.0E+00	n	4.4E+00	n	7.7E+03	n		1.6E+00	
5.4E-01	I	6.8E-05	I	4.0E-02	A	2.0E-03	I	V		1		1.1E+04	Acrylonitrile	107-13-1	2.4E-01	c*	1.2E+00	c*	3.6E-02	c*	1.8E-01	c*	4.5E-02	c*		9.8E-06	
						6.0E-03	P			1	0.1		Adiponitrile	111-69-3	8.5E+06	nm	3.6E+07	nm	6.3E+00	n	2.6E+01	n					
5.6E-02	C			1.0E-02	I					1	0.1		Alachlor	15972-60-8	8.7E+00	c*	3.1E+01	c					9.1E-01	c	2.0E+00	7.5E-04	1.6E-03
				1.0E-03	I					1	0.1		Aldicarb	116-06-3	6.1E+01	n	6.2E+02	n					1.5E+01	n	3.0E+00(F)	3.8E-03	7.5E-04
				1.0E-03	I					1	0.1		Aldicarb Sulfone	1646-88-4	6.1E+01	n	6.2E+02	n					1.6E+01	n	2.0E+00(F)	3.4E-03	4.4E-04
										1	0.1		Aldicarb sulfoxide	1646-87-3											4.0E+00(F)		8.8E-04
1.7E+01	I	4.9E-03	I	3.0E-05	I					1	0.1		Aldrin	309-00-2	2.9E-02	c*	1.0E-01	c	5.0E-04	c	2.5E-03	c	4.0E-03	c		6.5E-04	
				2.5E-01	I					1	0.1		Ally	74223-64-6	1.5E+04	n	1.5E+05	nm					3.8E+03	n		1.5E+00	
				5.0E-03	I	1.0E-04	X			1	0.1		Allyl Alcohol	107-18-6	3.0E+02	n	3.1E+03	n	1.0E-01	n	4.4E-01	n	7.8E+01	n		1.6E-02	
2.1E-02	C	6.0E-06	C			1.0E-03	I	V		1		1.4E+03	Allyl Chloride	107-05-1	6.8E-01	c**	3.4E+00	c**	4.1E-01	c**	2.0E+00	c**	6.3E-01	c**		2.0E-04	
				1.0E+00	P	5.0E-03	P			1			Aluminum	7429-90-5	7.7E+04	n	9.9E+05	nm	5.2E+00	n	2.2E+01	n	1.6E+04	n		2.3E+04	
				4.0E-04	I					1			Aluminum Phosphide	20859-73-8	3.1E+01	n	4.1E+02	n					6.2E+00	n			
				3.0E-04	I					1	0.1		Amdro	67485-29-4	1.8E+01	n	1.8E+02	n					4.6E+00	n		1.7E+03	
				9.0E-03	I					1	0.1		Ametryn	834-12-8	5.5E+02	n	5.5E+03	n					1.2E+02	n		1.2E-01	
2.1E+01	C	6.0E-03	C							1	0.1		Aminobiphenyl, 4-	92-67-1	2.3E-02	c	8.2E-02	c	4.1E-04	c	2.0E-03	c	2.6E-03	c		1.3E-05	
				8.0E-02	P					1	0.1		Aminophenol, m-	591-27-5	4.9E+03	n	4.9E+04	n					1.2E+03	n		4.7E-01	
				2.0E-02	P					1	0.1		Aminophenol, p-	123-30-8	1.2E+03	n	1.2E+04	n					3.1E+02	n		1.2E-01	
				2.5E-03	I					1	0.1		Amitraz	33089-61-1	1.5E+02	n	1.5E+03	n					5.9E+00	n		3.0E+00	
						1.0E-01	I			1			Ammonia	7664-41-7					1.0E+02	n	4.4E+02	n					
				2.0E-01	I					1			Ammonium Sulfamate	7773-06-0	1.6E+04	n	2.0E+05	nm					3.1E+03	n			
5.7E-03	I	1.6E-06	C	7.0E-03	P	1.0E-03	I			1	0.1		Aniline	62-53-3	8.5E+01	c**	3.0E+02	c*	1.0E+00	n	4.4E+00	n	1.2E+01	c**		3.9E-03	
4.0E-02	P			2.0E-03	X					1	0.1		Anthraquinone, 9,10-	84-65-1	1.2E+01	c*	4.3E+01	c*					1.2E+00	c*		1.2E-02	
				4.0E-04	I					0.15			Antimony (metallic)	7440-36-0	3.1E+01	n	4.1E+02	n					6.0E+00	n	6.0E+00	2.7E-01	2.7E-01
				5.0E-04	H					0.15			Antimony Pentoxide	1314-60-9	3.9E+01	n	5.1E+02	n					7.5E+00	n			
				9.0E-04	H					0.15			Antimony Potassium Tartrate	11071-15-1	7.0E+01	n	9.2E+02	n					1.3E+01	n			
				4.0E-04	H					0.15			Antimony Tetroxide	1332-81-6	3.1E+01	n	4.1E+02	n					6.0E+00	n			
						2.0E-04	I			0.15			Antimony Trioxide	1309-64-4	2.8E+05	nm	1.2E+06	nm	2.1E-01	n	8.8E-01	n					
				1.3E-02	I					1	0.1		Apollo	74115-24-5	7.9E+02	n	8.0E+03	n					1.8E+02	n		1.1E+01	
2.5E-02	I	7.1E-06	I	5.0E-02	H					1	0.1		Aramite	140-57-8	1.9E+01	c	6.9E+01	c	3.4E-01	c	1.7E+00	c	1.1E+00	c		1.3E-02	
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C			1	0.03		Arsenic, Inorganic	7440-38-2	3.9E-01	c*	1.6E+00	c	5.7E-04	c*	2.9E-03	c*	4.5E-02	c	1.0E+01	1.3E-03	2.9E-01
				3.5E-06	C	5.0E-05	I			1			Arsine	7784-42-1	2.7E-01	n	3.6E+00	n	5.2E-02	n	2.2E-01	n	5.4E-02	n			
				9.0E-03	I					1	0.1		Assure	76578-14-8	5.5E+02	n	5.5E+03	n					9.3E+01	n		1.4E+00	
				5.0E-02	I					1	0.1		Asulam	3337-71-1	3.1E+03	n	3.1E+04	n					7.8E+02	n		2.0E-01	
2.3E-01	C			3.5E-02	I					1	0.1		Atrazine	1912-24-9	2.1E+00	c	7.5E+00	c					2.6E-01	c	3.0E+00	1.7E-04	1.9E-03
8.8E-01	C	2.5E-04	C							1	0.1		Auramine	492-80-8	5.5E-01	c	2.0E+00	c	9.7E-03	c	4.9E-02	c	5.7E-02	c		5.2E-04	
				4.0E-04	I					1	0.1		Avermectin B1	65195-55-3	2.4E+01	n	2.5E+02	n					6.3E+00	n		1.1E+01	
1.1E-01	I	3.1E-05	I					V		1			Azobenzene	103-33-3	5.1E+00	c	2.3E+01	c	7.8E-02	c	4.0E-01	c	1.0E-01	c		8.0E-04	
				2.0E-01	I	5.0E-04	H			0.07			Barium	7440-39-3	1.5E+04	n	1.9E+05	nm	5.2E-01	n	2.2E+00	n	2.9E+03	n	2.0E+03	1.2E+02	8.2E+01
				4.0E-03	I					1	0.1		Baygon	114-26-1	2.4E+02	n	2.5E+03	n					6.1E+01	n		2.0E-02	
				3.0E-02	I					1	0.1		Bayleton	43121-43-3	1.8E+03	n	1.8E+04	n					4.3E+02	n		3.4E-01	
				2.5E-02	I					1	0.1		Baythroid	68359-37-5	1.5E+03	n	1.5E+04	n					8.7E+01	n		2.3E+01	
				3.0E-01	I					1	0.1		Benefin	1861-40-1	1.8E+04	n	1.8E+05	nm					1.2E+03	n		4.1E+01	
				5.0E-02	I					1	0.1		Benomyl	17804-35-2	3.1E+03	n	3.1E+04	n					7.5E+02	n		6.6E-01	
				3.0E-02	I					1	0.1		Bentazon	25057-89-0	1.8E+03	n	1.8E+04	n					4.4E+02	n		9.6E-02	
				1.0E-01	I			V		1		1.2E+03	Benzaldehyde	100-52-7	7.8E+03	ns	1.0E+05	nms					1.5E+03	n		3.3E-01	
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V		1		1.8E+03	Benzene	71-43-2	1.1E+00	c*	5.4E+00	c*	3.1E-01	c	1.6E+00	c*	3.9E-01	c*	5.0E+00	2.0E-04	2.6E-03
				2.0E-04	X					1	0.1		Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1	1.2E+01	n	1.2E+02	n					3.1E+00	n		8.7E-04	
				1.0E-03	P			V		1		1.3E+03	Benzenethiol	108-98-5	7.8E+01	n	1.0E+03	n					1.3E+01	n		8.6E-03	
2.3E+02	I	6.7E-02	I	3.0E-03	I				M	1	0.1		Benzidine	92-87-5	5.0E-04	c	7.5E-03	c	1.4E-05	c	1.8E-04	c	9.2E-05	c		2.4E-07	
				4.0E+00	I					1	0.1		Benzoic Acid	65-85-0	2.4E+05	nm	2.5E+06	nm					5.8E+04	n		1.4E+01	
1.3E+01	I							V		1		3.2E+02	Benzotrichloride	98-07-7	4.9E-02	c	2.2E-01	c					2.6E-03	c		5.6E-06	
				1.0E-01	P					1	0.1		Benzyl Alcohol	100-51-6	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.7E-01	
1.7E-01	I	4.9E-05	C	2.0E-03	P	1.0E-03	P	V		1		1.5E+03	Benzyl Chloride	100-44-7	1.0E+00	c*	4.9E+00	c*	5.0E-02	c*	2.5E-01	c*	7.7E-02	c*		8.4E-05	
		2.4E-03	I	2.0E-03	I	2.0E-05	I			0.007			Beryllium and compounds	7440-41-7	1.6E+02	n	2.0E+03	n	1.0E-03	c*	5.1E-03	c*	1.6E+01	n	4.0E+00	1.3E+01	3.2E+00
				1.0E-04	I					1	0.1		Bidrin	141-66-2	6.1E+00	n	6.2E+01	n					1.6E+00	n		3.6E-04	
				9.0E-03	P					1	0.1		Bifenox	42576-02-3	5.5E+02	n	5.5E+03	n					7.5E+01	n		5.7E-01	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				1.5E-02	I					1	0.1		Biphenthrin	82657-04-3	9.2E+02	n	9.2E+03	n					2.3E+02	n		1.1E+03	
8.0E-03	X			5.0E-02	I	4.0E-04	X	V		1			Biphenyl, 1,1'-	92-52-4	5.1E+01	n	2.1E+02	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		8.7E-03	
7.0E-02	H	1.0E-05	H	4.0E-02	I			V		1		1.0E+03	Bis(2-chloro-1-methylethyl) ether	108-60-1	4.6E+00	c	2.2E+01	c	2.4E-01	c	1.2E+00	c	3.1E-01	c		1.1E-04	
				3.0E-03	P					1	0.1		Bis(2-chloroethoxy)methane	111-91-1	1.8E+02	n	1.8E+03	n					4.6E+01	n		1.1E-02	
1.1E+00	I	3.3E-04	I					V		1		5.1E+03	Bis(2-chloroethyl)ether	111-44-4	2.1E-01	c	1.0E+00	c	7.4E-03	c	3.7E-02	c	1.2E-02	c		3.1E-06	
1.4E-02	I	2.4E-06	C	2.0E-02	I					1	0.1		Bis(2-ethylhexyl)phthalate	117-81-7	3.5E+01	c*	1.2E+02	c	1.0E+00	c	5.1E+00	c	4.8E+00	c*	6.0E+00	1.1E+00	1.4E+00
2.2E+02	I	6.2E-02	I					V		1		4.2E+03	Bis(chloromethyl)ether	542-88-1	7.7E-05	c	3.9E-04	c	3.9E-05	c	2.0E-04	c	6.2E-05	c		1.5E-08	
				5.0E-02	I					1	0.1		Bisphenol A	80-05-7	3.1E+03	n	3.1E+04	n					5.8E+02	n		4.4E+01	
				2.0E-01	I	2.0E-02	H			1			Boron And Borates Only	7440-42-8	1.6E+04	n	2.0E+05	nm	2.1E+01	n	8.8E+01	n	3.1E+03	n		9.9E+00	
				2.0E+00	P	2.0E-02	P		M	1			Boron Trichloride	10294-34-5	1.6E+05	nm	2.0E+06	nm	2.1E+01	n	8.8E+01	n	3.1E+04	n			
				4.0E-02	C	1.3E-02	C			1			Boron Trifluoride	7637-07-2	3.1E+03	n	4.1E+04	n	1.4E+01	n	5.7E+01	n	6.2E+02	n			
7.0E-01	I			4.0E-03	I					1			Bromate	15541-45-4	9.1E-01	c	4.1E+00	c					9.6E-02	c	1.0E+01	7.4E-04	7.7E-02
2.0E+00	X	6.0E-04	X					V		1		2.4E+03	Bromo-2-chloroethane, 1-	107-04-0	2.4E-02	c	1.2E-01	c	4.1E-03	c	2.0E-02	c	6.4E-03	c		1.8E-06	
				8.0E-03	I	6.0E-02	I	V		1		6.8E+02	Bromobenzene	108-86-1	3.0E+02	n	1.8E+03	ns	6.3E+01	n	2.6E+02	n	5.4E+01	n		3.6E-02	
						4.0E-02	X	V		1		4.0E+03	Bromochloromethane	74-97-5	1.6E+02	n	6.8E+02	n	4.2E+01	n	1.8E+02	n	8.3E+01	n		2.1E-02	
6.2E-02	I	3.7E-05	C	2.0E-02	I			V		1		9.3E+02	Bromodichloromethane	75-27-4	2.7E-01	c	1.4E+00	c	6.6E-02	c	3.3E-01	c	1.2E-01	c	8.0E+01(F)	3.2E-05	2.2E-02
7.9E-03	I	1.1E-06	I	2.0E-02	I					1	0.1		Bromoform	75-25-2	6.2E+01	c*	2.2E+02	c*	2.2E+00	c	1.1E+01	c	7.9E+00	c*	8.0E+01(F)	2.1E-03	2.1E-02
				1.4E-03	I	5.0E-03	I	V		1		3.6E+03	Bromomethane	74-83-9	7.3E+00	n	3.2E+01	n	5.2E+00	n	2.2E+01	n	7.0E+00	n		1.8E-03	
				5.0E-03	H					1	0.1		Bromophos	2104-96-3	3.1E+02	n	3.1E+03	n					2.6E+01	n		1.1E-01	
				2.0E-02	I					1	0.1		Bromoxynil	1689-84-5	1.2E+03	n	1.2E+04	n					2.5E+02	n		2.2E-01	
				2.0E-02	I					1	0.1		Bromoxynil Octanoate	1689-99-2	1.2E+03	n	1.2E+04	n					1.0E+02	n		8.7E-01	
3.4E+00	C	3.0E-05	I			2.0E-03	I	V		1		6.7E+02	Butadiene, 1,3-	106-99-0	5.4E-02	c*	2.6E-01	c*	8.1E-02	c*	4.1E-01	c*	1.6E-02	c		8.6E-06	
				1.0E-01	I					1	0.1		Butanol, N-	71-36-3	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.2E-01	
1.9E-03	P			2.0E-01	I					1	0.1		Butyl Benzyl Phthlate	85-68-7	2.6E+02	c*	9.1E+02	c					1.4E+01	c*		2.0E-01	
				2.0E+00	P	3.0E+01	P			1	0.1		Butyl alcohol, sec-	78-92-2	1.2E+05	nm	1.2E+06	nm	3.1E+04	n	1.3E+05	n	3.1E+04	n		6.3E+00	
				5.0E-02	I					1	0.1		Butylate	2008-41-5	3.1E+03	n	3.1E+04	n					3.4E+02	n		3.3E-01	
2.0E-04	C	5.7E-08	C							1	0.1		Butylated hydroxyanisole	25013-16-5	2.4E+03	c	8.6E+03	c	4.3E+01	c	2.2E+02	c	2.1E+02	c		3.9E-01	
				5.0E-02	P			V		1		1.1E+02	Butylbenzene, n-	104-51-8	3.9E+03	ns	5.1E+04	ns					7.8E+02	n		2.5E+00	
				1.0E+00	I					1	0.1		Butylphthalyl Butylglycolate	85-70-1	6.1E+04	n	6.2E+05	nm					1.0E+04	n		2.3E+02	
				2.0E-02	A					1	0.1		Cacodylic Acid	75-60-5	1.2E+03	n	1.2E+04	n					3.1E+02	n			
		1.8E-03	I	1.0E-03	I	2.0E-05	C			0.025	0.001		Cadmium (Diet)	7440-43-9	7.0E+01	n	8.0E+02	n									
		1.8E-03	I	5.0E-04	I	2.0E-05	C			0.05	0.001		Cadmium (Water)	7440-43-9					1.4E-03	c*	6.8E-03	c*	6.9E+00	n	5.0E+00	5.2E-01	3.8E-01
				5.0E-01	I					1	0.1		Caprolactam	105-60-2	3.1E+04	n	3.1E+05	nm					7.7E+03	n		1.9E+00	
1.5E-01	C	4.3E-05	C	2.0E-03	I					1	0.1		Captafol	2425-06-1	3.2E+00	c*	1.1E+01	c	5.7E-02	c	2.9E-01	c	3.5E-01	c*		6.1E-04	
2.3E-03	C	6.6E-07	C	1.3E-01	I					1	0.1		Captan	133-06-2	2.1E+02	c*	7.5E+02	c	3.7E+00	c	1.9E+01	c	2.7E+01	c*		1.9E-02	
				1.0E-01	I					1	0.1		Carbaryl	63-25-2	6.1E+03	n	6.2E+04	n					1.4E+03	n		1.3E+00	
				5.0E-03	I					1	0.1		Carbofuran	1563-66-2	3.1E+02	n	3.1E+03	n					7.3E+01	n	4.0E+01	2.8E-02	1.6E-02
				1.0E-01	I	7.0E-01	I	V		1		7.4E+02	Carbon Disulfide	75-15-0	8.2E+02	ns	3.7E+03	ns	7.3E+02	n	3.1E+03	n	7.2E+02	n		2.1E-01	
7.0E-02	I	6.0E-06	I	4.0E-03	I	1.0E-01	I	V		1		4.6E+02	Carbon Tetrachloride	56-23-5	6.1E-01	c	3.0E+00	c	4.1E-01	c	2.0E+00	c	3.9E-01	c	5.0E+00	1.5E-04	1.9E-03
				1.0E-02	I					1	0.1		Carbosulfan	55285-14-8	6.1E+02	n	6.2E+03	n					3.7E+01	n		9.0E-01	
				1.0E-01	I					1	0.1		Carboxin	5234-68-4	6.1E+03	n	6.2E+04	n					1.5E+03	n		8.0E-01	
						9.0E-04	I			1			Ceric oxide	1306-38-3	1.3E+06	nm	5.4E+06	nm	9.4E-01	n	3.9E+00	n					
				1.0E-01	I					1	0.1		Chloral Hydrate	302-17-0	6.1E+03	n	6.2E+04	n					1.5E+03	n		3.1E-01	
				1.5E-02	I					1	0.1		Chloramben	133-90-4	9.2E+02	n	9.2E+03	n					2.2E+02	n		5.5E-02	
4.0E-01	H									1	0.1		Chloranil	118-75-2	1.2E+00	c	4.3E+00	c					1.6E-01	c		1.3E-04	
3.5E-01	I	1.0E-04	I	5.0E-04	I	7.0E-04	I			1	0.04		Chlordane	12789-03-6	1.6E+00	c*	6.5E+00	c*	2.4E-02	c*	1.2E-01	c*	1.9E-01	c*	2.0E+00	1.3E-02	1.4E-01
1.0E+01	I	4.6E-03	C	3.0E-04	I					1	0.1		Chlordecone (Kepone)	143-50-0	4.9E-02	c	1.7E-01	c	5.3E-04	c	2.7E-03	c	3.0E-03	c		1.1E-04	
				7.0E-04	A					1	0.1		Chlorfenvinphos	470-90-6	4.3E+01	n	4.3E+02	n					8.6E+00	n		2.3E-02	
				2.0E-02	I					1	0.1		Chlorimuron, Ethyl-	90982-32-4	1.2E+03	n	1.2E+04	n					3.0E+02	n		1.0E-01	
				1.0E-01	I	1.5E-04	A			1			Chlorine	7782-50-5	7.5E+03	n	9.1E+04	n	1.5E-01	n	6.4E-01	n	1.6E+03	n		7.0E-01	
				3.0E-02	I	2.0E-04	I			1			Chlorine Dioxide	10049-04-4	2.3E+03	n	3.0E+04	n	2.1E-01	n	8.8E-01	n	4.7E+02	n			
				3.0E-02	I					1			Chlorite (Sodium Salt)	7758-19-2	2.3E+03	n	3.1E+04	n					4.7E+02	n	1.0E+03		
						5.0E+01	I	V		1		1.2E+03	Chloro-1,1-difluoroethane, 1-	75-68-3	5.8E+04	ns	2.4E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		5.2E+01	
		3.0E-04	I	2.0E-02	H	2.0E-02	I	V		1		7.5E+02	Chloro-1,3-butadiene, 2-	126-99-8	9.4E-03	c	4.7E-02	c	8.1E-03	c	4.1E-02	c	1.6E-02	c		8.5E-06	
4.6E-01	H									1	0.1		Chloro-2-methylaniline HCl, 4-	3165-93-3	1.1E+00	c	3.7E+00	c					1.5E-01	c		1.3E-04	
1.0E-01	P	7.7E-05	C	3.0E-03	X					1	0.1		Chloro-2-methylaniline, 4-	95-69-2	4.9E+00	c*	1.7E+01	c	3.2E-02	c	1.6E-01	c	6.0E-01	c*		3.4E-04	
2.7E-01	X							V		1	0.1	2.8E+04	Chloroacetaldehyde, 2-	107-20-0	1.8E+00	c	6.4E+00	c					2.5E-01	c		5.0E-05	
				2.0E-03	H					1	0.1		Chloroacetic Acid	79-11-8	1.2E+02	n	1.2E+03	n					3.1E+01	n	6.0E+01	6.3E-03	1.2E-02
						3.0E-05	I			1	0.1		Chloroacetophenone, 2-	532-27-4	4.3E+04	n	1.8E+05	nm	3.1E-02	n	1.3E-01	n					
2.0E-01	P			4.0E-03	I					1	0.1		Chloroaniline, p-	106-47-8	2.4E+00	c	8.6E+00	c					3.2E-01	c		1.3E-04	
				2.0E-02	I	5.0E-02	P	V		1		7.6E+02	Chlorobenzene	108-90-7	2.9E+02	n	1.4E+03	ns	5.2E+01	n	2.2E+02	n	7.2E+01	n	1.0E+02	4.9E-02	6.8E-02
1.1E-01	C	3.1E-05	C	2.0E-02	I					1	0.1		Chlorobenzilate	510-15-6	4.4E+00	c	1.6E+01	c	7.8E-02	c	4.0E-01	c	2.7E-01	c		8.8E-04	
				3.0E-02	X					1	0.1		Chlorobenzoic Acid, p-	74-11-3	1.8E+03	n	1.8E+04	n					3.9E+02	n		9.9E-02	
				3.0E-03	P	3.0E-01	P	V		1		1.2E+02	Chlorobenzotrifluoride, 4-	98-56-6	2.1E+02	ns	2.3E+03	ns	3.1E+02	n	1.3E+03	n	2.6E+01	n		9.3E-02	
				4.0E-02	P			V		1		7.3E+02	Chlorobutane, 1-	109-69-3	3.1E+03	ns	4.1E+04	ns					4.8E+02	n		2.0E-01	
						5.0E+01	I	V		1		1.7E+03	Chlorodifluoromethane	75-45-6	5.3E+04	ns	2.2E+05	nms	5.2E+04	n	2.2E+05	n	1.0E+05	n		4.3E+01	
				2.0E-02	P				M	1	0.1		Chloroethanol, 2-	107-07-3	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.3E-02	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V		1		2.5E+03	Chloroform	67-66-3	2.9E-01	c	1.5E+00	c	1.1E-01	c	5.3E-01	c	1.9E-01	c	8.0E+01(F)	5.3E-05	2.2E-02
						9.0E-02	I	V		1		1.3E+03	Chloromethane	74-87-3	1.2E+02	n	5.0E+02	n	9.4E+01	n	3.9E+02	n	1.9E+02	n		4.9E-02	
2.4E+00	C	6.9E-04	C					V		1		2.6E+04	Chloromethyl Methyl Ether	107-30-2	1.9E-02	c	9.4E-02	c	3.5E-03	c	1.8E-02	c	5.6E-03	c		1.2E-06	
				8.0E-02	I			V		1			Chloronaphthalene, Beta-	91-58-7	6.3E+03	n	8.2E+04	n					5.5E+02	n		2.9E+00	
3.0E-01	P			3.0E-03	P	1.0E-05	X			1	0.1		Chloronitrobenzene, o-	88-73-3	1.6E+00	c	5.7E+00	c	1.0E-02	n	4.4E-02	n	2.0E-01	c		1.9E-04	
6.3E-03	P			1.0E-03	P	6.0E-04	P			1	0.1		Chloronitrobenzene, p-	100-00-5	6.1E+01	n	2.7E+02	c**	6.3E-01	n	2.6E+00	n	9.4E+00	c**		8.7E-03	
				5.0E-03	I			V		1		2.2E+04	Chlorophenol, 2-	95-57-8	3.9E+02	n	5.1E+03	n					7.1E+01	n		5.7E-02	
						4.0E-04	C	V		1		6.2E+02	Chloropicrin	76-06-2	2.1E+00	n	8.8E+00	n	4.2E-01	n	1.8E+00	n	8.3E-01	n		2.5E-04	
3.1E-03	C	8.9E-07	C	1.5E-02	I					1	0.1		Chlorothalonil	1897-45-6	1.6E+02	c**	5.6E+02	c*	2.7E+00	c	1.4E+01	c	1.9E+01	c*		4.3E-02	
				2.0E-02	I			V		1		9.1E+02	Chlorotoluene, o-	95-49-8	1.6E+03	ns	2.0E+04	ns					1.8E+02	n		1.7E-01	
				2.0E-02	X			V		1		2.5E+02	Chlorotoluene, p-	106-43-4	1.6E+03	ns	2.0E+04	ns					1.9E+02	n		1.8E-01	
2.4E+02	C	6.9E-02	C							1	0.1		Chlorozotocin	54749-90-5	2.0E-03	c	7.2E-03	c	3.5E-05	c	1.8E-04	c	2.8E-04	c		6.2E-08	
				2.0E-01	I					1	0.1		Chlorpropham	101-21-3	1.2E+04	n	1.2E+05	nm					2.2E+03	n		1.9E+00	
				1.0E-03	A					1	0.1		Chlorpyrifos	2921-88-2	6.1E+01	n	6.2E+02	n					6.2E+00	n		9.2E-02	
				1.0E-02	H					1	0.1		Chlorpyrifos Methyl	5598-13-0	6.1E+02	n	6.2E+03	n					8.9E+01	n		4.1E-01	
				5.0E-02	I					1	0.1		Chlorsulfuron	64902-72-3	3.1E+03	n	3.1E+04	n					7.7E+02	n		6.5E-01	
				8.0E-04	H					1	0.1		Chlorthiophos	60238-56-4	4.9E+01	n	4.9E+02	n					2.0E+00	n		5.2E-02	
				1.5E+00	I					0.013			Chromium(III), Insoluble Salts	16065-83-1	1.2E+05	nm	1.5E+06	nm					1.6E+04	n		2.8E+07	
5.0E-01	J	8.4E-02	S	3.0E-03	I	1.0E-04	I		M	0.025			Chromium(VI)	18540-29-9	2.9E-01	c	5.6E+00	c	1.1E-05	c	1.5E-04	c	3.1E-02	c		5.9E-04	
										0.013			Chromium, Total	7440-47-3											1.0E+02		1.8E+05
		9.0E-03	P	3.0E-04	P	6.0E-06	P			1			Cobalt	7440-48-4	2.3E+01	n	3.0E+02	n	2.7E-04	c*	1.4E-03	c*	4.7E+00	n		2.1E-01	
		6.2E-04	I						M	1	0.1		Coke Oven Emissions	8007-45-2					1.5E-03	c	2.0E-02	c					
				4.0E-02	H					1			Copper	7440-50-8	3.1E+03	n	4.1E+04	n					6.2E+02	n	1.3E+03	2.2E+01	4.6E+01
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, m-	108-39-4	3.1E+03	n	3.1E+04	n	6.3E+02	n	2.6E+03	n	7.2E+02	n		5.7E-01	
				5.0E-02	I	6.0E-01	C			1	0.1		Cresol, o-	95-48-7	3.1E+03	n	3.1E+04	n	6.3E+02	n	2.6E+03	n	7.2E+02	n		5.8E-01	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresol, p-	106-44-5	6.1E+03	n	6.2E+04	n	6.3E+02	n	2.6E+03	n	1.4E+03	n		1.1E+00	
				1.0E-01	A					1	0.1		Cresol, p-chloro-m-	59-50-7	6.1E+03	n	6.2E+04	n					1.1E+03	n		1.3E+00	
				1.0E-01	A	6.0E-01	C			1	0.1		Cresols	1319-77-3	6.1E+03	n	6.2E+04	n	6.3E+02	n	2.6E+03	n	1.4E+03	n		1.2E+00	
1.9E+00	H			1.0E-03	P			V		1		1.7E+04	Crotonaldehyde, trans-	123-73-9	3.4E-01	c	1.5E+00	c					3.5E-02	c		7.1E-06	
				1.0E-01	I	4.0E-01	I	V		1		2.7E+02	Cumene	98-82-8	2.1E+03	ns	1.1E+04	ns	4.2E+02	n	1.8E+03	n	3.9E+02	n		6.4E-01	
2.2E-01	C	6.3E-05	C							1	0.1		Cupferron	135-20-6	2.2E+00	c	7.8E+00	c	3.9E-02	c	1.9E-01	c	3.1E-01	c		5.3E-04	
8.4E-01	H			2.0E-03	H					1	0.1		Cyanazine	21725-46-2	5.8E-01	c	2.1E+00	c					7.6E-02	c		3.5E-05	
													Cyanides														
				1.0E-03	I					1			~Calcium Cyanide	592-01-8	7.8E+01	n	1.0E+03	n					1.6E+01	n			
				5.0E-03	I					1			~Copper Cyanide	544-92-3	3.9E+02	n	5.1E+03	n					7.8E+01	n			
				6.0E-04	I	8.0E-04	S	V		1		1.0E+07	~Cyanide (CN-)	57-12-5	2.2E+01	n	1.4E+02	n	8.3E-01	n	3.5E+00	n	1.4E+00	n	2.0E+02	1.4E-02	2.0E+00
				1.0E-03	I			V		1			~Cyanogen	460-19-5	7.8E+01	n	1.0E+03	n					1.6E+01	n			
				9.0E-02	I			V		1			~Cyanogen Bromide	506-68-3	7.0E+03	n	9.2E+04	n					1.4E+03	n			
				5.0E-02	I			V		1			~Cyanogen Chloride	506-77-4	3.9E+03	n	5.1E+04	n					7.8E+02	n			
				6.0E-04	I	8.0E-04	I	V		1		1.0E+07	~Hydrogen Cyanide	74-90-8	2.3E+01	n	1.5E+02	n	8.3E-01	n	3.5E+00	n	1.4E+00	n		1.4E-02	
				2.0E-03	I					1			~Potassium Cyanide	151-50-8	1.6E+02	n	2.0E+03	n					3.1E+01	n			
				5.0E-03	I					0.04			~Potassium Silver Cyanide	506-61-6	3.9E+02	n	5.1E+03	n					5.9E+01	n			
				1.0E-01	I					0.04			~Silver Cyanide	506-64-9	7.8E+03	n	1.0E+05	nm					1.3E+03	n			
				1.0E-03	I					1			~Sodium Cyanide	143-33-9	7.8E+01	n	1.0E+03	n					1.6E+01	n	2.0E+02		
				2.0E-04	X					1			~Thiocyanate	463-56-9	1.6E+01	n	2.0E+02	n					3.1E+00	n			
				5.0E-02	I					1			~Zinc Cyanide	557-21-1	3.9E+03	n	5.1E+04	n					7.8E+02	n			
						6.0E+00	I	V		1		1.2E+02	Cyclohexane	110-82-7	7.0E+03	ns	2.9E+04	ns	6.3E+03	n	2.6E+04	n	1.3E+04	n		1.3E+01	
2.3E-02	H									1	0.1		Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3	2.1E+01	c	7.5E+01	c					2.1E+00	c		1.2E-02	
				5.0E+00	I	7.0E-01	P			1	0.1		Cyclohexanone	108-94-1	3.1E+05	nm	3.1E+06	nm	7.3E+02	n	3.1E+03	n	7.7E+04	n		1.8E+01	
				5.0E-03	P	1.0E+00	X	V		1		2.8E+02	Cyclohexene	110-83-8	3.1E+02	ns	2.8E+03	ns	1.0E+03	n	4.4E+03	n	5.3E+01	n		3.5E-02	
				2.0E-01	I					1	0.1		Cyclohexylamine	108-91-8	1.2E+04	n	1.2E+05	nm					3.0E+03	n		7.9E-01	
				5.0E-03	I					1	0.1		Cyhalothrin/karate	68085-85-8	3.1E+02	n	3.1E+03	n					7.8E+01	n		5.3E+01	
				1.0E-02	I					1	0.1		Cypermethrin	52315-07-8	6.1E+02	n	6.2E+03	n					1.6E+02	n		2.5E+01	
				7.5E-03	I					1	0.1		Cyromazine	66215-27-8	4.6E+02	n	4.6E+03	n					1.2E+02	n		3.0E-02	
2.4E-01	I	6.9E-05	C							1	0.1		DDD	72-54-8	2.0E+00	c	7.2E+00	c	3.5E-02	c	1.8E-01	c	2.7E-02	c		6.4E-03	
3.4E-01	I	9.7E-05	C							1	0.1		DDE, p,p'-	72-55-9	1.4E+00	c	5.1E+00	c	2.5E-02	c	1.3E-01	c	2.0E-01	c		4.6E-02	
3.4E-01	I	9.7E-05	I	5.0E-04	I					1	0.03		DDT	50-29-3	1.7E+00	c*	7.0E+00	c*	2.5E-02	c	1.3E-01	c	2.0E-01	c*		6.7E-02	
				1.0E-02	I					1	0.1		Dacthal	1861-32-1	6.1E+02	n	6.2E+03	n					9.3E+01	n		1.1E-01	
				3.0E-02	I					1	0.1		Dalapon	75-99-0	1.8E+03	n	1.8E+04	n					4.6E+02	n	2.0E+02	9.6E-02	4.1E-02
7.0E-04	I			7.0E-03	I					1	0.1		Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5	4.3E+02	n	2.5E+03	c**					9.6E+01	c**		5.3E+01	
				4.0E-05	I					1	0.1		Demeton	8065-48-3	2.4E+00	n	2.5E+01	n					5.2E-01	n			
1.2E-03	I			6.0E-01	I					1	0.1		Di(2-ethylhexyl)adipate	103-23-1	4.1E+02	c*	1.4E+03	c					5.6E+01	c	4.0E+02	4.0E+00	2.9E+01
6.1E-02	H									1	0.1		Diallate	2303-16-4	8.0E+00	c	2.8E+01	c					4.6E-01	c		6.8E-04	
				7.0E-04	A					1	0.1		Diazinon	333-41-5	4.3E+01	n	4.3E+02	n					7.9E+00	n		4.9E-02	
8.0E-01	P	6.0E-03	P	2.0E-04	P	2.0E-04	I	V	M	1		9.8E+02	Dibromo-3-chloropropane, 1,2-	96-12-8	5.4E-03	c	6.9E-02	c	1.6E-04	c	2.0E-03	c	3.2E-04	c	2.0E-01	1.4E-07	8.6E-05
				1.0E-02	I					1	0.1		Dibromobenzene, 1,4-	106-37-6	6.1E+02	n	6.2E+03	n					9.8E+01	n		9.3E-02	
8.4E-02	I	2.7E-05	C	2.0E-02	I			V		1	0.1	8.0E+02	Dibromochloromethane	124-48-1	6.8E-01	c	3.3E+00	c	9.0E-02	c	4.5E-01	c	1.5E-01	c	8.0E+01(F)	3.9E-05	2.1E-02

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
2.0E+00	I	6.0E-04	I	9.0E-03	I	9.0E-03	I	V		1		1.3E+03	Dibromoethane, 1,2-	106-93-4	3.4E-02	c	1.7E-01	c	4.1E-03	c	2.0E-02	c	6.5E-03	c	5.0E-02	1.8E-06	1.4E-05
				1.0E-02	H	4.0E-03	X	V		1		2.8E+03	Dibromomethane (Methylene Bromide)	74-95-3	2.5E+01	n	1.1E+02	n	4.2E+00	n	1.8E+01	n	7.9E+00	n		1.9E-03	
				1.0E-01	I					1	0.1		Dibutyl Phthalate	84-74-2	6.1E+03	n	6.2E+04	n					6.7E+02	n		1.7E+00	
				3.0E-04	P					1	0.1		Dibutyltin Compounds	NA	1.8E+01	n	1.8E+02	n					4.7E+00	n			
				3.0E-02	I					1	0.1		Dicamba	1918-00-9	1.8E+03	n	1.8E+04	n					4.4E+02	n		1.1E-01	
		4.2E-03	P					V		1		5.2E+02	Dichloro-2-butene, 1,4-	764-41-0	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
		4.2E-03	P					V		1	0.1	5.2E+02	Dichloro-2-butene, cis-1,4-	1476-11-5	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
		4.2E-03	P					V		1	0.1	7.6E+02	Dichloro-2-butene, trans-1,4-	110-57-6	6.9E-03	c	3.5E-02	c	5.8E-04	c	2.9E-03	c	1.2E-03	c		5.4E-07	
5.0E-02	I			4.0E-03	I					1	0.1		Dichloroacetic Acid	79-43-6	9.7E+00	c*	3.4E+01	c*					1.3E+00	c*	6.0E+01	2.7E-04	1.2E-02
				9.0E-02	I	2.0E-01	H	V		1		3.8E+02	Dichlorobenzene, 1,2-	95-50-1	1.9E+03	ns	9.8E+03	ns	2.1E+02	n	8.8E+02	n	2.8E+02	n	6.0E+02	2.7E-01	5.8E-01
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V		1			Dichlorobenzene, 1,4-	106-46-7	2.4E+00	c	1.2E+01	c	2.2E-01	c	1.1E+00	c	4.2E-01	c	7.5E+01	4.0E-04	7.2E-02
4.5E-01	I	3.4E-04	C							1	0.1		Dichlorobenzidine, 3,3'-	91-94-1	1.1E+00	c	3.8E+00	c	7.2E-03	c	3.6E-02	c	1.1E-01	c		7.1E-04	
				9.0E-03	X					1	0.1		Dichlorobenzophenone, 4,4'-	90-98-2	5.5E+02	n	5.5E+03	n					5.7E+01	n		3.5E-01	
				2.0E-01	I	1.0E-01	X	V		1		8.5E+02	Dichlorodifluoromethane	75-71-8	9.4E+01	n	4.0E+02	n	1.0E+02	n	4.4E+02	n	1.9E+02	n		3.0E-01	
5.7E-03	C	1.6E-06	C	2.0E-01	P			V		1		1.7E+03	Dichloroethane, 1,1-	75-34-3	3.3E+00	c	1.7E+01	c	1.5E+00	c	7.7E+00	c	2.4E+00	c		6.8E-04	
9.1E-02	I	2.6E-05	I	6.0E-03	X	7.0E-03	P	V		1		3.0E+03	Dichloroethane, 1,2-	107-06-2	4.3E-01	c*	2.2E+00	c*	9.4E-02	c*	4.7E-01	c*	1.5E-01	c*	5.0E+00	4.2E-05	1.4E-03
				5.0E-02	I	2.0E-01	I	V		1		1.2E+03	Dichloroethylene, 1,1-	75-35-4	2.4E+02	n	1.1E+03	n	2.1E+02	n	8.8E+02	n	2.6E+02	n	7.0E+00	9.3E-02	2.5E-03
				9.0E-03	H			V		1		1.3E+03	Dichloroethylene, 1,2- (Mixed Isomers)	540-59-0	7.0E+02	n	9.2E+03	ns					1.3E+02	n		3.7E-02	
				2.0E-03	I			V		1		2.4E+03	Dichloroethylene, 1,2-cis-	156-59-2	1.6E+02	n	2.0E+03	n					2.8E+01	n	7.0E+01	8.2E-03	2.1E-02
				2.0E-02	I	6.0E-02	P	V		1		1.7E+03	Dichloroethylene, 1,2-trans-	156-60-5	1.5E+02	n	6.9E+02	n	6.3E+01	n	2.6E+02	n	8.6E+01	n	1.0E+02	2.5E-02	2.9E-02
				3.0E-03	I					1	0.1		Dichlorophenol, 2,4-	120-83-2	1.8E+02	n	1.8E+03	n					3.5E+01	n		4.1E-02	
				1.0E-02	I					1	0.05		Dichlorophenoxy Acetic Acid, 2,4-	94-75-7	6.9E+02	n	7.7E+03	n					1.3E+02	n	7.0E+01	3.5E-02	1.8E-02
				8.0E-03	I					1	0.1		Dichlorophenoxy)butyric Acid, 4-(2,4-	94-82-6	4.9E+02	n	4.9E+03	n					9.1E+01	n		3.6E-02	
3.6E-02	C	1.0E-05	C	9.0E-02	A	4.0E-03	I	V		1		1.4E+03	Dichloropropane, 1,2-	78-87-5	9.4E-01	c*	4.7E+00	c*	2.4E-01	c*	1.2E+00	c*	3.8E-01	c*	5.0E+00	1.3E-04	1.7E-03
				2.0E-02	P			V		1		1.5E+03	Dichloropropane, 1,3-	142-28-9	1.6E+03	ns	2.0E+04	ns					2.9E+02	n		9.9E-02	
				3.0E-03	I					1	0.1		Dichloropropanol, 2,3-	616-23-9	1.8E+02	n	1.8E+03	n					4.6E+01	n		9.8E-03	
1.0E-01	I	4.0E-06	I	3.0E-02	I	2.0E-02	I	V		1		1.6E+03	Dichloropropene, 1,3-	542-75-6	1.7E+00	c*	8.3E+00	c*	6.1E-01	c*	3.1E+00	c*	4.1E-01	c*		1.5E-04	
2.9E-01	I	8.3E-05	C	5.0E-04	I	5.0E-04	I			1	0.1		Dichlorvos	62-73-7	1.7E+00	c*	5.9E+00	c*	2.9E-02	c*	1.5E-01	c*	2.3E-01	c*		7.0E-05	
				8.0E-03	P	7.0E-03	P	V		1			Dicyclopentadiene	77-73-6	3.1E+01	n	1.3E+02	n	7.3E+00	n	3.1E+01	n	1.2E+01	n		4.3E-02	
1.6E+01	I	4.6E-03	I	5.0E-05	I					1	0.1		Dieldrin	60-57-1	3.0E-02	c	1.1E-01	c	5.3E-04	c	2.7E-03	c	1.5E-03	c		6.1E-05	
		3.0E-04	C			5.0E-03	I			1	0.1		Diesel Engine Exhaust	NA					8.1E-03	c	4.1E-02	c					
				2.0E-03	P	2.0E-04	P			1	0.1		Diethanolamine	111-42-2	1.2E+02	n	1.2E+03	n	2.1E-01	n	8.8E-01	n	3.1E+01	n		6.3E-03	
				8.0E-01	I					1	0.1		Diethyl Phthalate	84-66-2	4.9E+04	n	4.9E+05	nm					1.1E+04	n		4.7E+00	
				3.0E-02	P	1.0E-04	P			1	0.1		Diethylene Glycol Monobutyl Ether	112-34-5	1.8E+03	n	1.8E+04	n	1.0E-01	n	4.4E-01	n	4.7E+02	n		1.0E-01	
				6.0E-02	P	3.0E-04	P			1	0.1		Diethylene Glycol Monoethyl Ether	111-90-0	3.6E+03	n	3.6E+04	n	3.1E-01	n	1.3E+00	n	9.4E+02	n		1.9E-01	
				1.0E-03	P					1	0.1		Diethylformamide	617-84-5	6.1E+01	n	6.2E+02	n					1.6E+01	n		3.2E-03	
3.5E+02	C	1.0E-01	C							1	0.1		Diethylstilbestrol	56-53-1	1.4E-03	c	4.9E-03	c	2.4E-05	c	1.2E-04	c	4.3E-05	c		2.4E-05	
				8.0E-02	I					1	0.1		Difenzoquat	43222-48-6	4.9E+03	n	4.9E+04	n					1.2E+03	n			
				2.0E-02	I					1	0.1		Diflubenzuron	35367-38-5	1.2E+03	n	1.2E+04	n					2.2E+02	n		2.5E-01	
						4.0E+01	I	V		1		1.4E+03	Difluoroethane, 1,1-	75-37-6	5.2E+04	ns	2.2E+05	nms	4.2E+04	n	1.8E+05	n	8.3E+04	n		2.8E+01	
4.4E-02	C	1.3E-05	C					V		1	0.1		Dihydrosafrole	94-58-6	2.4E-01	c	1.2E+00	c	1.9E-01	c	9.4E-01	c	2.6E-01	c		3.2E-04	
						7.0E-01	P	V		1		2.3E+03	Diisopropyl Ether	108-20-3	2.4E+03	ns	1.0E+04	ns	7.3E+02	n	3.1E+03	n	1.5E+03	n		3.7E-01	
				8.0E-02	I			V		1		5.3E+02	Diisopropyl Methylphosphonate	1445-75-6	6.3E+03	ns	8.2E+04	ns					1.2E+03	n		3.5E-01	
				2.0E-02	I					1	0.1		Dimethipin	55290-64-7	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.9E-02	
				2.0E-04	I					1	0.1		Dimethoate	60-51-5	1.2E+01	n	1.2E+02	n					3.1E+00	n		7.0E-04	
1.4E-02	H									1	0.1		Dimethoxybenzidine, 3,3'-	119-90-4	3.5E+01	c	1.2E+02	c					4.7E+00	c		5.7E-03	
1.7E-03	P			6.0E-02	P					1	0.1		Dimethyl methylphosphonate	756-79-6	2.9E+02	c*	1.0E+03	c*					3.9E+01	c*		8.3E-03	
4.6E+00	C	1.3E-03	C							1	0.1		Dimethylamino azobenzene [p-]	60-11-7	1.1E-01	c	3.7E-01	c	1.9E-03	c	9.4E-03	c	4.3E-03	c		1.8E-05	
5.8E-01	H									1	0.1		Dimethylaniline HCl, 2,4-	21436-96-4	8.4E-01	c	3.0E+00	c					1.2E-01	c		1.0E-04	
2.0E-01	P			2.0E-03	X					1	0.1		Dimethylaniline, 2,4-	95-68-1	2.4E+00	c*	8.6E+00	c					3.2E-01	c*		1.8E-04	
				2.0E-03	I			V		1		8.3E+02	Dimethylaniline, N,N-	121-69-7	1.6E+02	n	2.0E+03	ns					2.7E+01	n		9.8E-03	
1.1E+01	P									1	0.1		Dimethylbenzidine, 3,3'-	119-93-7	4.4E-02	c	1.6E-01	c					5.6E-03	c		3.7E-05	
				1.0E-01	P	3.0E-02	I			1	0.1		Dimethylformamide	68-12-2	6.1E+03	n	6.2E+04	n	3.1E+01	n	1.3E+02	n	1.6E+03	n		3.2E-01	
				1.0E-04	X	2.0E-06	X			1	0.1		Dimethylhydrazine, 1,1-	57-14-7	6.1E+00	n	6.1E+01	n	2.1E-03	n	8.8E-03	n	1.6E+00	n		3.5E-04	
5.5E+02	C	1.6E-01	C							1	0.1		Dimethylhydrazine, 1,2-	540-73-8	8.8E-04	c	3.1E-03	c	1.5E-05	c	7.7E-05	c	1.2E-04	c		2.8E-08	
				2.0E-02	I					1	0.1		Dimethylphenol, 2,4-	105-67-9	1.2E+03	n	1.2E+04	n					2.7E+02	n		3.2E-01	
				6.0E-04	I					1	0.1		Dimethylphenol, 2,6-	576-26-1	3.7E+01	n	3.7E+02	n					8.1E+00	n		9.8E-03	
				1.0E-03	I					1	0.1		Dimethylphenol, 3,4-	95-65-8	6.1E+01	n	6.2E+02	n					1.4E+01	n		1.6E-02	
				1.0E-01	I			V		1			Dimethylterephthalate	120-61-6	7.8E+03	n	1.0E+05	nm					1.4E+03	n		3.8E-01	
4.5E-02	C	1.3E-05	C					V		1	0.1	1.1E+03	Dimethylvinylchloride	513-37-1	2.0E-01	c	1.0E+00	c	1.9E-01	c	9.4E-01	c	2.8E-01	c		1.8E-04	
				8.0E-05	X					1	0.1		Dinitro-o-cresol, 4,6-	534-52-1	4.9E+00	n	4.9E+01	n					1.2E+00	n		2.0E-03	
				2.0E-03	I					1	0.1		Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5	1.2E+02	n	1.2E+03	n					1.7E+01	n		5.7E-01	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,2-	528-29-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				1.0E-04	I					1	0.1		Dinitrobenzene, 1,3-	99-65-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				1.0E-04	P					1	0.1		Dinitrobenzene, 1,4-	100-25-4	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.4E-03	
				2.0E-03	I					1	0.1		Dinitrophenol, 2,4-	51-28-5	1.2E+02	n	1.2E+03	n					3.0E+01	n		3.4E-02	
6.8E-01	I									1	0.1		Dinitrotoluene Mixture, 2,4/2,6-	25321-14-6	7.2E-01	c	2.5E+00	c					9.2E-02	c		1.3E-04	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
3.1E-01	C	8.9E-05	C	2.0E-03	I					1	0.102		Dinitrotoluene, 2,4-	121-14-2	1.6E+00	c*	5.5E+00	c	2.7E-02	c	1.4E-01	c	2.0E-01	c		2.8E-04	
				1.0E-03	P					1	0.099		Dinitrotoluene, 2,6-	606-20-2	6.1E+01	n	6.2E+02	n					1.5E+01	n		2.0E-02	
				2.0E-03	S					1	0.006		Dinitrotoluene, 2-Amino-4,6-	35572-78-2	1.5E+02	n	2.0E+03	n					3.0E+01	n		2.3E-02	
				2.0E-03	S					1	0.009		Dinitrotoluene, 4-Amino-2,6-	19406-51-0	1.5E+02	n	1.9E+03	n					3.0E+01	n		2.3E-02	
				1.0E-03	I					1	0.1		Dinoseb	88-85-7	6.1E+01	n	6.2E+02	n					1.1E+01	n	7.0E+00	9.8E-02	6.2E-02
1.0E-01	I	7.7E-06	C	3.0E-02	I	3.0E+00	C			1	0.1		Dioxane, 1,4-	123-91-1	4.9E+00	c	1.7E+01	c	3.2E-01	c	1.6E+00	c	6.7E-01	c		1.4E-04	
													Dioxins														
6.2E+03	I	1.3E+00	I							1	0.03		~Hexachlorodibenzo-p-dioxin, Mixture	NA	9.4E-05	c	3.9E-04	c	1.9E-06	c	9.4E-06	c	1.1E-05	c		1.5E-05	
1.3E+05	C	3.8E+01	C	7.0E-10	I	4.0E-08	C			1	0.03		~TCDD, 2,3,7,8-	1746-01-6	4.5E-06	c*	1.8E-05	c*	6.4E-08	c	3.2E-07	c	5.2E-07	c*	3.0E-05	2.6E-07	1.5E-05
				3.0E-02	I					1	0.1		Diphenamid	957-51-7	1.8E+03	n	1.8E+04	n					4.1E+02	n		4.0E+00	
				8.0E-04	X					1	0.1		Diphenyl Sulfone	127-63-9	4.9E+01	n	4.9E+02	n					1.1E+01	n		2.8E-02	
				2.5E-02	I					1	0.1		Diphenylamine	122-39-4	1.5E+03	n	1.5E+04	n					2.4E+02	n		4.4E-01	
8.0E-01	I	2.2E-04	I							1	0.1		Diphenylhydrazine, 1,2-	122-66-7	6.1E-01	c	2.2E+00	c	1.1E-02	c	5.6E-02	c	6.7E-02	c		2.2E-04	
				2.2E-03	I					1	0.1		Diquat	85-00-7	1.3E+02	n	1.4E+03	n					3.4E+01	n	2.0E+01	6.5E-01	3.7E-01
7.4E+00	C	2.1E-03	C							1	0.1		Direct Black 38	1937-37-7	6.6E-02	c	2.3E-01	c	1.2E-03	c	5.8E-03	c	9.1E-03	c		4.4E+00	
7.4E+00	C	2.1E-03	C							1	0.1		Direct Blue 6	2602-46-2	6.6E-02	c	2.3E-01	c	1.2E-03	c	5.8E-03	c	9.1E-03	c		1.4E+01	
6.7E+00	C	1.9E-03	C							1	0.1		Direct Brown 95	16071-86-6	7.3E-02	c	2.6E-01	c	1.3E-03	c	6.5E-03	c	1.0E-02	c			
				4.0E-05	I					1	0.1		Disulfoton	298-04-4	2.4E+00	n	2.5E+01	n					3.8E-01	n		7.1E-04	
				1.0E-02	I			V		1	0.1		Dithiane, 1,4-	505-29-3	6.1E+02	n	6.2E+03	n					1.5E+02	n		7.6E-02	
				2.0E-03	I					1	0.1		Diuron	330-54-1	1.2E+02	n	1.2E+03	n					2.8E+01	n		1.2E-02	
				4.0E-03	I					1	0.1		Dodine	2439-10-3	2.4E+02	n	2.5E+03	n					6.2E+01	n		3.2E-01	
				2.5E-02	I			V		1			EPTC	759-94-4	2.0E+03	n	2.6E+04	n					2.9E+02	n		1.5E-01	
				6.0E-03	I					1	0.1		Endosulfan	115-29-7	3.7E+02	n	3.7E+03	n					7.8E+01	n		1.1E+00	
				2.0E-02	I					1	0.1		Endothall	145-73-3	1.2E+03	n	1.2E+04	n					3.0E+02	n	1.0E+02	7.1E-02	2.4E-02
				3.0E-04	I					1	0.1		Endrin	72-20-8	1.8E+01	n	1.8E+02	n					1.7E+00	n	2.0E+00	6.8E-02	8.1E-02
9.9E-03	I	1.2E-06	I	6.0E-03	P	1.0E-03	I	V		1		1.1E+04	Epichlorohydrin	106-89-8	2.0E+01	n	8.8E+01	n	1.0E+00	n	4.4E+00	n	2.0E+00	n		4.5E-04	
						2.0E-02	I	V		1		1.5E+04	Epoxybutane, 1,2-	106-88-7	1.7E+02	n	7.2E+02	n	2.1E+01	n	8.8E+01	n	4.2E+01	n		9.2E-03	
				5.0E-03	I					1	0.1		Ethephon	16672-87-0	3.1E+02	n	3.1E+03	n					7.8E+01	n		1.6E-02	
				5.0E-04	I					1	0.1		Ethion	563-12-2	3.1E+01	n	3.1E+02	n					3.2E+00	n		6.3E-03	
				1.0E-01	P	6.0E-02	P			1	0.1		Ethoxyethanol Acetate, 2-	111-15-9	6.1E+03	n	6.2E+04	n	6.3E+01	n	2.6E+02	n	1.5E+03	n		3.2E-01	
				4.0E-01	H	2.0E-01	I			1	0.1		Ethoxyethanol, 2-	110-80-5	2.4E+04	n	2.5E+05	nm	2.1E+02	n	8.8E+02	n	6.2E+03	n		1.3E+00	
				9.0E-01	I			V		1		1.1E+04	Ethyl Acetate	141-78-6	7.0E+04	ns	9.2E+05	nms					1.4E+04	n		2.9E+00	
4.8E-02	H							V		1		2.5E+03	Ethyl Acrylate	140-88-5	1.3E+01	c	6.0E+01	c					1.4E+00	c		3.0E-04	
						1.0E+01	I	V		1		2.1E+03	Ethyl Chloride	75-00-3	1.5E+04	ns	6.1E+04	ns	1.0E+04	n	4.4E+04	n	2.1E+04	n		5.9E+00	
				2.0E-01	I			V		1		1.0E+04	Ethyl Ether	60-29-7	1.6E+04	ns	2.0E+05	nms					3.1E+03	n		6.8E-01	
				9.0E-02	H	3.0E-01	P	V		1		1.1E+03	Ethyl Methacrylate	97-63-2	1.5E+03	ns	7.5E+03	ns	3.1E+02	n	1.3E+03	n	4.2E+02	n		9.9E-02	
				1.0E-05	I					1	0.1		Ethyl-p-nitrophenyl Phosphonate	2104-64-5	6.1E-01	n	6.2E+00	n					6.6E-02	n		2.1E-03	
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V		1		4.8E+02	Ethylbenzene	100-41-4	5.4E+00	c	2.7E+01	c	9.7E-01	c	4.9E+00	c	1.3E+00	c	7.0E+02	1.5E-03	7.8E-01
				7.0E-02	P					1	0.1		Ethylene Cyanohydrin	109-78-4	4.3E+03	n	4.3E+04	n					1.1E+03	n		2.2E-01	
				9.0E-02	P					1	0.1		Ethylene Diamine	107-15-3	5.5E+03	n	5.5E+04	n					1.4E+03	n		3.2E-01	
				2.0E+00	I	4.0E-01	C			1	0.1		Ethylene Glycol	107-21-1	1.2E+05	nm	1.2E+06	nm	4.2E+02	n	1.8E+03	n	3.1E+04	n		6.3E+00	
				1.0E-01	I	1.6E+00	I			1	0.1		Ethylene Glycol Monobutyl Ether	111-76-2	6.1E+03	n	6.2E+04	n	1.7E+03	n	7.0E+03	n	1.5E+03	n		3.2E-01	
3.1E-01	C	8.8E-05	C			3.0E-02	C	V		1		1.2E+05	Ethylene Oxide	75-21-8	1.7E-01	c	8.3E-01	c	2.8E-02	c	1.4E-01	c	4.4E-02	c		9.1E-06	
4.5E-02	C	1.3E-05	C	8.0E-05	I					1	0.1		Ethylene Thiourea	96-45-7	4.9E+00	n	3.8E+01	c**	1.9E-01	c	9.4E-01	c	1.2E+00	n		2.8E-04	
6.5E+01	C	1.9E-02	C					V		1	0.1	1.5E+05	Ethyleneimine	151-56-4	2.3E-03	c	1.0E-02	c	1.3E-04	c	6.5E-04	c	2.1E-04	c		4.5E-08	
				3.0E+00	I					1	0.1		Ethylphthalyl Ethyl Glycolate	84-72-0	1.8E+05	nm	1.8E+06	nm					4.5E+04	n		1.0E+02	
				8.0E-03	I					1	0.1		Express	101200-48-0	4.9E+02	n	4.9E+03	n					1.2E+02	n		4.7E-02	
				2.5E-04	I					1	0.1		Fenamiphos	22224-92-6	1.5E+01	n	1.5E+02	n					3.4E+00	n		3.3E-03	
				2.5E-02	I					1	0.1		Fenpropathrin	39515-41-8	1.5E+03	n	1.5E+04	n					4.6E+01	n		2.1E+00	
				1.3E-02	I					1	0.1		Fluometuron	2164-17-2	7.9E+02	n	8.0E+03	n					1.9E+02	n		1.4E-01	
				4.0E-02	C	1.3E-02	C			1			Fluoride	16984-48-8	3.1E+03	n	4.1E+04	n	1.4E+01	n	5.7E+01	n	6.2E+02	n		9.3E+01	
				6.0E-02	I	1.3E-02	C			1			Fluorine (Soluble Fluoride)	7782-41-4	4.7E+03	n	6.1E+04	n	1.4E+01	n	5.7E+01	n	9.3E+02	n	4.0E+03	1.4E+02	6.0E+02
				8.0E-02	I					1	0.1		Fluridone	59756-60-4	4.9E+03	n	4.9E+04	n					1.1E+03	n		1.3E+02	
				2.0E-02	I					1	0.1		Flurprimidol	56425-91-3	1.2E+03	n	1.2E+04	n					2.6E+02	n		1.2E+00	
				6.0E-02	I					1	0.1		Flutolanil	66332-96-5	3.7E+03	n	3.7E+04	n					7.2E+02	n		3.9E+00	
				1.0E-02	I					1	0.1		Fluvalinate	69409-94-5	6.1E+02	n	6.2E+03	n					1.6E+02	n		2.3E+02	
3.5E-03	I			1.0E-01	I					1	0.1		Folpet	133-07-3	1.4E+02	c*	4.9E+02	c					1.7E+01	c*		4.1E-03	
1.9E-01	I									1	0.1		Fomesafen	72178-02-0	2.6E+00	c	9.1E+00	c					3.4E-01	c		1.1E-03	
				2.0E-03	I					1	0.1		Fonofos	944-22-9	1.2E+02	n	1.2E+03	n					1.8E+01	n		3.5E-02	
		1.3E-05	I	2.0E-01	I	9.8E-03	A			1	0.1		Formaldehyde	50-00-0	1.2E+04	n	1.2E+05	nm	1.9E-01	c*	9.4E-01	c*	3.1E+03	n		6.2E-01	
				9.0E-01	P	3.0E-04	X			1	0.1		Formic Acid	64-18-6	4.9E+04	n	4.2E+05	nm	3.1E-01	n	1.3E+00	n	1.4E+04	n		2.8E+00	
				3.0E+00	I					1	0.1		Fosetyl-AL	39148-24-8	1.8E+05	nm	1.8E+06	nm					4.7E+04	n			
													Furans														
				1.0E-03	X			V		1			~Dibenzofuran	132-64-9	7.8E+01	n	1.0E+03	n					5.8E+00	n		1.1E-01	
				1.0E-03	I			V		1		6.2E+03	~Furan	110-00-9	7.8E+01	n	1.0E+03	n					1.5E+01	n		5.7E-03	
				9.0E-01	I	2.0E+00	I	V		1	0.1	1.7E+05	~Tetrahydrofuran	109-99-9	1.8E+04	n	9.5E+04	n	2.1E+03	n	8.8E+03	n	3.2E+03	n		7.1E-01	
3.8E+00	H									1	0.1		Furazolidone	67-45-8	1.3E-01	c	4.5E-01	c					1.8E-02	c		3.4E-05	

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				3.0E-03	I	5.0E-02	H			1	0.1		Furfural	98-01-1	1.8E+02	n	1.8E+03	n	5.2E+01	n	2.2E+02	n	4.6E+01	n		9.9E-03	
1.5E+00	C	4.3E-04	C							1	0.1		Furium	531-82-8	3.2E-01	c	1.1E+00	c	5.7E-03	c	2.9E-02	c	4.4E-02	c		5.9E-05	
3.0E-02	I	8.6E-06	C							1	0.1		Furmecyclox	60568-05-0	1.6E+01	c	5.7E+01	c	2.8E-01	c	1.4E+00	c	9.6E-01	c		1.0E-03	
				4.0E-04	I					1	0.1		Glufosinate, Ammonium	77182-82-2	2.4E+01	n	2.5E+02	n					6.3E+00	n		1.4E-03	
						8.0E-05	C			1	0.1		Glutaraldehyde	111-30-8	1.1E+05	nm	4.8E+05	nm	8.3E-02	n	3.5E-01	n					
				4.0E-04	I	1.0E-03	H			1	0.1		Glycidyl	765-34-4	2.4E+01	n	2.5E+02	n	1.0E+00	n	4.4E+00	n	6.2E+00	n		1.3E-03	
				1.0E-01	I					1	0.1		Glyphosate	1071-83-6	6.1E+03	n	6.2E+04	n					1.6E+03	n	7.0E+02	3.2E-01	1.4E-01
				3.0E-03	I					1	0.1		Goal	42874-03-3	1.8E+02	n	1.8E+03	n					2.4E+01	n		1.9E+00	
				3.0E-03	A	1.0E-02	A			1	0.1		Guthion	86-50-0	1.8E+02	n	1.8E+03	n	1.0E+01	n	4.4E+01	n	4.3E+01	n		1.3E-02	
				5.0E-05	I					1	0.1		Haloxyfop, Methyl	69806-40-2	3.1E+00	n	3.1E+01	n					5.8E-01	n		6.4E-03	
				1.3E-02	I					1	0.1		Harmony	79277-27-3	7.9E+02	n	8.0E+03	n					2.0E+02	n		6.1E-02	
4.5E+00	I	1.3E-03	I	5.0E-04	I					1	0.1		Heptachlor	76-44-8	1.1E-01	c	3.8E-01	c	1.9E-03	c	9.4E-03	c	1.8E-03	c	4.0E-01	1.4E-04	3.3E-02
9.1E+00	I	2.6E-03	I	1.3E-05	I					1	0.1		Heptachlor Epoxide	1024-57-3	5.3E-02	c*	1.9E-01	c*	9.4E-04	c	4.7E-03	c	3.3E-03	c*	2.0E-01	6.8E-05	4.1E-03
				2.0E-03	I					1	0.1		Hexabromobenzene	87-82-1	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.8E-01	
				2.0E-04	I					1	0.1		Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2	1.2E+01	n	1.2E+02	n					3.1E+00	n			
1.6E+00	I	4.6E-04	I	8.0E-04	I					1	0.1		Hexachlorobenzene	118-74-1	3.0E-01	c	1.1E+00	c	5.3E-03	c	2.7E-02	c	4.2E-02	c	1.0E+00	5.3E-04	1.3E-02
7.8E-02	I	2.2E-05	I	1.0E-03	P					1	0.1		Hexachlorobutadiene	87-68-3	6.2E+00	c**	2.2E+01	c*	1.1E-01	c	5.6E-01	c	2.6E-01	c*		5.0E-04	
6.3E+00	I	1.8E-03	I	8.0E-03	A					1	0.1		Hexachlorocyclohexane, Alpha-	319-84-6	7.7E-02	c	2.7E-01	c	1.4E-03	c	6.8E-03	c	6.2E-03	c		3.6E-05	
1.8E+00	I	5.3E-04	I							1	0.1		Hexachlorocyclohexane, Beta-	319-85-7	2.7E-01	c	9.6E-01	c	4.6E-03	c	2.3E-02	c	2.2E-02	c		1.3E-04	
1.1E+00	C	3.1E-04	C	3.0E-04	I					1	0.04		Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.2E-01	c*	2.1E+00	c	7.8E-03	c	4.0E-02	c	3.6E-02	c*	2.0E-01	2.1E-04	1.2E-03
1.8E+00	I	5.1E-04	I							1	0.1		Hexachlorocyclohexane, Technical	608-73-1	2.7E-01	c	9.6E-01	c	4.8E-03	c	2.4E-02	c	2.2E-02	c		1.3E-04	
				6.0E-03	I	2.0E-04	I			1	0.1		Hexachlorocyclopentadiene	77-47-4	3.7E+02	n	3.7E+03	n	2.1E-01	n	8.8E-01	n	2.2E+01	n	5.0E+01	7.0E-02	1.6E-01
4.0E-02	I	1.1E-05	C	7.0E-04	I	3.0E-02	I			1	0.1		Hexachloroethane	67-72-1	1.2E+01	c**	4.3E+01	c*	2.2E-01	c	1.1E+00	c	7.9E-01	c**		4.8E-04	
				3.0E-04	I					1	0.1		Hexachlorophene	70-30-4	1.8E+01	n	1.8E+02	n					4.7E+00	n		6.3E+00	
1.1E-01	I			3.0E-03	I					1	0.015		Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	5.6E+00	c*	2.4E+01	c					6.1E-01	c*		2.3E-04	
						1.0E-05	I	V		1		5.2E+03	Hexamethylene Diisocyanate, 1,6-	822-06-0	3.4E+00	n	1.4E+01	n	1.0E-02	n	4.4E-02	n	2.1E-02	n		2.1E-04	
				4.0E-04	P					1	0.1		Hexamethylphosphoramide	680-31-9	2.4E+01	n	2.5E+02	n					6.2E+00	n		1.4E-03	
				6.0E-02	H	7.0E-01	I	V		1		1.4E+02	Hexane, N-	110-54-3	5.7E+02	ns	2.6E+03	ns	7.3E+02	n	3.1E+03	n	2.5E+02	n		1.8E+00	
				2.0E+00	P					1	0.1		Hexanedioic Acid	124-04-9	1.2E+05	nm	1.2E+06	nm					3.1E+04	n		7.7E+00	
				5.0E-03	I	3.0E-02	I	V		1		3.3E+03	Hexanone, 2-	591-78-6	2.1E+02	n	1.4E+03	n	3.1E+01	n	1.3E+02	n	3.4E+01	n		7.9E-03	
				3.3E-02	I					1	0.1		Hexazinone	51235-04-2	2.0E+03	n	2.0E+04	n					5.0E+02	n		2.3E-01	
3.0E+00	I	4.9E-03	I			3.0E-05	P			1			Hydrazine	302-01-2	2.1E-01	c	9.5E-01	c	5.0E-04	c*	2.5E-03	c*	2.2E-02	c			
3.0E+00	I	4.9E-03	I							1			Hydrazine Sulfate	10034-93-2	2.1E-01	c	9.5E-01	c	5.0E-04	c	2.5E-03	c	2.2E-02	c			
						2.0E-02	I			1			Hydrogen Chloride	7647-01-0	2.8E+07	nm	1.2E+08	nm	2.1E+01	n	8.8E+01	n					
				4.0E-02	C	1.4E-02	C			1			Hydrogen Fluoride	7664-39-3	3.1E+03	n	4.1E+04	n	1.5E+01	n	6.1E+01	n	6.2E+02	n			
						2.0E-03	I			1			Hydrogen Sulfide	7783-06-4	2.8E+06	nm	1.2E+07	nm	2.1E+00	n	8.8E+00	n					
6.0E-02	P			4.0E-02	P					1	0.1		Hydroquinone	123-31-9	8.1E+00	c	2.9E+01	c					1.1E+00	c		7.5E-04	
				1.3E-02	I					1	0.1		Imazalil	35554-44-0	7.9E+02	n	8.0E+03	n					1.4E+02	n		2.5E+00	
				2.5E-01	I					1	0.1		Imazaquin	81335-37-7	1.5E+04	n	1.5E+05	nm					3.8E+03	n		1.9E+01	
				1.0E-02	A					1			Iodine	7553-56-2	7.8E+02	n	1.0E+04	n					1.6E+02	n		9.4E+00	
				4.0E-02	I					1	0.1		Iprodione	36734-19-7	2.4E+03	n	2.5E+04	n					5.7E+02	n		1.7E-01	
				7.0E-01	P					1			Iron	7439-89-6	5.5E+04	n	7.2E+05	nm					1.1E+04	n		2.7E+02	
				3.0E-01	I					1	0.1		Isobutyl Alcohol	78-83-1	1.8E+04	n	1.8E+05	nm					4.6E+03	n		9.5E-01	
9.5E-04	I			2.0E-01	I	2.0E+00	C			1	0.1		Isophorone	78-59-1	5.1E+02	c*	1.8E+03	c*	2.1E+03	n	8.8E+03	n	6.7E+01	c*		2.2E-02	
				1.5E-02	I					1	0.1		Isopropalin	33820-53-0	9.2E+02	n	9.2E+03	n					2.9E+01	n		6.6E-01	
						7.0E+00	C			1	0.1		Isopropanol	67-63-0	9.9E+09	nm	4.2E+10	nm	7.3E+03	n	3.1E+04	n					
				1.0E-01	I					1	0.1		Isopropyl Methyl Phosphonic Acid	1832-54-8	6.1E+03	n	6.2E+04	n					1.6E+03	n		3.4E-01	
				5.0E-02	I					1	0.1		Isoxaben	82558-50-7	3.1E+03	n	3.1E+04	n					5.6E+02	n		1.5E+00	
						3.0E-01	A	V		1			JP-7	NA	4.3E+08	nm	1.8E+09	nm	3.1E+02	n	1.3E+03	n	6.3E+02	n			
				7.5E-02	I					1	0.1		Kerb	23950-58-5	4.6E+03	n	4.6E+04	n					9.0E+02	n		9.1E-01	
				2.0E-03	I					1	0.1		Lactofen	77501-63-4	1.2E+02	n	1.2E+03	n					1.9E+01	n		8.7E-01	
													Lead Compounds														
2.8E-01	C	8.0E-05	C							1	0.1		~Lead acetate	301-04-2	1.7E+00	c	6.2E+00	c	3.0E-02	c	1.5E-01	c	2.4E-01	c			
										1			~Lead and Compounds	7439-92-1	4.0E+02	L	8.0E+02	L	1.5E-01	L		L		L	1.5E+01		1.4E+01
3.8E-02	C	1.1E-05	C							1	0.1		~Lead subacetate	1335-32-6	1.3E+01	c	4.5E+01	c	2.2E-01	c	1.1E+00	c	1.8E+00	c			
				1.0E-07	I					1	0.1		~Tetraethyl Lead	78-00-2	6.1E-03	n	6.2E-02	n					9.9E-04	n		3.5E-06	
				2.0E-03	I					1	0.1		Linuron	330-55-2	1.2E+02	n	1.2E+03	n					2.6E+01	n		2.3E-02	
				2.0E-03	P					1			Lithium	7439-93-2	1.6E+02	n	2.0E+03	n					3.1E+01	n		9.3E+00	
				2.0E-01	I					1	0.1		Londax	83055-99-6	1.2E+04	n	1.2E+05	nm					3.1E+03	n		7.9E-01	
				5.0E-04	I					1	0.1		MCPA	94-74-6	3.1E+01	n	3.1E+02	n					5.7E+00	n		1.5E-03	
				1.0E-02	I					1	0.1		MCPB	94-81-5	6.1E+02	n	6.2E+03	n					1.1E+02	n		4.4E-02	
				1.0E-03	I					1	0.1		MCPP	93-65-2	6.1E+01	n	6.2E+02	n					1.2E+01	n		3.5E-03	
				2.0E-02	I					1	0.1		Malathion	121-75-5	1.2E+03	n	1.2E+04	n					3.0E+02	n		7.9E-02	
				1.0E-01	I	7.0E-04	C			1	0.1		Maleic Anhydride	108-31-6	6.1E+03	n	6.1E+04	n	7.3E-01	n	3.1E+00	n	1.5E+03	n		3.0E-01	
				5.0E-01	I					1	0.1		Maleic Hydrazide	123-33-1	3.1E+04	n	3.1E+05	nm					7.8E+03	n		1.6E+00	
				1.0E-04	P					1	0.1		Malononitrile	109-77-3	6.1E+00	n	6.2E+01	n					1.6E+00	n		3.2E-04	
				3.0E-02	H					1	0.1		Mancozeb	8018-01-7	1.8E+03	n	1.8E+04	n					4.6E+02	n		6.5E-01	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				5.0E-03	I					1	0.1		Maneb	12427-38-2	3.1E+02	n	3.1E+03	n					7.7E+01	n		1.1E-01	
				1.4E-01	I	5.0E-05	I			1			Manganese (Diet)	7439-96-5													
				2.4E-02	S	5.0E-05	I			0.04			Manganese (Non-diet)	7439-96-5	1.8E+03	n	2.3E+04	n	5.2E-02	n	2.2E-01	n	3.2E+02	n		2.1E+01	
				9.0E-05	H					1	0.1		Mephosfolan	950-10-7	5.5E+00	n	5.5E+01	n					1.4E+00	n		2.1E-03	
				3.0E-02	I					1	0.1		Mepiquat Chloride	24307-26-4	1.8E+03	n	1.8E+04	n					4.7E+02	n		1.6E-01	
													Mercury Compounds														
				3.0E-04	I	3.0E-04	S			0.07			~Mercuric Chloride (and other Mercury salts)	7487-94-7	2.3E+01	n	3.1E+02	n	3.1E-01	n	1.3E+00	n	4.3E+00	n	2.0E+00		
						3.0E-04	I	V		1		3.1E+00	~Mercury (elemental)	7439-97-6	1.0E+01	ns	4.3E+01	ns	3.1E-01	n	1.3E+00	n	6.3E-01	n	2.0E+00	3.3E-02	1.0E-01
				1.0E-04	I					1			~Methyl Mercury	22967-92-6	7.8E+00	n	1.0E+02	n					1.6E+00	n			
				8.0E-05	I					1	0.1		~Phenylmercuric Acetate	62-38-4	4.9E+00	n	4.9E+01	n					1.2E+00	n		3.9E-04	
				3.0E-05	I					1	0.1		Merphos	150-50-5	1.8E+00	n	1.8E+01	n					4.7E-01	n		4.6E-02	
				3.0E-05	I					1	0.1		Merphos Oxide	78-48-8	1.8E+00	n	1.8E+01	n					6.1E-02	n		3.0E-04	
				6.0E-02	I					1	0.1		Metalaxyl	57837-19-1	3.7E+03	n	3.7E+04	n					9.2E+02	n		2.5E-01	
				1.0E-04	I	3.0E-02	P	V		1		4.6E+03	Methacrylonitrile	126-98-7	7.6E+00	n	9.2E+01	n	3.1E+01	n	1.3E+02	n	1.5E+00	n		3.4E-04	
				5.0E-05	I					1	0.1		Methamidophos	10265-92-6	3.1E+00	n	3.1E+01	n					7.8E-01	n		1.6E-04	
				5.0E-01	I	4.0E+00	C			1	0.1		Methanol	67-56-1	3.1E+04	n	3.1E+05	nm	4.2E+03	n	1.8E+04	n	7.8E+03	n		1.6E+00	
				1.0E-03	I					1	0.1		Methidathion	950-37-8	6.1E+01	n	6.2E+02	n					1.5E+01	n		3.7E-03	
				2.5E-02	I					1	0.1		Methomyl	16752-77-5	1.5E+03	n	1.5E+04	n					3.9E+02	n		8.5E-02	
4.9E-02	C	1.4E-05	C							1	0.1		Methoxy-5-nitroaniline, 2-	99-59-2	9.9E+00	c	3.5E+01	c	1.7E-01	c	8.8E-01	c	1.3E+00	c		4.6E-04	
				5.0E-03	I					1	0.1		Methoxychlor	72-43-5	3.1E+02	n	3.1E+03	n					2.7E+01	n	4.0E+01	1.5E+00	2.2E+00
				8.0E-03	P	1.0E-03	P			1	0.1		Methoxyethanol Acetate, 2-	110-49-6	4.9E+02	n	4.9E+03	n	1.0E+00	n	4.4E+00	n	1.2E+02	n		2.6E-02	
				5.0E-03	P	2.0E-02	I			1	0.1		Methoxyethanol, 2-	109-86-4	3.1E+02	n	3.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n		1.6E-02	
				1.0E+00	X			V		1		2.9E+04	Methyl Acetate	79-20-9	7.8E+04	ns	1.0E+06	nms					1.6E+04	n		3.2E+00	
				3.0E-02	H	2.0E-02	P	V		1		6.8E+03	Methyl Acrylate	96-33-3	1.5E+02	n	6.4E+02	n	2.1E+01	n	8.8E+01	n	3.8E+01	n		8.1E-03	
				6.0E-01	I	5.0E+00	I	V		1		2.8E+04	Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.8E+04	n	2.0E+05	nms	5.2E+03	n	2.2E+04	n	4.9E+03	n		1.0E+00	
		1.0E-03	X	1.0E-03	P	2.0E-05	X			1	0.1		Methyl Hydrazine	60-34-4	6.1E+01	n	6.1E+02	n	2.4E-03	c**	1.2E-02	c**	1.6E+01	n		3.5E-03	
				8.0E-02	H	3.0E+00	I	V		1		3.4E+03	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	5.3E+03	ns	5.3E+04	ns	3.1E+03	n	1.3E+04	n	1.0E+03	n		2.3E-01	
						1.0E-03	C	V		1	0.1	1.7E+04	Methyl Isocyanate	624-83-9	5.0E+00	n	2.1E+01	n	1.0E+00	n	4.4E+00	n	2.1E+00	n		5.9E-04	
				1.4E+00	I	7.0E-01	I	V		1		2.4E+03	Methyl Methacrylate	80-62-6	4.8E+03	ns	2.1E+04	ns	7.3E+02	n	3.1E+03	n	1.4E+03	n		3.0E-01	
				2.5E-04	I					1	0.1		Methyl Parathion	298-00-0	1.5E+01	n	1.5E+02	n					3.4E+00	n		5.7E-03	
				6.0E-02	X					1	0.1		Methyl Phosphonic Acid	993-13-5	3.7E+03	n	3.7E+04	n					9.4E+02	n		1.9E-01	
				6.0E-03	H	4.0E-02	H	V		1		3.9E+02	Methyl Styrene (Mixed Isomers)	25013-15-4	2.4E+02	n	1.5E+03	ns	4.2E+01	n	1.8E+02	n	3.2E+01	n		5.2E-02	
9.9E-02	C	2.8E-05	C							1	0.1		Methyl methanesulfonate	66-27-3	4.9E+00	c	1.7E+01	c	8.7E-02	c	4.4E-01	c	6.8E-01	c		1.4E-04	
1.8E-03	C	2.6E-07	C			3.0E+00	I	V		1		8.9E+03	Methyl tert-Butyl Ether (MTBE)	1634-04-4	4.3E+01	c	2.2E+02	c	9.4E+00	c	4.7E+01	c	1.2E+01	c		2.8E-03	
				2.0E-04	X					1	0.1		Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2	1.2E+01	n	1.2E+02	n					3.1E+00	n		1.9E-03	
9.0E-03	P			2.0E-02	X					1	0.1		Methyl-5-Nitroaniline, 2-	99-55-8	5.4E+01	c*	1.9E+02	c*					7.0E+00	c*		3.9E-03	
8.3E+00	C	2.4E-03	C							1	0.1		Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	5.9E-02	c	2.1E-01	c	1.0E-03	c	5.1E-03	c	8.1E-03	c		2.8E-06	
1.3E-01	C	3.7E-05	C							1	0.1		Methylaniline Hydrochloride, 2-	636-21-5	3.7E+00	c	1.3E+01	c	6.6E-02	c	3.3E-01	c	5.0E-01	c		2.1E-04	
				1.0E-02	A					1	0.1		Methylarsonic acid	124-58-3	6.1E+02	n	6.2E+03	n					1.6E+02	n			
				2.0E-04	X					1	0.1		Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7	1.2E+01	n	1.2E+02	n					3.1E+00	n			
				2.0E-04	X					1	0.1		Methylbenzene-1,4-diamine sulfate, 2-	615-50-9	1.2E+01	n	1.2E+02	n					3.1E+00	n			
2.2E+01	C	6.3E-03	C						M	1	0.1		Methylcholanthrene, 3-	56-49-5	5.2E-03	c	7.8E-02	c	1.5E-04	c	1.9E-03	c	9.8E-04	c		1.9E-03	
2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	V	M	1		3.3E+03	Methylene Chloride	75-09-2	5.6E+01	c**	9.6E+02	c**	9.6E+01	c**	1.2E+03	c**	9.9E+00	c**	5.0E+00	2.5E-03	1.3E-03
1.0E-01	P	4.3E-04	C	2.0E-03	P				M	1	0.1		Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	1.2E+00	c	1.7E+01	c*	2.2E-03	c	2.9E-02	c	1.4E-01	c		1.6E-03	
4.6E-02	I	1.3E-05	C							1	0.1		Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	1.1E+01	c	3.7E+01	c	1.9E-01	c	9.4E-01	c	4.1E-01	c		2.3E-03	
1.6E+00	C	4.6E-04	C			2.0E-02	C			1	0.1		Methylenebisbenzenamine, 4,4'-	101-77-9	3.0E-01	c	1.1E+00	c	5.3E-03	c	2.7E-02	c	4.1E-02	c		1.8E-04	
						6.0E-04	I			1	0.1		Methylenediphenyl Diisocyanate	101-68-8	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n					
				7.0E-02	H			V		1		5.0E+02	Methylstyrene, Alpha-	98-83-9	5.5E+03	ns	7.2E+04	ns					5.8E+02	n		9.3E-01	
				1.5E-01	I					1	0.1		Metolachlor	51218-45-2	9.2E+03	n	9.2E+04	n					2.1E+03	n		2.5E+00	
				2.5E-02	I					1	0.1		Metribuzin	21087-64-9	1.5E+03	n	1.5E+04	n					3.8E+02	n		1.2E-01	
				3.0E+00	P			V		1	0.1	3.4E-01	Mineral oils	8012-95-1	1.8E+05	nms	1.8E+06	nms					4.7E+04	n		1.9E+03	
1.8E+01	C	5.1E-03	C	2.0E-04	I					1	0.1		Mirex	2385-85-5	2.7E-02	c	9.6E-02	c	4.8E-04	c	2.4E-03	c	3.7E-03	c		2.7E-03	
				2.0E-03	I					1	0.1		Molinate	2212-67-1	1.2E+02	n	1.2E+03	n					2.3E+01	n		1.3E-02	
				5.0E-03	I					1			Molybdenum	7439-98-7	3.9E+02	n	5.1E+03	n					7.8E+01	n		1.6E+00	
				1.0E-01	I					1			Monochloramine	10599-90-3	7.8E+03	n	1.0E+05	nm					1.6E+03	n	4.0E+03		
				2.0E-03	P					1	0.1		Monomethylaniline	100-61-8	1.2E+02	n	1.2E+03	n					3.0E+01	n		1.1E-02	
				3.0E-04	X					1	0.1		N,N'-Diphenyl-1,4-benzenediamine	74-31-7	1.8E+01	n	1.8E+02	n					2.7E+00	n		2.8E-01	
				2.0E-03	I					1	0.1		Naled	300-76-5	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.4E-02	
				3.0E-02	X	1.0E-01	P	V		1			Naphtha, High Flash Aromatic (HFAN)	64724-95-6	2.3E+03	n	3.1E+04	n	1.0E+02	n	4.4E+02	n	1.4E+02	n			
1.8E+00	C	0.0E+00	C							1	0.1		Naphthylamine, 2-	91-59-8	2.7E-01	c	9.6E-01	c					3.3E-02	c		1.7E-04	
				1.0E-01	I					1	0.1		Napropamide	15299-99-7	6.1E+03	n	6.2E+04	n					1.3E+03	n		8.3E+00	
				5.0E-02	C	5.0E-05	C			0.04			Nickel Carbonyl	13463-39-3	3.7E+03	n	4.4E+04	n	5.2E-02	n	2.2E-01	n	6.7E+02	n			
				5.0E-02	C	1.0E-04	C			1			Nickel Oxide	1313-99-1	3.8E+03	n	4.7E+04	n	1.0E-01	n	4.4E-01	n	7.8E+02	n			
		2.4E-04	I	5.0E-02	C	5.0E-05	C			0.04			Nickel Refinery Dust	NA	3.7E+03	n	4.4E+04	n	1.0E-02	c**	5.1E-02	c**	7.6E+02	n		1.1E+02	
		2.6E-04	C	2.0E-02	I	9.0E-05	A			0.04			Nickel Soluble Salts	7440-02-0	1.5E+03	n	2.0E+04	n	9.4E-03	c*	4.7E-02	c**	3.0E+02	n		2.0E+01	
1.7E+00	C	4.8E-04	I	5.0E-02	C	5.0E-05	C			0.04			Nickel Subsulfide	12035-72-2	3.8E-01	c	1.7E+00	c	5.1E-03	c*	2.6E-02	c**	3.9E-02	c			
				1.6E+00	I					1			Nitrate	14797-55-8	1.3E+05	nm	1.6E+06	nm					2.5E+04	n	1.0E+04		

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Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
										1			Nitrate + Nitrite (as N)	NA											1.0E+04		
				1.0E-01	I					1			Nitrite	14797-65-0	7.8E+03	n	1.0E+05	nm					1.6E+03	n	1.0E+03		
				1.0E-02	X	5.0E-05	X			1	0.1		Nitroaniline, 2-	88-74-4	6.1E+02	n	6.0E+03	n	5.2E-02	n	2.2E-01	n	1.5E+02	n		6.2E-02	
2.0E-02	P			4.0E-03	P	6.0E-03	P			1	0.1		Nitroaniline, 4-	100-01-6	2.4E+01	c*	8.6E+01	c*	6.3E+00	n	2.6E+01	n	3.3E+00	c*		1.4E-03	
		4.0E-05	I	2.0E-03	I	9.0E-03	I	V		1		3.1E+03	Nitrobenzene	98-95-3	4.8E+00	c*	2.4E+01	c*	6.1E-02	c	3.1E-01	c	1.2E-01	c*		7.9E-05	
				3.0E+03	P					1	0.1		Nitrocellulose	9004-70-0	1.8E+08	nm	1.8E+09	nm					4.7E+07	n		1.0E+04	
				7.0E-02	H					1	0.1		Nitrofurantoin	67-20-9	4.3E+03	n	4.3E+04	n					1.1E+03	n		4.7E-01	
1.3E+00	C	3.7E-04	C							1	0.1		Nitrofurazone	59-87-0	3.7E-01	c	1.3E+00	c	6.6E-03	c	3.3E-02	c	5.2E-02	c		4.6E-05	
1.7E-02	P			1.0E-04	P					1	0.1		Nitroglycerin	55-63-0	6.1E+00	n	6.2E+01	n					1.5E+00	n		6.6E-04	
				1.0E-01	I					1	0.1		Nitroguanidine	556-88-7	6.1E+03	n	6.2E+04	n					1.6E+03	n		3.8E-01	
		9.0E-06	P			2.0E-02	P	V		1		1.8E+04	Nitromethane	75-52-5	4.9E+00	c*	2.5E+01	c*	2.7E-01	c*	1.4E+00	c*	5.4E-01	c*		1.2E-04	
		2.7E-03	H			2.0E-02	I	V		1		4.9E+03	Nitropropane, 2-	79-46-9	1.3E-02	c	6.4E-02	c	9.0E-04	c	4.5E-03	c	1.8E-03	c		4.7E-07	
2.7E+01	C	7.7E-03	C						M	1	0.1		Nitroso-N-ethylurea, N-	759-73-9	4.3E-03	c	6.4E-02	c	1.2E-04	c	1.6E-03	c	7.9E-04	c		1.9E-07	
1.2E+02	C	3.4E-02	C						M	1	0.1		Nitroso-N-methylurea, N-	684-93-5	9.6E-04	c	1.4E-02	c	2.8E-05	c	3.6E-04	c	1.8E-04	c		4.0E-08	
5.4E+00	I	1.6E-03	I					V		1			Nitroso-di-N-butylamine, N-	924-16-3	8.7E-02	c	4.0E-01	c	1.5E-03	c	7.7E-03	c	2.4E-03	c		4.8E-06	
7.0E+00	I	2.0E-03	C							1	0.1		Nitroso-di-N-propylamine, N-	621-64-7	6.9E-02	c	2.5E-01	c	1.2E-03	c	6.1E-03	c	9.3E-03	c		7.0E-06	
2.8E+00	I	8.0E-04	C							1	0.1		Nitrosodiethanolamine, N-	1116-54-7	1.7E-01	c	6.2E-01	c	3.0E-03	c	1.5E-02	c	2.4E-02	c		4.8E-06	
1.5E+02	I	4.3E-02	I						M	1	0.1		Nitrosodiethylamine, N-	55-18-5	7.7E-04	c	1.1E-02	c	2.2E-05	c	2.9E-04	c	1.4E-04	c		5.2E-08	
5.1E+01	I	1.4E-02	I	8.0E-06	P	4.0E-05	X		M	1	0.1		Nitrosodimethylamine, N-	62-75-9	2.3E-03	c	3.4E-02	c	6.9E-05	c	8.8E-04	c	4.2E-04	c		1.0E-07	
4.9E-03	I	2.6E-06	C							1	0.1		Nitrosodiphenylamine, N-	86-30-6	9.9E+01	c	3.5E+02	c	9.4E-01	c	4.7E+00	c	1.0E+01	c		5.7E-02	
2.2E+01	I	6.3E-03	C							1	0.1		Nitrosomethylethylamine, N-	10595-95-6	2.2E-02	c	7.8E-02	c	3.9E-04	c	1.9E-03	c	3.0E-03	c		8.7E-07	
6.7E+00	C	1.9E-03	C							1	0.1		Nitrosomorpholine [N-]	59-89-2	7.3E-02	c	2.6E-01	c	1.3E-03	c	6.5E-03	c	1.0E-02	c		2.5E-06	
9.4E+00	C	2.7E-03	C							1	0.1		Nitrosopiperidine [N-]	100-75-4	5.2E-02	c	1.8E-01	c	9.0E-04	c	4.5E-03	c	7.1E-03	c		3.8E-06	
2.1E+00	I	6.1E-04	I							1	0.1		Nitrosopyrrolidine, N-	930-55-2	2.3E-01	c	8.2E-01	c	4.0E-03	c	2.0E-02	c	3.2E-02	c		1.2E-05	
				1.0E-04	X					1	0.1		Nitrotoluene, m-	99-08-1	6.1E+00	n	6.2E+01	n					1.3E+00	n		1.2E-03	
2.2E-01	P			9.0E-04	P			V		1		1.5E+03	Nitrotoluene, o-	88-72-2	2.9E+00	c*	1.3E+01	c*					2.7E-01	c*		2.5E-04	
1.6E-02	P			4.0E-03	P					1	0.1		Nitrotoluene, p-	99-99-0	3.0E+01	c**	1.1E+02	c*					3.7E+00	c*		3.4E-03	
				3.0E-04	X	2.0E-01	P	V		1		6.9E+00	Nonane, n-	111-84-2	2.1E+01	ns	2.3E+02	ns	2.1E+02	n	8.8E+02	n	4.6E+00	n		6.6E-02	
				4.0E-02	I					1	0.1		Norflurazon	27314-13-2	2.4E+03	n	2.5E+04	n					6.0E+02	n		3.9E+00	
				7.0E-04	I					1	0.1		Nustar	85509-19-9	4.3E+01	n	4.3E+02	n					8.3E+00	n		1.4E+00	
				3.0E-03	I					1	0.1		Octabromodiphenyl Ether	32536-52-0	1.8E+02	n	1.8E+03	n					4.7E+01	n		9.3E+00	
				5.0E-02	I					1	0.006		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetra (HMX)	2691-41-0	3.8E+03	n	4.9E+04	n					7.8E+02	n		9.9E-01	
				2.0E-03	H					1	0.1		Octamethylpyrophosphoramide	152-16-9	1.2E+02	n	1.2E+03	n					3.1E+01	n		7.5E-03	
				1.2E-02	P					1	0.1		Octyl Phthalate, di-N-	117-84-0	7.3E+02	n	7.4E+03	n					1.9E+02	n		5.3E+01	
				5.0E-02	I					1	0.1		Oryzalin	19044-88-3	3.1E+03	n	3.1E+04	n					6.2E+02	n		1.1E+00	
				5.0E-03	I					1	0.1		Oxadiazon	19666-30-9	3.1E+02	n	3.1E+03	n					3.5E+01	n		3.6E-01	
				2.5E-02	I					1	0.1		Oxamyl	23135-22-0	1.5E+03	n	1.5E+04	n					3.9E+02	n	2.0E+02	8.6E-02	4.4E-02
				1.3E-02	I					1	0.1		Paclobutrazol	76738-62-0	7.9E+02	n	8.0E+03	n					1.7E+02	n		3.6E-01	
				4.5E-03	I					1	0.1		Paraquat Dichloride	1910-42-5	2.7E+02	n	2.8E+03	n					7.0E+01	n		9.7E-01	
				6.0E-03	H					1	0.1		Parathion	56-38-2	3.7E+02	n	3.7E+03	n					6.5E+01	n		3.3E-01	
				5.0E-02	H					1	0.1		Pebulate	1114-71-2	3.1E+03	n	3.1E+04	n					4.2E+02	n		3.3E-01	
				4.0E-02	I					1	0.1		Pendimethalin	40487-42-1	2.4E+03	n	2.5E+04	n					1.3E+02	n		1.5E+00	
				2.0E-03	I					1	0.1		Pentabromodiphenyl Ether	32534-81-9	1.2E+02	n	1.2E+03	n					3.1E+01	n		1.4E+00	
				1.0E-04	I					1	0.1		Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9	6.1E+00	n	6.2E+01	n					1.6E+00	n		6.8E-02	
				8.0E-04	I					1	0.1		Pentachlorobenzene	608-93-5	4.9E+01	n	4.9E+02	n					2.3E+00	n		1.7E-02	
9.0E-02	P									1	0.1		Pentachloroethane	76-01-7	5.4E+00	c	1.9E+01	c					5.6E-01	c		2.7E-04	
2.6E-01	H			3.0E-03	I					1	0.1		Pentachloronitrobenzene	82-68-8	1.9E+00	c*	6.6E+00	c					1.0E-01	c		1.3E-03	
4.0E-01	I	5.1E-06	C	5.0E-03	I					1	0.25		Pentachlorophenol	87-86-5	8.9E-01	c	2.7E+00	c	4.8E-01	c	2.4E+00	c	3.5E-02	c	1.0E+00	3.6E-04	1.0E-02
4.0E-03	X			2.0E-03	P					1	0.1		Pentaerythritol tetranitrate (PETN)	78-11-5	1.2E+02	c**	4.3E+02	c**					1.6E+01	c**		2.4E-02	
						1.0E+00	P	V		1		3.9E+02	Pentane, n-	109-66-0	8.7E+02	ns	3.7E+03	ns	1.0E+03	n	4.4E+03	n	2.1E+03	n		1.0E+01	
													Perchlorates														
				7.0E-04	I					1			~Ammonium Perchlorate	7790-98-9	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Lithium Perchlorate	7791-03-9	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Perchlorate and Perchlorate Salts	14797-73-0	5.5E+01	n	7.2E+02	n					1.1E+01	n	1.5E+01(F)		
				7.0E-04	I					1			~Potassium Perchlorate	7778-74-7	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				7.0E-04	I					1			~Sodium Perchlorate	7601-89-0	5.5E+01	n	7.2E+02	n					1.1E+01	n			
				5.0E-02	I					1	0.1		Permethrin	52645-53-1	3.1E+03	n	3.1E+04	n					7.8E+02	n		1.9E+02	
2.2E-03	C	6.3E-07	C							1	0.1		Phenacetin	62-44-2	2.2E+02	c	7.8E+02	c	3.9E+00	c	1.9E+01	c	3.0E+01	c		8.3E-03	
				2.5E-01	I					1	0.1		Phenmedipham	13684-63-4	1.5E+04	n	1.5E+05	nm					3.0E+03	n		1.6E+01	
				3.0E-01	I	2.0E-01	C			1	0.1		Phenol	108-95-2	1.8E+04	n	1.8E+05	nm	2.1E+02	n	8.8E+02	n	4.5E+03	n		2.6E+00	
				5.0E-04	X					1	0.1		Phenothiazine	92-84-2	3.1E+01	n	3.1E+02	n					3.2E+00	n		1.0E-02	
				6.0E-03	I					1	0.1		Phenylenediamine, m-	108-45-2	3.7E+02	n	3.7E+03	n					9.4E+01	n		2.5E-02	
4.7E-02	H									1	0.1		Phenylenediamine, o-	95-54-5	1.0E+01	c	3.7E+01	c					1.4E+00	c		3.8E-04	
				1.9E-01	H					1	0.1		Phenylenediamine, p-	106-50-3	1.2E+04	n	1.2E+05	nm					3.0E+03	n		7.9E-01	
1.9E-03	H									1	0.1		Phenylphenol, 2-	90-43-7	2.5E+02	c	8.9E+02	c					2.6E+01	c		3.5E-01	
				2.0E-04	H					1	0.1		Phorate	298-02-2	1.2E+01	n	1.2E+02	n					2.3E+00	n		2.6E-03	
						3.0E-04	I	V		1		1.6E+03	Phosgene	75-44-5	3.3E-01	n	1.4E+00	n	3.1E-01	n	1.3E+00	n					

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Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				2.0E-02	I					1	0.1		Phosmet	732-11-6	1.2E+03	n	1.2E+04	n					2.9E+02	n		6.4E-02	
													Phosphates, Inorganic														
				4.9E+01	P					1			~Aluminum metaphosphate	13776-88-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Ammonium polyphosphate	68333-79-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Calcium pyrophosphate	7790-76-3	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Diammonium phosphate	7783-28-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dicalcium phosphate	7757-93-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dimagnesium phosphate	7782-75-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Dipotassium phosphate	7758-11-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Disodium phosphate	7558-79-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monoaluminum phosphate	13530-50-2	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monoammonium phosphate	7722-76-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monocalcium phosphate	7758-23-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monomagnesium phosphate	7757-86-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monopotassium phosphate	7778-77-0	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Monosodium phosphate	7558-80-7	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Polyphosphoric acid	8017-16-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Potassium tripolyphosphate	13845-36-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium acid pyrophosphate	7758-16-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (acidic)	7785-88-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (anhydrous)	10279-59-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium aluminum phosphate (tetrahydrate)	10305-76-7	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium hexametaphosphate	10124-56-8	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium polyphosphate	68915-31-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium trimetaphosphate	7785-84-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Sodium tripolyphosphate	7758-29-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tetrapotassium phosphate	7320-34-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tetrasodium pyrophosphate	7722-88-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	15136-87-5	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tricalcium phosphate	7758-87-4	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trimagnesium phosphate	7757-87-1	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Tripotassium phosphate	7778-53-2	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				4.9E+01	P					1			~Trisodium phosphate	7601-54-9	3.8E+06	nm	5.0E+07	nm					7.6E+05	n			
				3.0E-04	I	3.0E-04	I			1			Phosphine	7803-51-2	2.3E+01	n	3.1E+02	n	3.1E-01	n	1.3E+00	n	4.7E+00	n			
				4.9E+01	P	1.0E-02	I			1			Phosphoric Acid	7664-38-2	3.0E+06	nm	2.7E+07	nm	1.0E+01	n	4.4E+01	n	7.6E+05	n			
				2.0E-05	I					1			Phosphorus, White	7723-14-0	1.6E+00	n	2.0E+01	n					3.1E-01	n		1.1E-03	
				1.0E+00	H					1	0.1		Phthalic Acid, P-	100-21-0	6.1E+04	n	6.2E+05	nm					1.5E+04	n		5.3E+00	
				2.0E+00	I	2.0E-02	C			1	0.1		Phthalic Anhydride	85-44-9	1.2E+05	nm	1.2E+06	nm	2.1E+01	n	8.8E+01	n	3.0E+04	n		6.6E+00	
				7.0E-02	I					1	0.1		Picloram	1918-02-1	4.3E+03	n	4.3E+04	n					1.1E+03	n	5.0E+02	2.9E-01	1.4E-01
				1.0E-04	X					1	0.1		Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3	6.1E+00	n	6.2E+01	n					1.5E+00	n		1.0E-03	
				1.0E-02	I					1	0.1		Pirimiphos, Methyl	29232-93-7	6.1E+02	n	6.2E+03	n					9.1E+01	n		8.7E-02	
3.0E+01	C	8.6E-03	C	7.0E-06	H					1	0.1		Polybrominated Biphenyls	59536-65-1	1.6E-02	c*	5.7E-02	c*	2.8E-04	c	1.4E-03	c	2.2E-03	c*			
													Polychlorinated Biphenyls (PCBs)														
7.0E-02	S	2.0E-05	S	7.0E-05	I					1	0.14		~Aroclor 1016	12674-11-2	3.9E+00	n	2.1E+01	c**	1.2E-01	c	6.1E-01	c	9.6E-01	c**		9.2E-02	
2.0E+00	S	5.7E-04	S					V		1	0.14	7.6E+02	~Aroclor 1221	11104-28-2	1.4E-01	c	5.4E-01	c	4.3E-03	c	2.1E-02	c	4.0E-03	c		6.9E-05	
2.0E+00	S	5.7E-04	S					V		1	0.14	7.3E+01	~Aroclor 1232	11141-16-5	1.4E-01	c	5.4E-01	c	4.3E-03	c	2.1E-02	c	4.0E-03	c		6.9E-05	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1242	53469-21-9	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		5.3E-03	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1248	12672-29-6	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		5.2E-03	
2.0E+00	S	5.7E-04	S	2.0E-05	I					1	0.14		~Aroclor 1254	11097-69-1	2.2E-01	c**	7.4E-01	c*	4.3E-03	c	2.1E-02	c	3.4E-02	c**		8.8E-03	
2.0E+00	S	5.7E-04	S							1	0.14		~Aroclor 1260	11096-82-5	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c	3.4E-02	c		2.4E-02	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		1.2E-02	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.2E-03	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	69782-90-7	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.4E-03	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	38380-08-4	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		7.4E-03	
3.9E+03	E	1.1E+00	E	3.3E-08	E	1.3E-06	E			1	0.14		~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	1.1E-04	c*	3.8E-04	c*	2.1E-06	c	1.1E-05	c	1.7E-05	c*		7.2E-06	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.4E-03	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
3.9E+00	E	1.1E-03	E	3.3E-05	E	1.3E-03	E			1	0.14		~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	1.1E-01	c*	3.8E-01	c*	2.1E-03	c	1.1E-02	c	1.7E-02	c*		4.5E-03	
1.3E+04	E	3.8E+00	E	1.0E-08	E	4.0E-07	E			1	0.14		~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	3.4E-05	c*	1.1E-04	c*	6.4E-07	c	3.2E-06	c	5.2E-06	c*		1.3E-06	
2.0E+00	I	5.7E-04	I							1	0.14		~Polychlorinated Biphenyls (high risk)	1336-36-3	2.2E-01	c	7.4E-01	c	4.3E-03	c	2.1E-02	c					
4.0E-01	I	1.0E-04	I							1	0.14		~Polychlorinated Biphenyls (low risk)	1336-36-3					2.4E-02	c	1.2E-01	c	1.7E-01	c	5.0E-01	2.6E-02	7.8E-02
7.0E-02	I	2.0E-05	I							1	0.14		~Polychlorinated Biphenyls (lowest risk)	1336-36-3					1.2E-01	c	6.1E-01	c					
1.3E+01	E	3.8E-03	E	1.0E-05	E	4.0E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	3.4E-02	c*	1.1E-01	c*	6.4E-04	c	3.2E-03	c	5.2E-03	c*		8.1E-04	
3.9E+01	E	1.1E-02	E	3.3E-06	E	1.3E-04	E			1	0.14		~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	1.1E-02	c*	3.8E-02	c*	2.1E-04	c	1.1E-03	c	1.7E-03	c*		2.7E-04	
						6.0E-04	I			1	0.1		Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9	8.5E+05	nm	3.6E+06	nm	6.3E-01	n	2.6E+00	n					
													Polynuclear Aromatic Hydrocarbons (PAHs)														

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				6.0E-02	I			V		1	0.13		~Acenaphthene	83-32-9	3.4E+03	n	3.3E+04	n					4.0E+02	n		4.1E+00	
				3.0E-01	I			V		1	0.13		~Anthracene	120-12-7	1.7E+04	n	1.7E+05	nm					1.3E+03	n		4.2E+01	
7.3E-01	E	1.1E-04	C						M	1	0.13		~Benz[a]anthracene	56-55-3	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		1.0E-02	
1.2E+00	C	1.1E-04	C							1	0.13		~Benzo(j)fluoranthene	205-82-3	3.8E-01	c	1.3E+00	c	2.2E-02	c	1.1E-01	c	5.6E-02	c		6.7E-02	
7.3E+00	I	1.1E-03	C						M	1	0.13		~Benzo[a]pyrene	50-32-8	1.5E-02	c	2.1E-01	c	8.7E-04	c	1.1E-02	c	2.9E-03	c	2.0E-01	3.5E-03	2.4E-01
7.3E-01	E	1.1E-04	C						M	1	0.13		~Benzo[b]fluoranthene	205-99-2	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		3.5E-02	
7.3E-02	E	1.1E-04	C						M	1	0.13		~Benzo[k]fluoranthene	207-08-9	1.5E+00	c	2.1E+01	c	8.7E-03	c	1.1E-01	c	2.9E-01	c		3.5E-01	
7.3E-03	E	1.1E-05	C						M	1	0.13		~Chrysene	218-01-9	1.5E+01	c	2.1E+02	c	8.7E-02	c	1.1E+00	c	2.9E+00	c		1.1E+00	
7.3E+00	E	1.2E-03	C						M	1	0.13		~Dibenz[a,h]anthracene	53-70-3	1.5E-02	c	2.1E-01	c	8.0E-04	c	1.0E-02	c	2.9E-03	c		1.1E-02	
1.2E+01	C	1.1E-03	C							1	0.13		~Dibenzo(a,e)pyrene	192-65-4	3.8E-02	c	1.3E-01	c	2.2E-03	c	1.1E-02	c	5.6E-03	c		7.3E-02	
2.5E+02	C	7.1E-02	C						M	1	0.13		~Dimethylbenz(a)anthracene, 7,12-	57-97-6	4.3E-04	c	6.2E-03	c	1.4E-05	c	1.7E-04	c	8.6E-05	c		8.5E-05	
				4.0E-02	I					1	0.13		~Fluoranthene	206-44-0	2.3E+03	n	2.2E+04	n					6.3E+02	n		7.0E+01	
				4.0E-02	I			V		1	0.13		~Fluorene	86-73-7	2.3E+03	n	2.2E+04	n					2.2E+02	n		4.0E+00	
7.3E-01	E	1.1E-04	C						M	1	0.13		~Indeno[1,2,3-cd]pyrene	193-39-5	1.5E-01	c	2.1E+00	c	8.7E-03	c	1.1E-01	c	2.9E-02	c		2.0E-01	
2.9E-02	P			7.0E-02	A			V		1	0.13		~Methylnaphthalene, 1-	90-12-0	1.6E+01	c	5.3E+01	c					9.7E-01	c		5.1E-03	
				4.0E-03	I			V		1	0.13		~Methylnaphthalene, 2-	91-57-6	2.3E+02	n	2.2E+03	n					2.7E+01	n		1.4E-01	
		3.4E-05	C	2.0E-02	I	3.0E-03	I	V		1	0.13		~Naphthalene	91-20-3	3.6E+00	c*	1.8E+01	c*	7.2E-02	c*	3.6E-01	c*	1.4E-01	c*		4.7E-04	
1.2E+00	C	1.1E-04	C							1	0.13		~Nitropyrene, 4-	57835-92-4	3.8E-01	c	1.3E+00	c	2.2E-02	c	1.1E-01	c	1.6E-02	c		2.8E-03	
				3.0E-02	I			V		1	0.13		~Pyrene	129-00-0	1.7E+03	n	1.7E+04	n					8.7E+01	n		9.5E+00	
1.5E-01	I			9.0E-03	I					1	0.1		Prochloraz	67747-09-5	3.2E+00	c	1.1E+01	c					3.2E-01	c		1.6E-03	
				6.0E-03	H					1	0.1		Profluralin	26399-36-0	3.7E+02	n	3.7E+03	n					1.9E+01	n		1.2E+00	
				1.5E-02	I					1	0.1		Prometon	1610-18-0	9.2E+02	n	9.2E+03	n					1.9E+02	n		9.2E-02	
				4.0E-03	I					1	0.1		Prometryn	7287-19-6	2.4E+02	n	2.5E+03	n					4.5E+01	n		6.9E-02	
				1.3E-02	I					1	0.1		Propachlor	1918-16-7	7.9E+02	n	8.0E+03	n					1.9E+02	n		1.2E-01	
				5.0E-03	I					1	0.1		Propanil	709-98-8	3.1E+02	n	3.1E+03	n					6.3E+01	n		3.5E-02	
				2.0E-02	I					1	0.1		Propargite	2312-35-8	1.2E+03	n	1.2E+04	n					1.2E+02	n		8.8E+00	
				2.0E-03	I					1	0.1		Propargyl Alcohol	107-19-7	1.2E+02	n	1.2E+03	n					3.1E+01	n		6.4E-03	
				2.0E-02	I					1	0.1		Propazine	139-40-2	1.2E+03	n	1.2E+04	n					2.6E+02	n		2.3E-01	
				2.0E-02	I					1	0.1		Propham	122-42-9	1.2E+03	n	1.2E+04	n					2.7E+02	n		1.7E-01	
				1.3E-02	I					1	0.1		Propiconazole	60207-90-1	7.9E+02	n	8.0E+03	n					1.6E+02	n		5.3E-01	
						8.0E-03	I	V		1		3.3E+04	Propionaldehyde	123-38-6	8.0E+01	n	3.4E+02	n	8.3E+00	n	3.5E+01	n	1.7E+01	n		3.4E-03	
				1.0E-01	X	1.0E+00	X	V		1	0.1	2.6E+02	Propyl benzene	103-65-1	3.4E+03	ns	2.1E+04	ns	1.0E+03	n	4.4E+03	n	5.3E+02	n		9.9E-01	
						3.0E+00	C	V		1	0.1	3.5E+02	Propylene	115-07-1	2.4E+03	ns	1.0E+04	ns	3.1E+03	n	1.3E+04	n	6.3E+03	n		6.0E+00	
				2.0E+01	P					1	0.1		Propylene Glycol	57-55-6	1.2E+06	nm	1.2E+07	nm					3.1E+05	n		6.3E+01	
						2.7E-04	A			1	0.1		Propylene Glycol Dinitrate	6423-43-4	3.9E+05	nm	1.6E+06	nm	2.8E-01	n	1.2E+00	n					
				7.0E-01	H					1	0.1		Propylene Glycol Monoethyl Ether	1569-02-4	4.3E+04	n	4.3E+05	nm					1.1E+04	n		2.2E+00	
				7.0E-01	H	2.0E+00	I			1	0.1		Propylene Glycol Monomethyl Ether	107-98-2	4.3E+04	n	4.3E+05	nm	2.1E+03	n	8.8E+03	n	1.1E+04	n		2.2E+00	
2.4E-01	I	3.7E-06	I			3.0E-02	I	V		1		7.8E+04	Propylene Oxide	75-56-9	2.0E+00	c	9.0E+00	c	6.6E-01	c*	3.3E+00	c*	2.3E-01	c		4.8E-05	
				2.5E-01	I					1	0.1		Pursuit	81335-77-5	1.5E+04	n	1.5E+05	nm					3.6E+03	n		3.2E+00	
				2.5E-02	I					1	0.1		Pydrin	51630-58-1	1.5E+03	n	1.5E+04	n					3.9E+02	n		2.5E+02	
				1.0E-03	I			V		1		5.3E+05	Pyridine	110-86-1	7.8E+01	n	1.0E+03	n					1.5E+01	n		5.3E-03	
				5.0E-04	I					1	0.1		Quinalphos	13593-03-8	3.1E+01	n	3.1E+02	n					3.8E+00	n		3.2E-02	
3.0E+00	I									1	0.1		Quinoline	91-22-5	1.6E-01	c	5.7E-01	c					2.1E-02	c		6.8E-05	
						3.0E-02	A			1			Refractory Ceramic Fibers	NA	4.3E+07	nm	1.8E+08	nm	3.1E+01	n	1.3E+02	n					
				3.0E-02	I					1	0.1		Resmethrin	10453-86-8	1.8E+03	n	1.8E+04	n					4.8E+01	n		3.0E+01	
				5.0E-02	H					1	0.1		Ronnel	299-84-3	3.1E+03	n	3.1E+04	n					3.0E+02	n		2.7E+00	
				4.0E-03	I					1	0.1		Rotenone	83-79-4	2.4E+02	n	2.5E+03	n					4.7E+01	n		2.4E+01	
2.2E-01	C	6.3E-05	C						M	1	0.1		Safrole	94-59-7	5.2E-01	c	7.8E+00	c	1.5E-02	c	1.9E-01	c	8.3E-02	c		5.1E-05	
				2.5E-02	I					1	0.1		Savey	78587-05-0	1.5E+03	n	1.5E+04	n					8.1E+01	n		3.6E-01	
				5.0E-03	I					1			Selenious Acid	7783-00-8	3.9E+02	n	5.1E+03	n					7.8E+01	n			
				5.0E-03	I	2.0E-02	C			1			Selenium	7782-49-2	3.9E+02	n	5.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n	5.0E+01	4.0E-01	2.6E-01
				5.0E-03	C	2.0E-02	C			1			Selenium Sulfide	7446-34-6	3.9E+02	n	5.1E+03	n	2.1E+01	n	8.8E+01	n	7.8E+01	n			
				9.0E-02	I					1	0.1		Sethoxydim	74051-80-2	5.5E+03	n	5.5E+04	n					7.8E+02	n		6.9E+00	
						3.0E-03	C			1			Silica (crystalline, respirable)	7631-86-9	4.3E+06	nm	1.8E+07	nm	3.1E+00	n	1.3E+01	n					
				5.0E-03	I					0.04			Silver	7440-22-4	3.9E+02	n	5.1E+03	n					7.1E+01	n		6.0E-01	
1.2E-01	H			5.0E-03	I					1	0.1		Simazine	122-34-9	4.1E+00	c*	1.4E+01	c					5.2E-01	c	4.0E+00	2.6E-04	2.0E-03
				1.3E-02	I					1	0.1		Sodium Acifluorfen	62476-59-9	7.9E+02	n	8.0E+03	n					2.0E+02	n		1.6E+00	
				4.0E-03	I					1			Sodium Azide	26628-22-8	3.1E+02	n	4.1E+03	n					6.2E+01	n			
2.7E-01	H			3.0E-02	I					1	0.1		Sodium Diethyldithiocarbamate	148-18-5	1.8E+00	c	6.4E+00	c					2.5E-01	c			
				5.0E-02	A	1.3E-02	C			1			Sodium Fluoride	7681-49-4	3.9E+03	n	5.1E+04	n	1.4E+01	n	5.7E+01	n	7.8E+02	n			
				2.0E-05	I					1	0.1		Sodium Fluoroacetate	62-74-8	1.2E+00	n	1.2E+01	n					3.1E-01	n		6.3E-05	
				1.0E-03	H					1			Sodium Metavanadate	13718-26-8	7.8E+01	n	1.0E+03	n					1.6E+01	n			
2.4E-02	H			3.0E-02	I					1	0.1		Stirofos (Tetrachlorovinphos)	961-11-5	2.0E+01	c*	7.2E+01	c					2.4E+00	c		7.0E-03	
				6.0E-01	I					1			Strontium, Stable	7440-24-6	4.7E+04	n	6.1E+05	nm					9.3E+03	n		3.3E+02	
				3.0E-04	I					1	0.1		Strychnine	57-24-9	1.8E+01	n	1.8E+02	n					4.6E+00	n		5.1E-02	
				2.0E-01	I	1.0E+00	I	V		1		8.7E+02	Styrene	100-42-5	6.3E+03	ns	3.6E+04	ns	1.0E+03	n	4.4E+03	n	1.1E+03	n	1.0E+02	1.2E+00	1.1E-01
				1.0E-03	P	2.0E-03	P			1	0.1		Sulfolane	126-33-0	6.1E+01	n	6.2E+02	n	2.1E+00	n	8.8E+00	n	1.6E+01	n		3.4E-03	

Key: I = IRIS; P = PPRTV; A = ATSDR; C = Cal EPA; X = PPRTV Appendix; H = HEAST; J = New Jersey; O = EPA Office of Water; E = Environmental Criteria and Assessment Office; S = see user guide Section 5; L = see user guide on lead; M = mutagen; V = volatile; F = See FAQ; c = cancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; n = noncancer; m = Concentration may exceed ceiling limit (See User Guide); s = Concentration may exceed Csat (See User Guide); SSL values are based on DAF=1

Toxicity and Chemical-specific Information													Contaminant		Screening Levels										Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
				8.0E-04	P					1	0.1		Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9	4.9E+01	n	4.9E+02	n					8.3E+00	n		4.9E-02	
						1.0E-03	C			1			Sulfuric Acid	7664-93-9	1.4E+06	nm	6.0E+06	nm	1.0E+00	n	4.4E+00	n					
				2.5E-02	I					1	0.1		Systhane	88671-89-0	1.5E+03	n	1.5E+04	n					3.5E+02	n		4.3E+00	
				3.0E-02	H					1	0.1		TCMTB	21564-17-0	1.8E+03	n	1.8E+04	n					3.7E+02	n		2.6E+00	
				7.0E-02	I					1	0.1		Tebuthiuron	34014-18-1	4.3E+03	n	4.3E+04	n					1.1E+03	n		3.0E-01	
				2.0E-02	H					1	0.1		Temephos	3383-96-8	1.2E+03	n	1.2E+04	n					3.1E+02	n		6.0E+01	
				1.3E-02	I					1	0.1		Terbacil	5902-51-2	7.9E+02	n	8.0E+03	n					2.0E+02	n		5.9E-02	
				2.5E-05	H					1	0.1		Terbufos	13071-79-9	1.5E+00	n	1.5E+01	n					1.8E-01	n		3.9E-04	
				1.0E-03	I					1	0.1		Terbutryn	886-50-0	6.1E+01	n	6.2E+02	n					1.0E+01	n		1.4E-02	
				1.0E-04	I					1	0.1		Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1	6.1E+00	n	6.2E+01	n					1.6E+00	n		4.2E-02	
				3.0E-04	I					1	0.1		Tetrachlorobenzene, 1,2,4,5-	95-94-3	1.8E+01	n	1.8E+02	n					1.2E+00	n		5.8E-03	
2.6E-02	I	7.4E-06	I	3.0E-02	I			V		1		6.8E+02	Tetrachloroethane, 1,1,1,2-	630-20-6	1.9E+00	c	9.3E+00	c	3.3E-01	c	1.7E+00	c	5.0E-01	c		1.9E-04	
2.0E-01	I	5.8E-05	C	2.0E-02	I			V		1		1.9E+03	Tetrachloroethane, 1,1,2,2-	79-34-5	5.6E-01	c	2.8E+00	c	4.2E-02	c	2.1E-01	c	6.6E-02	c		2.6E-05	
2.1E-03	I	2.6E-07	I	6.0E-03	I	4.0E-02	I	V		1		1.7E+02	Tetrachloroethylene	127-18-4	2.2E+01	c**	1.1E+02	c**	9.4E+00	c**	4.7E+01	c**	9.7E+00	c**	5.0E+00	4.4E-03	2.3E-03
				3.0E-02	I					1	0.1		Tetrachlorophenol, 2,3,4,6-	58-90-2	1.8E+03	n	1.8E+04	n					1.7E+02	n		1.1E+00	
2.0E+01	H									1	0.1		Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1	2.4E-02	c	8.6E-02	c					1.1E-03	c		3.9E-06	
				5.0E-04	I					1	0.1		Tetraethyl Dithiopyrophosphate	3689-24-5	3.1E+01	n	3.1E+02	n					5.3E+00	n		3.9E-03	
						8.0E+01	I	V		1		1.1E+03	Tetrafluoroethane, 1,1,1,2-	811-97-2	1.1E+05	nms	4.6E+05	nms	8.3E+04	n	3.5E+05	n	1.7E+05	n		9.3E+01	
				4.0E-03	P					1	0.1		Tetryl (Trinitrophenylmethylnitramine)	479-45-8	2.4E+02	n	2.5E+03	n					6.1E+01	n		5.8E-01	
				7.0E-06	X					1			Thallium (I) Nitrate	10102-45-1	5.5E-01	n	7.2E+00	n					1.1E-01	n			
				1.0E-05	X					1			Thallium (Soluble Salts)	7440-28-0	7.8E-01	n	1.0E+01	n					1.6E-01	n	2.0E+00	1.1E-02	1.4E-01
				6.0E-06	X					1			Thallium Acetate	563-68-8	4.7E-01	n	6.1E+00	n					9.3E-02	n			
				2.0E-05	X					1			Thallium Carbonate	6533-73-9	1.6E+00	n	2.0E+01	n					3.1E-01	n			
				6.0E-06	X					1			Thallium Chloride	7791-12-0	4.7E-01	n	6.1E+00	n					9.3E-02	n			
				2.0E-05	X					1			Thallium Sulfate	7446-18-6	1.6E+00	n	2.0E+01	n					3.1E-01	n			
				1.0E-02	I					1	0.1		Thiobencarb	28249-77-6	6.1E+02	n	6.2E+03	n					1.2E+02	n		4.2E-01	
				7.0E-02	X					1	0.008		Thiodiglycol	111-48-8	5.4E+03	n	6.8E+04	n					1.1E+03	n		2.2E-01	
				3.0E-04	H					1	0.1		Thiofanox	39196-18-4	1.8E+01	n	1.8E+02	n					4.1E+00	n		1.4E-03	
				8.0E-02	I					1	0.1		Thiophanate, Methyl	23564-05-8	4.9E+03	n	4.9E+04	n					1.2E+03	n		1.1E+00	
				5.0E-03	I					1	0.1		Thiram	137-26-8	3.1E+02	n	3.1E+03	n					7.6E+01	n		1.1E-01	
				6.0E-01	H					1			Tin	7440-31-5	4.7E+04	n	6.1E+05	nm					9.3E+03	n		2.3E+03	
						1.0E-04	A			1			Titanium Tetrachloride	7550-45-0	1.4E+05	nm	6.0E+05	nm	1.0E-01	n	4.4E-01	n					
				8.0E-02	I	5.0E+00	I	V		1		8.2E+02	Toluene	108-88-3	5.0E+03	ns	4.5E+04	ns	5.2E+03	n	2.2E+04	n	8.6E+02	n	1.0E+03	5.9E-01	6.9E-01
				6.0E-01	H					1	0.1		Toluene-2,5-diamine	95-70-5	3.7E+04	n	3.7E+05	nm					9.3E+03	n		2.9E+00	
3.0E-02	P			4.0E-03	X					1	0.1		Toluidine, p-	106-49-0	1.6E+01	c*	5.7E+01	c*					2.2E+00	c*		9.2E-04	
1.1E+00	I	3.2E-04	I							1	0.1		Toxaphene	8001-35-2	4.4E-01	c	1.6E+00	c	7.6E-03	c	3.8E-02	c	1.3E-02	c	3.0E+00	2.1E-03	4.6E-01
				7.5E-03	I					1	0.1		Tralomethrin	66841-25-6	4.6E+02	n	4.6E+03	n					1.2E+02	n		4.5E+01	
				3.0E-04	A					1	0.1		Tri-n-butyltin	688-73-3	1.8E+01	n	1.8E+02	n					2.8E+00	n		6.2E-02	
				8.0E+01	X				M	1	0.1		Triacetin	102-76-1	4.9E+06	nm	4.9E+07	nm					1.2E+06	n		3.5E+02	
				1.3E-02	I					1	0.1		Triallate	2303-17-5	7.9E+02	n	8.0E+03	n					8.7E+01	n		1.9E-01	
				1.0E-02	I					1	0.1		Triasulfuron	82097-50-5	6.1E+02	n	6.2E+03	n					1.6E+02	n		1.6E-01	
				5.0E-03	I					1	0.1		Tribromobenzene, 1,2,4-	615-54-3	3.1E+02	n	3.1E+03	n					3.3E+01	n		4.7E-02	
9.0E-03	P			1.0E-02	P					1	0.1		Tributyl Phosphate	126-73-8	5.4E+01	c*	1.9E+02	c*					4.5E+00	c*		2.2E-02	
				3.0E-04	P					1	0.1		Tributyltin Compounds	NA	1.8E+01	n	1.8E+02	n					4.7E+00	n			
				3.0E-04	I					1	0.1		Tributyltin Oxide	56-35-9	1.8E+01	n	1.8E+02	n					4.4E+00	n		2.3E+02	
				3.0E+01	I	3.0E+01	H	V		1		9.1E+02	Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	4.3E+04	ns	1.8E+05	nms	3.1E+04	n	1.3E+05	n	5.3E+04	n		1.3E+02	
7.0E-02	I			2.0E-02	I					1	0.1		Trichloroacetic Acid	76-03-9	6.9E+00	c	2.5E+01	c					9.4E-01	c	6.0E+01	1.9E-04	1.2E-02
2.9E-02	H									1	0.1		Trichloroaniline HCl, 2,4,6-	33663-50-2	1.7E+01	c	5.9E+01	c					2.3E+00	c		6.4E-03	
7.0E-03	X			3.0E-05	X					1	0.1		Trichloroaniline, 2,4,6-	634-93-5	1.8E+00	n	1.8E+01	n					3.0E-01	n		2.7E-03	
				8.0E-04	X			V		1	0.1		Trichlorobenzene, 1,2,3-	87-61-6	4.9E+01	n	4.9E+02	n					5.2E+00	n		1.5E-02	
2.9E-02	P			1.0E-02	I	2.0E-03	P	V		1		4.0E+02	Trichlorobenzene, 1,2,4-	120-82-1	2.2E+01	c**	9.9E+01	c**	2.1E+00	n	8.8E+00	n	9.9E-01	c**	7.0E+01	2.9E-03	2.0E-01
				2.0E+00	I	5.0E+00	I	V		1		6.4E+02	Trichloroethane, 1,1,1-	71-55-6	8.7E+03	ns	3.8E+04	ns	5.2E+03	n	2.2E+04	n	7.5E+03	n	2.0E+02	2.6E+00	7.0E-02
5.7E-02	I	1.6E-05	I	4.0E-03	I	2.0E-04	X	V		1		2.2E+03	Trichloroethane, 1,1,2-	79-00-5	1.1E+00	c**	5.3E+00	c**	1.5E-01	c**	7.7E-01	c**	2.4E-01	c**	5.0E+00	7.7E-05	1.6E-03
4.6E-02	I	4.1E-06	I	5.0E-04	I	2.0E-03	I	V	M	1		6.9E+02	Trichloroethylene	79-01-6	9.1E-01	c**	6.4E+00	c**	4.3E-01	c**	3.0E+00	c**	4.4E-01	c**	5.0E+00	1.6E-04	1.8E-03
				3.0E-01	I	7.0E-01	H	V		1		1.2E+03	Trichlorofluoromethane	75-69-4	7.9E+02	n	3.4E+03	ns	7.3E+02	n	3.1E+03	n	1.1E+03	n		6.9E-01	
				1.0E-01	I					1	0.1		Trichlorophenol, 2,4,5-	95-95-4	6.1E+03	n	6.2E+04	n					8.9E+02	n		3.3E+00	
1.1E-02	I	3.1E-06	I	1.0E-03	P					1	0.1		Trichlorophenol, 2,4,6-	88-06-2	4.4E+01	c**	1.6E+02	c**	7.8E-01	c	4.0E+00	c	3.5E+00	c**		1.3E-02	
				1.0E-02	I					1	0.1		Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5	6.1E+02	n	6.2E+03	n					1.2E+02	n		5.2E-02	
				8.0E-03	I					1	0.1		Trichlorophenoxypropionic acid, -2,4,5	93-72-1	4.9E+02	n	4.9E+03	n					8.4E+01	n	5.0E+01	4.6E-02	2.8E-02
				5.0E-03	I			V		1		1.3E+03	Trichloropropane, 1,1,2-	598-77-6	3.9E+02	n	5.1E+03	ns					6.8E+01	n		2.7E-02	
3.0E+01	I			4.0E-03	I	3.0E-04	I	V	M	1		1.4E+03	Trichloropropane, 1,2,3-	96-18-4	5.0E-03	c	9.5E-02	c	3.1E-01	n	1.3E+00	n	6.5E-04	c		2.8E-07	
				3.0E-03	X	3.0E-04	P	V		1		4.5E+02	Trichloropropene, 1,2,3-	96-19-5	7.8E-01	n	3.3E+00	n	3.1E-01	n	1.3E+00	n	6.2E-01	n		3.1E-04	
				3.0E-03	I					1	0.1		Tridiphane	58138-08-2	1.8E+02	n	1.8E+03	n					1.3E+01	n		9.3E-02	
						7.0E-03	I	V		1		2.8E+04	Triethylamine	121-44-8	1.2E+02	n	5.2E+02	n	7.3E+00	n	3.1E+01	n	1.5E+01	n		4.4E-03	
7.7E-03	I			7.5E-03	I					1	0.1		Trifluralin	1582-09-8	6.3E+01	c**	2.2E+02	c*					2.2E+00	c*		7.2E-02	
2.0E-02	P			1.0E-02	P					1	0.1		Trimethyl Phosphate	512-56-1	2.4E+01	c*	8.6E+01	c*					3.4E+00	c*		7.4E-04	
						5.0E-03	P	V		1		2.9E+02	Trimethylbenzene, 1,2,3-	526-73-8	5.3E+01	n	2.2E+02	n	5.2E+00	n	2.2E+01	n	1.0E+01	n		1.5E-02	

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Toxicity and Chemical-specific Information												Contaminant		Screening Levels											Protection of Ground Water SSLs	
SFO (mg/kg-day)$^{-1}$	key	IUR (ug/m^3)$^{-1}$	key	RfD_o (mg/kg-day)	key	RfC_i (mg/m^3)	key	voc	muta-gen	GIABS	ABS	C_{sat} (mg/kg)	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Resident Air (ug/m^3)	key	Industrial Air (ug/m^3)	key	Tapwater (ug/L)	key	MCL (ug/L)	Risk-based SSL (mg/kg)	MCL-based SSL (mg/kg)
						7.0E-03	P	V		1		2.2E+02	Trimethylbenzene, 1,2,4-	95-63-6	6.2E+01	n	2.6E+02	ns	7.3E+00	n	3.1E+01	n	1.5E+01	n		2.1E-02	
				1.0E-02	X			V		1		1.8E+02	Trimethylbenzene, 1,3,5-	108-67-8	7.8E+02	ns	1.0E+04	ns					8.7E+01	n		1.2E-01	
				3.0E-02	I					1	0.019		Trinitrobenzene, 1,3,5-	99-35-4	2.2E+03	n	2.7E+04	n					4.6E+02	n		1.7E+00	
3.0E-02	I			5.0E-04	I					1	0.032		Trinitrotoluene, 2,4,6-	118-96-7	1.9E+01	c**	7.9E+01	c**					2.2E+00	c**		1.3E-02	
				2.0E-02	P					1	0.1		Triphenylphosphine Oxide	791-28-6	1.2E+03	n	1.2E+04	n					2.8E+02	n		1.2E+00	
				1.0E-02	X				M	1	0.1		Tris(1-chloro-2-propyl)phosphate	13674-84-5	6.1E+02	n	6.2E+03	n					1.5E+02	n		5.0E-01	
2.0E-02	P			7.0E-03	P					1	0.1		Tris(2-chloroethyl)phosphate	115-96-8	2.4E+01	c*	8.6E+01	c*					3.3E+00	c*		3.2E-03	
3.2E-03	P			1.0E-01	P					1	0.1		Tris(2-ethylhexyl)phosphate	78-42-2	1.5E+02	c*	5.4E+02	c					2.1E+01	c*		1.0E+02	
				3.0E-03	I					1			Uranium (Soluble Salts)	NA	2.3E+02	n	3.1E+03	n					4.7E+01	n	3.0E+01	2.1E+01	1.4E+01
1.0E+00	C	2.9E-04	C						M	1	0.1		Urethane	51-79-6	1.2E-01	c	1.7E+00	c	3.3E-03	c	4.2E-02	c	2.1E-02	c		4.8E-06	
		8.3E-03	P	9.0E-03	I	7.0E-06	P			0.026			Vanadium Pentoxide	1314-62-1	4.0E+02	c**	2.0E+03	c**	2.9E-04	c*	1.5E-03	c*	1.1E+02	n			
				5.0E-03	S					1			Vanadium and Compounds	NA	3.9E+02	n	5.2E+03	n					7.8E+01	n		7.8E+01	
				1.0E-03	I					1	0.1		Vernolate	1929-77-7	6.1E+01	n	6.2E+02	n					8.3E+00	n		6.6E-03	
				2.5E-02	I					1	0.1		Vinclozolin	50471-44-8	1.5E+03	n	1.5E+04	n					3.4E+02	n		2.6E-01	
				1.0E+00	H	2.0E-01	I	V		1		2.8E+03	Vinyl Acetate	108-05-4	9.7E+02	n	4.1E+03	ns	2.1E+02	n	8.8E+02	n	4.1E+02	n		8.7E-02	
		3.2E-05	H			3.0E-03	I	V		1		3.4E+03	Vinyl Bromide	593-60-2	1.1E-01	c*	5.6E-01	c*	7.6E-02	c*	3.8E-01	c*	1.5E-01	c*		4.4E-05	
7.2E-01	I	4.4E-06	I	3.0E-03	I	1.0E-01	I	V	M	1		3.9E+03	Vinyl Chloride	75-01-4	6.0E-02	c	1.7E+00	c	1.6E-01	c	2.8E+00	c	1.5E-02	c	2.0E+00	5.3E-06	6.9E-04
				3.0E-04	I					1	0.1		Warfarin	81-81-2	1.8E+01	n	1.8E+02	n					4.4E+00	n		4.6E-03	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, P-	106-42-3	6.0E+02	ns	2.6E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.8E-01	
				2.0E-01	S	1.0E-01	S	V		1		3.9E+02	Xylene, m-	108-38-3	5.9E+02	ns	2.5E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.8E-01	
				2.0E-01	S	1.0E-01	S	V		1		4.3E+02	Xylene, o-	95-47-6	6.9E+02	ns	3.0E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n		1.9E-01	
				2.0E-01	I	1.0E-01	I	V		1		2.6E+02	Xylenes	1330-20-7	6.3E+02	ns	2.7E+03	ns	1.0E+02	n	4.4E+02	n	1.9E+02	n	1.0E+04	1.9E-01	9.8E+00
				3.0E-04	I					1			Zinc Phosphide	1314-84-7	2.3E+01	n	3.1E+02	n					4.7E+00	n			
				3.0E-01	I					1			Zinc and Compounds	7440-66-6	2.3E+04	n	3.1E+05	nm					4.7E+03	n		2.9E+02	
				5.0E-02	I					1	0.1		Zineb	12122-67-7	3.1E+03	n	3.1E+04	n					7.7E+02	n		2.2E+00	
				8.0E-05	P					1			Zirconium	7440-67-7	6.3E+00	n	8.2E+01	n					1.2E+00	n		3.7E+00	

USEPA Region III Regional Screening Level (RSL) Table
Fish Ingestion
November 2012

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
1.8E-02	C	1.5E-01	I			ALAR	1596-84-5	1.8E-01	2.0E+02
8.7E-03	I	4.0E-03	I			Acephate	30560-19-1	3.6E-01	5.4E+00
				V		Acetaldehyde	75-07-0		
		2.0E-02	I			Acetochlor	34256-82-1		2.7E+01
		9.0E-01	I	V		Acetone	67-64-1		1.2E+03
				V		Acetone Cyanohydrin	75-86-5		
				V		Acetonitrile	75-05-8		
		1.0E-01	I	V		Acetophenone	98-86-2		1.4E+02
3.8E+00	C					Acetylaminofluorene, 2-	53-96-3	8.3E-04	
		5.0E-04	I	V		Acrolein	107-02-8		6.8E-01
5.0E-01	I	2.0E-03	I		M	Acrylamide	79-06-1	6.3E-03	2.7E+00
		5.0E-01	I			Acrylic Acid	79-10-7		6.8E+02
5.4E-01	I	4.0E-02	A	V		Acrylonitrile	107-13-1	5.8E-03	5.4E+01
						Adiponitrile	111-69-3		
5.6E-02	C	1.0E-02	I			Alachlor	15972-60-8	5.6E-02	1.4E+01
		1.0E-03	I			Aldicarb	116-06-3		1.4E+00
		1.0E-03	I			Aldicarb Sulfone	1646-88-4		1.4E+00
						Aldicarb sulfoxide	1646-87-3		
1.7E+01	I	3.0E-05	I			Aldrin	309-00-2	1.9E-04	4.1E-02
		2.5E-01	I			Ally	74223-64-6		3.4E+02
		5.0E-03	I			Allyl Alcohol	107-18-6		6.8E+00
2.1E-02	C			V		Allyl Chloride	107-05-1	1.5E-01	
		1.0E+00	P			Aluminum	7429-90-5		1.4E+03
		4.0E-04	I			Aluminum Phosphide	20859-73-8		5.4E-01
		3.0E-04	I			Amdro	67485-29-4		4.1E-01
		9.0E-03	I			Ametryn	834-12-8		1.2E+01
2.1E+01	C					Aminobiphenyl, 4-	92-67-1	1.5E-04	
		8.0E-02	P			Aminophenol, m-	591-27-5		1.1E+02
		2.0E-02	P			Aminophenol, p-	123-30-8		2.7E+01
		2.5E-03	I			Amitraz	33089-61-1		3.4E+00
						Ammonia	7664-41-7		
		2.0E-01	I			Ammonium Sulfamate	7773-06-0		2.7E+02
5.7E-03	I	7.0E-03	P			Aniline	62-53-3	5.5E-01	9.5E+00
4.0E-02	P	2.0E-03	X			Anthraquinone, 9,10-	84-65-1	7.9E-02	2.7E+00
		4.0E-04	I			Antimony (metallic)	7440-36-0		5.4E-01
		5.0E-04	H			Antimony Pentoxide	1314-60-9		6.8E-01
		9.0E-04	H			Antimony Potassium Tartrate	11071-15-1		1.2E+00
		4.0E-04	H			Antimony Tetroxide	1332-81-6		5.4E-01
						Antimony Trioxide	1309-64-4		
		1.3E-02	I			Apollo	74115-24-5		1.8E+01
2.5E-02	I	5.0E-02	H			Aramite	140-57-8	1.3E-01	6.8E+01
1.5E+00	I	3.0E-04	I			Arsenic, Inorganic	7440-38-2	2.1E-03	4.1E-01
		3.5E-06	C			Arsine	7784-42-1		4.7E-03
		9.0E-03	I			Assure	76578-14-8		1.2E+01
		5.0E-02	I			Asulam	3337-71-1		6.8E+01
2.3E-01	C	3.5E-02	I			Atrazine	1912-24-9	1.4E-02	4.7E+01
8.8E-01	C					Auramine	492-80-8	3.6E-03	
		4.0E-04	I			Avermectin B1	65195-55-3		5.4E-01
1.1E-01	I			V		Azobenzene	103-33-3	2.9E-02	
		2.0E-01	I			Barium	7440-39-3		2.7E+02
		4.0E-03	I			Baygon	114-26-1		5.4E+00
		3.0E-02	I			Bayleton	43121-43-3		4.1E+01
		2.5E-02	I			Baythroid	68359-37-5		3.4E+01
		3.0E-01	I			Benefin	1861-40-1		4.1E+02
		5.0E-02	I			Benomyl	17804-35-2		6.8E+01
		3.0E-02	I			Bentazon	25057-89-0		4.1E+01
		1.0E-01	I	V		Benzaldehyde	100-52-7		1.4E+02
5.5E-02	I	4.0E-03	I	V		Benzene	71-43-2	5.7E-02	5.4E+00
		2.0E-04	X			Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1		2.7E-01
		1.0E-03	P	V		Benzenethiol	108-98-5		1.4E+00
2.3E+02	I	3.0E-03	I		M	Benzidine	92-87-5	1.4E-05	4.1E+00
		4.0E+00	I			Benzoic Acid	65-85-0		5.4E+03
1.3E+01	I			V		Benzotrichloride	98-07-7	2.4E-04	
		1.0E-01	P			Benzyl Alcohol	100-51-6		1.4E+02
1.7E-01	I	2.0E-03	P	V		Benzyl Chloride	100-44-7	1.9E-02	2.7E+00
		2.0E-03	I			Beryllium and compounds	7440-41-7		2.7E+00
		1.0E-04	I			Bidrin	141-66-2		1.4E-01
		9.0E-03	P			Bifenox	42576-02-3		1.2E+01
		1.5E-02	I			Biphenthrin	82657-04-3		2.0E+01
8.0E-03	X	5.0E-02	I	V		Biphenyl, 1,1'-	92-52-4	3.9E-01	6.8E+01
7.0E-02	H	4.0E-02	I	V		Bis(2-chloro-1-methylethyl) ether	108-60-1	4.5E-02	5.4E+01
		3.0E-03	P			Bis(2-chloroethoxy)methane	111-91-1		4.1E+00
1.1E+00	I			V		Bis(2-chloroethyl)ether	111-44-4	2.9E-03	
1.4E-02	I	2.0E-02	I			Bis(2-ethylhexyl)phthalate	117-81-7	2.3E-01	2.7E+01
2.2E+02	I			V		Bis(chloromethyl)ether	542-88-1	1.4E-05	
		5.0E-02	I			Bisphenol A	80-05-7		6.8E+01
		2.0E-01	I			Boron And Borates Only	7440-42-8		2.7E+02
		2.0E+00	P		M	Boron Trichloride	10294-34-5		2.7E+03
		4.0E-02	C			Boron Trifluoride	7637-07-2		5.4E+01

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
7.0E-01	I	4.0E-03	I			Bromate	15541-45-4	4.5E-03	5.4E+00
2.0E+00	X			V		Bromo-2-chloroethane, 1-	107-04-0	1.6E-03	
		8.0E-03	I	V		Bromobenzene	108-86-1		1.1E+01
				V		Bromochloromethane	74-97-5		
6.2E-02	I	2.0E-02	I	V		Bromodichloromethane	75-27-4	5.1E-02	2.7E+01
7.9E-03	I	2.0E-02	I			Bromoform	75-25-2	4.0E-01	2.7E+01
		1.4E-03	I	V		Bromomethane	74-83-9		1.9E+00
		5.0E-03	H			Bromophos	2104-96-3		6.8E+00
		2.0E-02	I			Bromoxynil	1689-84-5		2.7E+01
		2.0E-02	I			Bromoxynil Octanoate	1689-99-2		2.7E+01
3.4E+00	C			V		Butadiene, 1,3-	106-99-0	9.3E-04	
		1.0E-01	I			Butanol, N-	71-36-3		1.4E+02
1.9E-03	P	2.0E-01	I			Butyl Benzyl Phthlate	85-68-7	1.7E+00	2.7E+02
		2.0E+00	P			Butyl alcohol, sec-	78-92-2		2.7E+03
		5.0E-02	I			Butylate	2008-41-5		6.8E+01
2.0E-04	C					Butylated hydroxyanisole	25013-16-5	1.6E+01	
		5.0E-02	P	V		Butylbenzene, n-	104-51-8		6.8E+01
		1.0E+00	I			Butylphthalyl Butylglycolate	85-70-1		1.4E+03
		2.0E-02	A			Cacodylic Acid	75-60-5		2.7E+01
		1.0E-03	I			Cadmium (Diet)	7440-43-9		1.4E+00
		5.0E-04	I			Cadmium (Water)	7440-43-9		
		5.0E-01	I			Caprolactam	105-60-2		6.8E+02
1.5E-01	C	2.0E-03	I			Captafol	2425-06-1	2.1E-02	2.7E+00
2.3E-03	C	1.3E-01	I			Captan	133-06-2	1.4E+00	1.8E+02
		1.0E-01	I			Carbaryl	63-25-2		1.4E+02
		5.0E-03	I			Carbofuran	1563-66-2		6.8E+00
		1.0E-01	I	V		Carbon Disulfide	75-15-0		1.4E+02
7.0E-02	I	4.0E-03	I	V		Carbon Tetrachloride	56-23-5	4.5E-02	5.4E+00
		1.0E-02	I			Carbosulfan	55285-14-8		1.4E+01
		1.0E-01	I			Carboxin	5234-68-4		1.4E+02
						Ceric oxide	1306-38-3		
		1.0E-01	I			Chloral Hydrate	302-17-0		1.4E+02
		1.5E-02	I			Chloramben	133-90-4		2.0E+01
4.0E-01	H					Chloranil	118-75-2	7.8E-03	
3.5E-01	I	5.0E-04	I			Chlordane	12789-03-6	9.0E-03	6.8E-01
1.0E+01	I	3.0E-04	I			Chlordecone (Kepone)	143-50-0	3.2E-04	4.1E-01
		7.0E-04	A			Chlorfenvinphos	470-90-6		9.5E-01
		2.0E-02	I			Chlorimuron, Ethyl-	90982-32-4		2.7E+01
		1.0E-01	I			Chlorine	7782-50-5		1.4E+02
		3.0E-02	I			Chlorine Dioxide	10049-04-4		4.1E+01
		3.0E-02	I			Chlorite (Sodium Salt)	7758-19-2		4.1E+01
				V		Chloro-1,1-difluoroethane, 1-	75-68-3		
		2.0E-02	H	V		Chloro-1,3-butadiene, 2-	126-99-8		2.7E+01
4.6E-01	H					Chloro-2-methylaniline HCl, 4-	3165-93-3	6.9E-03	
1.0E-01	P	3.0E-03	X			Chloro-2-methylaniline, 4-	95-69-2	3.2E-02	4.1E+00
2.7E-01	X			V		Chloroacetaldehyde, 2-	107-20-0	1.2E-02	
		2.0E-03	H			Chloroacetic Acid	79-11-8		2.7E+00
						Chloroacetophenone, 2-	532-27-4		
2.0E-01	P	4.0E-03	I			Chloroaniline, p-	106-47-8	1.6E-02	5.4E+00
		2.0E-02	I	V		Chlorobenzene	108-90-7		2.7E+01
1.1E-01	C	2.0E-02	I			Chlorobenzilate	510-15-6	2.9E-02	2.7E+01
		3.0E-02	X			Chlorobenzoic Acid, p-	74-11-3		4.1E+01
		3.0E-03	P	V		Chlorobenzotrifluoride, 4-	98-56-6		4.1E+00
		4.0E-02	P	V		Chlorobutane, 1-	109-69-3		5.4E+01
				V		Chlorodifluoromethane	75-45-6		
		2.0E-02	P		M	Chloroethanol, 2-	107-07-3		2.7E+01
3.1E-02	C	1.0E-02	I	V		Chloroform	67-66-3	1.0E-01	1.4E+01
				V		Chloromethane	74-87-3		
2.4E+00	C			V		Chloromethyl Methyl Ether	107-30-2	1.3E-03	
		8.0E-02	I	V		Chloronaphthalene, Beta-	91-58-7		1.1E+02
3.0E-01	P	3.0E-03	P			Chloronitrobenzene, o-	88-73-3	1.1E-02	4.1E+00
6.3E-03	P	1.0E-03	P			Chloronitrobenzene, p-	100-00-5	5.0E-01	1.4E+00
		5.0E-03	I	V		Chlorophenol, 2-	95-57-8		6.8E+00
				V		Chloropicrin	76-06-2		
3.1E-03	C	1.5E-02	I			Chlorothalonil	1897-45-6	1.0E+00	2.0E+01
		2.0E-02	I	V		Chlorotoluene, o-	95-49-8		2.7E+01
		2.0E-02	X	V		Chlorotoluene, p-	106-43-4		2.7E+01
2.4E+02	C					Chlorozotocin	54749-90-5	1.3E-05	
		2.0E-01	I			Chlorpropham	101-21-3		2.7E+02
		1.0E-03	A			Chlorpyrifos	2921-88-2		1.4E+00
		1.0E-02	H			Chlorpyrifos Methyl	5598-13-0		1.4E+01
		5.0E-02	I			Chlorsulfuron	64902-72-3		6.8E+01
		8.0E-04	H			Chlorthiophos	60238-56-4		1.1E+00
		1.5E+00	I			Chromium(III), Insoluble Salts	16065-83-1		2.0E+03
5.0E-01	J	3.0E-03	I		M	Chromium(VI)	18540-29-9	6.3E-03	4.1E+00
						Chromium, Total	7440-47-3		
		3.0E-04	P			Cobalt	7440-48-4		4.1E-01
					M	Coke Oven Emissions	8007-45-2		
		4.0E-02	H			Copper	7440-50-8		5.4E+01

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		5.0E-02	I			Cresol, m-	108-39-4		6.8E+01
		5.0E-02	I			Cresol, o-	95-48-7		6.8E+01
		1.0E-01	A			Cresol, p-	106-44-5		1.4E+02
		1.0E-01	A			Cresol, p-chloro-m-	59-50-7		1.4E+02
		1.0E-01	A			Cresols	1319-77-3		1.4E+02
1.9E+00	H	1.0E-03	P	V		Crotonaldehyde, trans-	123-73-9	1.7E-03	1.4E+00
		1.0E-01	I	V		Cumene	98-82-8		1.4E+02
2.2E-01	C					Cupferron	135-20-6	1.4E-02	
8.4E-01	H	2.0E-03	H			Cyanazine	21725-46-2	3.8E-03	2.7E+00
						Cyanides			
		1.0E-03	I			~Calcium Cyanide	592-01-8		1.4E+00
		5.0E-03	I			~Copper Cyanide	544-92-3		6.8E+00
		6.0E-04	I	V		~Cyanide (CN-)	57-12-5		8.1E-01
		1.0E-03	I	V		~Cyanogen	460-19-5		1.4E+00
		9.0E-02	I	V		~Cyanogen Bromide	506-68-3		1.2E+02
		5.0E-02	I	V		~Cyanogen Chloride	506-77-4		6.8E+01
		6.0E-04	I	V		~Hydrogen Cyanide	74-90-8		8.1E-01
		2.0E-03	I			~Potassium Cyanide	151-50-8		2.7E+00
		5.0E-03	I			~Potassium Silver Cyanide	506-61-6		6.8E+00
		1.0E-01	I			~Silver Cyanide	506-64-9		1.4E+02
		1.0E-03	I			~Sodium Cyanide	143-33-9		1.4E+00
		2.0E-04	X			~Thiocyanate	463-56-9		2.7E-01
		5.0E-02	I			~Zinc Cyanide	557-21-1		6.8E+01
				V		Cyclohexane	110-82-7		
2.3E-02	H					Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3	1.4E-01	
		5.0E+00	I			Cyclohexanone	108-94-1		6.8E+03
		5.0E-03	P	V		Cyclohexene	110-83-8		6.8E+00
		2.0E-01	I			Cyclohexylamine	108-91-8		2.7E+02
		5.0E-03	I			Cyhalothrin/karate	68085-85-8		6.8E+00
		1.0E-02	I			Cypermethrin	52315-07-8		1.4E+01
		7.5E-03	I			Cyromazine	66215-27-8		1.0E+01
2.4E-01	I					DDD	72-54-8	1.3E-02	
3.4E-01	I					DDE, p,p'-	72-55-9	9.3E-03	
3.4E-01	I	5.0E-04	I			DDT	50-29-3	9.3E-03	6.8E-01
		1.0E-02	I			Dacthal	1861-32-1		1.4E+01
		3.0E-02	I			Dalapon	75-99-0		4.1E+01
7.0E-04	I	7.0E-03	I			Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5	4.5E+00	9.5E+00
		4.0E-05	I			Demeton	8065-48-3		5.4E-02
1.2E-03	I	6.0E-01	I			Di(2-ethylhexyl)adipate	103-23-1	2.6E+00	8.1E+02
6.1E-02	H					Diallate	2303-16-4	5.2E-02	
		7.0E-04	A			Diazinon	333-41-5		9.5E-01
8.0E-01	P	2.0E-04	P	V	M	Dibromo-3-chloropropane, 1,2-	96-12-8	3.9E-03	2.7E-01
		1.0E-02	I			Dibromobenzene, 1,4-	106-37-6		1.4E+01
8.4E-02	I	2.0E-02	I	V		Dibromochloromethane	124-48-1	3.8E-02	2.7E+01
2.0E+00	I	9.0E-03	I	V		Dibromoethane, 1,2-	106-93-4	1.6E-03	1.2E+01
		1.0E-02	H	V		Dibromomethane (Methylene Bromide)	74-95-3		1.4E+01
		1.0E-01	I			Dibutyl Phthalate	84-74-2		1.4E+02
		3.0E-04	P			Dibutyltin Compounds	NA		4.1E-01
		3.0E-02	I			Dicamba	1918-00-9		4.1E+01
				V		Dichloro-2-butene, 1,4-	764-41-0		
				V		Dichloro-2-butene, cis-1,4-	1476-11-5		
				V		Dichloro-2-butene, trans-1,4-	110-57-6		
5.0E-02	I	4.0E-03	I			Dichloroacetic Acid	79-43-6	6.3E-02	5.4E+00
		9.0E-02	I	V		Dichlorobenzene, 1,2-	95-50-1		1.2E+02
5.4E-03	C	7.0E-02	A	V		Dichlorobenzene, 1,4-	106-46-7	5.8E-01	9.5E+01
4.5E-01	I					Dichlorobenzidine, 3,3'-	91-94-1	7.0E-03	
		9.0E-03	X			Dichlorobenzophenone, 4,4'-	90-98-2		1.2E+01
		2.0E-01	I	V		Dichlorodifluoromethane	75-71-8		2.7E+02
5.7E-03	C	2.0E-01	P	V		Dichloroethane, 1,1-	75-34-3	5.5E-01	2.7E+02
9.1E-02	I	6.0E-03	X	V		Dichloroethane, 1,2-	107-06-2	3.5E-02	8.1E+00
		5.0E-02	I	V		Dichloroethylene, 1,1-	75-35-4		6.8E+01
		9.0E-03	H	V		Dichloroethylene, 1,2- (Mixed Isomers)	540-59-0		1.2E+01
		2.0E-03	I	V		Dichloroethylene, 1,2-cis-	156-59-2		2.7E+00
		2.0E-02	I	V		Dichloroethylene, 1,2-trans-	156-60-5		2.7E+01
		3.0E-03	I			Dichlorophenol, 2,4-	120-83-2		4.1E+00
		1.0E-02	I			Dichlorophenoxy Acetic Acid, 2,4-	94-75-7		1.4E+01
		8.0E-03	I			Dichlorophenoxy)butyric Acid, 4-(2,4-	94-82-6		1.1E+01
3.6E-02	C	9.0E-02	A	V		Dichloropropane, 1,2-	78-87-5	8.8E-02	1.2E+02
		2.0E-02	P	V		Dichloropropane, 1,3-	142-28-9		2.7E+01
		3.0E-03	I			Dichloropropanol, 2,3-	616-23-9		4.1E+00
1.0E-01	I	3.0E-02	I	V		Dichloropropene, 1,3-	542-75-6	3.2E-02	4.1E+01
2.9E-01	I	5.0E-04	I			Dichlorvos	62-73-7	1.1E-02	6.8E-01
		8.0E-03	P	V		Dicyclopentadiene	77-73-6		1.1E+01
1.6E+01	I	5.0E-05	I			Dieldrin	60-57-1	2.0E-04	6.8E-02
						Diesel Engine Exhaust	NA		
		2.0E-03	P			Diethanolamine	111-42-2		2.7E+00
		8.0E-01	I			Diethyl Phthalate	84-66-2		1.1E+03
		3.0E-02	P			Diethylene Glycol Monobutyl Ether	112-34-5		4.1E+01

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		6.0E-02	P			Diethylene Glycol Monoethyl Ether	111-90-0		8.1E+01
		1.0E-03	P			Diethylformamide	617-84-5		1.4E+00
3.5E+02	C					Diethylstilbestrol	56-53-1	9.0E-06	
		8.0E-02	I			Difenzoquat	43222-48-6		1.1E+02
		2.0E-02	I			Diflubenzuron	35367-38-5		2.7E+01
				V		Difluoroethane, 1,1-	75-37-6		
4.4E-02	C			V		Dihydrosafrole	94-58-6	7.2E-02	
				V		Diisopropyl Ether	108-20-3		
		8.0E-02	I	V		Diisopropyl Methylphosphonate	1445-75-6		1.1E+02
		2.0E-02	I			Dimethipin	55290-64-7		2.7E+01
		2.0E-04	I			Dimethoate	60-51-5		2.7E-01
1.4E-02	H					Dimethoxybenzidine, 3,3'-	119-90-4	2.3E-01	
1.7E-03	P	6.0E-02	P			Dimethyl methylphosphonate	756-79-6	1.9E+00	8.1E+01
4.6E+00	C					Dimethylamino azobenzene [p-]	60-11-7	6.9E-04	
5.8E-01	H					Dimethylaniline HCl, 2,4-	21436-96-4	5.4E-03	
2.0E-01	P	2.0E-03	X			Dimethylaniline, 2,4-	95-68-1	1.6E-02	2.7E+00
		2.0E-03	I	V		Dimethylaniline, N,N-	121-69-7		2.7E+00
1.1E+01	P					Dimethylbenzidine, 3,3'-	119-93-7	2.9E-04	
		1.0E-01	P			Dimethylformamide	68-12-2		1.4E+02
		1.0E-04	X			Dimethylhydrazine, 1,1-	57-14-7		1.4E-01
5.5E+02	C					Dimethylhydrazine, 1,2-	540-73-8	5.7E-06	
		2.0E-02	I			Dimethylphenol, 2,4-	105-67-9		2.7E+01
		6.0E-04	I			Dimethylphenol, 2,6-	576-26-1		8.1E-01
		1.0E-03	I			Dimethylphenol, 3,4-	95-65-8		1.4E+00
		1.0E-01	I	V		Dimethylterephthalate	120-61-6		1.4E+02
4.5E-02	C			V		Dimethylvinylchloride	513-37-1	7.0E-02	
		8.0E-05	X			Dinitro-o-cresol, 4,6-	534-52-1		1.1E-01
		2.0E-03	I			Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5		2.7E+00
		1.0E-04	P			Dinitrobenzene, 1,2-	528-29-0		1.4E-01
		1.0E-04	I			Dinitrobenzene, 1,3-	99-65-0		1.4E-01
		1.0E-04	P			Dinitrobenzene, 1,4-	100-25-4		1.4E-01
		2.0E-03	I			Dinitrophenol, 2,4-	51-28-5		2.7E+00
6.8E-01	I					Dinitrotoluene Mixture, 2,4/2,6-	25321-14-6	4.6E-03	
3.1E-01	C	2.0E-03	I			Dinitrotoluene, 2,4-	121-14-2	1.0E-02	2.7E+00
		1.0E-03	P			Dinitrotoluene, 2,6-	606-20-2		1.4E+00
		2.0E-03	S			Dinitrotoluene, 2-Amino-4,6-	35572-78-2		2.7E+00
		2.0E-03	S			Dinitrotoluene, 4-Amino-2,6-	19406-51-0		2.7E+00
		1.0E-03	I			Dinoseb	88-85-7		1.4E+00
1.0E-01	I	3.0E-02	I			Dioxane, 1,4-	123-91-1	3.2E-02	4.1E+01
						Dioxins			
6.2E+03	I					~Hexachlorodibenzo-p-dioxin, Mixture	NA	5.1E-07	
1.3E+05	C	7.0E-10	I			~TCDD, 2,3,7,8-	1746-01-6	2.4E-08	9.5E-07
		3.0E-02	I			Diphenamid	957-51-7		4.1E+01
		8.0E-04	X			Diphenyl Sulfone	127-63-9		1.1E+00
		2.5E-02	I			Diphenylamine	122-39-4		3.4E+01
8.0E-01	I					Diphenylhydrazine, 1,2-	122-66-7	3.9E-03	
		2.2E-03	I			Diquat	85-00-7		3.0E+00
7.4E+00	C					Direct Black 38	1937-37-7	4.3E-04	
7.4E+00	C					Direct Blue 6	2602-46-2	4.3E-04	
6.7E+00	C					Direct Brown 95	16071-86-6	4.7E-04	
		4.0E-05	I			Disulfoton	298-04-4		5.4E-02
		1.0E-02	I	V		Dithiane, 1,4-	505-29-3		1.4E+01
		2.0E-03	I			Diuron	330-54-1		2.7E+00
		4.0E-03	I			Dodine	2439-10-3		5.4E+00
		2.5E-02	I	V		EPTC	759-94-4		3.4E+01
		6.0E-03	I			Endosulfan	115-29-7		8.1E+00
		2.0E-02	I			Endothall	145-73-3		2.7E+01
		3.0E-04	I			Endrin	72-20-8		4.1E-01
9.9E-03	I	6.0E-03	P	V		Epichlorohydrin	106-89-8	3.2E-01	8.1E+00
				V		Epoxybutane, 1,2-	106-88-7		
		5.0E-03	I			Ethephon	16672-87-0		6.8E+00
		5.0E-04	I			Ethion	563-12-2		6.8E-01
		1.0E-01	P			Ethoxyethanol Acetate, 2-	111-15-9		1.4E+02
		4.0E-01	H			Ethoxyethanol, 2-	110-80-5		5.4E+02
		9.0E-01	I	V		Ethyl Acetate	141-78-6		1.2E+03
4.8E-02	H			V		Ethyl Acrylate	140-88-5	6.6E-02	
				V		Ethyl Chloride	75-00-3		
		2.0E-01	I	V		Ethyl Ether	60-29-7		2.7E+02
		9.0E-02	H	V		Ethyl Methacrylate	97-63-2		1.2E+02
		1.0E-05	I			Ethyl-p-nitrophenyl Phosphonate	2104-64-5		1.4E-02
1.1E-02	C	1.0E-01	I	V		Ethylbenzene	100-41-4	2.9E-01	1.4E+02
		7.0E-02	P			Ethylene Cyanohydrin	109-78-4		9.5E+01
		9.0E-02	P			Ethylene Diamine	107-15-3		1.2E+02
		2.0E+00	I			Ethylene Glycol	107-21-1		2.7E+03
		1.0E-01	I			Ethylene Glycol Monobutyl Ether	111-76-2		1.4E+02
3.1E-01	C			V		Ethylene Oxide	75-21-8	1.0E-02	
4.5E-02	C	8.0E-05	I			Ethylene Thiourea	96-45-7	7.0E-02	1.1E-01
6.5E+01	C			V		Ethyleneimine	151-56-4	4.9E-05	

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SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		3.0E+00	I			Ethylphthalyl Ethyl Glycolate	84-72-0		4.1E+03
		8.0E-03	I			Express	101200-48-0		1.1E+01
		2.5E-04	I			Fenamiphos	22224-92-6		3.4E-01
		2.5E-02	I			Fenpropathrin	39515-41-8		3.4E+01
		1.3E-02	I			Fluometuron	2164-17-2		1.8E+01
		4.0E-02	C			Fluoride	16984-48-8		5.4E+01
		6.0E-02	I			Fluorine (Soluble Fluoride)	7782-41-4		8.1E+01
		8.0E-02	I			Fluridone	59756-60-4		1.1E+02
		2.0E-02	I			Flurprimidol	56425-91-3		2.7E+01
		6.0E-02	I			Flutolanil	66332-96-5		8.1E+01
		1.0E-02	I			Fluvalinate	69409-94-5		1.4E+01
3.5E-03	I	1.0E-01	I			Folpet	133-07-3	9.0E-01	1.4E+02
1.9E-01	I					Fomesafen	72178-02-0	1.7E-02	
		2.0E-03	I			Fonofos	944-22-9		2.7E+00
		2.0E-01	I			Formaldehyde	50-00-0		2.7E+02
		9.0E-01	P			Formic Acid	64-18-6		1.2E+03
		3.0E+00	I			Fosetyl-AL	39148-24-8		4.1E+03
						Furans			
		1.0E-03	X	V		~Dibenzofuran	132-64-9		1.4E+00
		1.0E-03	I	V		~Furan	110-00-9		1.4E+00
		9.0E-01	I	V		~Tetrahydrofuran	109-99-9		1.2E+03
3.8E+00	H					Furazolidone	67-45-8	8.3E-04	
		3.0E-03	I			Furfural	98-01-1		4.1E+00
1.5E+00	C					Furium	531-82-8	2.1E-03	
3.0E-02	I					Furmecyclox	60568-05-0	1.1E-01	
		4.0E-04	I			Glufosinate, Ammonium	77182-82-2		5.4E-01
						Glutaraldehyde	111-30-8		
		4.0E-04	I			Glycidyl	765-34-4		5.4E-01
		1.0E-01	I			Glyphosate	1071-83-6		1.4E+02
		3.0E-03	I			Goal	42874-03-3		4.1E+00
		3.0E-03	A			Guthion	86-50-0		4.1E+00
		5.0E-05	I			Haloxyfop, Methyl	69806-40-2		6.8E-02
		1.3E-02	I			Harmony	79277-27-3		1.8E+01
4.5E+00	I	5.0E-04	I			Heptachlor	76-44-8	7.0E-04	6.8E-01
9.1E+00	I	1.3E-05	I			Heptachlor Epoxide	1024-57-3	3.5E-04	1.8E-02
		2.0E-03	I			Hexabromobenzene	87-82-1		2.7E+00
		2.0E-04	I			Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2		2.7E-01
1.6E+00	I	8.0E-04	I			Hexachlorobenzene	118-74-1	2.0E-03	1.1E+00
7.8E-02	I	1.0E-03	P			Hexachlorobutadiene	87-68-3	4.0E-02	1.4E+00
6.3E+00	I	8.0E-03	A			Hexachlorocyclohexane, Alpha-	319-84-6	5.0E-04	1.1E+01
1.8E+00	I					Hexachlorocyclohexane, Beta-	319-85-7	1.8E-03	
1.1E+00	C	3.0E-04	I			Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	2.9E-03	4.1E-01
1.8E+00	I					Hexachlorocyclohexane, Technical	608-73-1	1.8E-03	
		6.0E-03	I			Hexachlorocyclopentadiene	77-47-4		8.1E+00
4.0E-02	I	7.0E-04	I			Hexachloroethane	67-72-1	7.9E-02	9.5E-01
		3.0E-04	I			Hexachlorophene	70-30-4		4.1E-01
1.1E-01	I	3.0E-03	I			Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	2.9E-02	4.1E+00
				V		Hexamethylene Diisocyanate, 1,6-	822-06-0		
		4.0E-04	P			Hexamethylphosphoramide	680-31-9		5.4E-01
		6.0E-02	H	V		Hexane, N-	110-54-3		8.1E+01
		2.0E+00	P			Hexanedioic Acid	124-04-9		2.7E+03
		5.0E-03	I	V		Hexanone, 2-	591-78-6		6.8E+00
		3.3E-02	I			Hexazinone	51235-04-2		4.5E+01
3.0E+00	I					Hydrazine	302-01-2	1.1E-03	
3.0E+00	I					Hydrazine Sulfate	10034-93-2	1.1E-03	
						Hydrogen Chloride	7647-01-0		
		4.0E-02	C			Hydrogen Fluoride	7664-39-3		5.4E+01
						Hydrogen Sulfide	7783-06-4		
6.0E-02	P	4.0E-02	P			Hydroquinone	123-31-9	5.3E-02	5.4E+01
		1.3E-02	I			Imazalil	35554-44-0		1.8E+01
		2.5E-01	I			Imazaquin	81335-37-7		3.4E+02
		1.0E-02	A			Iodine	7553-56-2		1.4E+01
		4.0E-02	I			Iprodione	36734-19-7		5.4E+01
		7.0E-01	P			Iron	7439-89-6		9.5E+02
		3.0E-01	I			Isobutyl Alcohol	78-83-1		4.1E+02
9.5E-04	I	2.0E-01	I			Isophorone	78-59-1	3.3E+00	2.7E+02
		1.5E-02	I			Isopropalin	33820-53-0		2.0E+01
						Isopropanol	67-63-0		
		1.0E-01	I			Isopropyl Methyl Phosphonic Acid	1832-54-8		1.4E+02
		5.0E-02	I			Isoxaben	82558-50-7		6.8E+01
				V		JP-7	NA		
		7.5E-02	I			Kerb	23950-58-5		1.0E+02
		2.0E-03	I			Lactofen	77501-63-4		2.7E+00
						Lead Compounds			
2.8E-01	C					~Lead acetate	301-04-2	1.1E-02	
						~Lead and Compounds	7439-92-1		
3.8E-02	C					~Lead subacetate	1335-32-6	8.3E-02	
		1.0E-07	I			~Tetraethyl Lead	78-00-2		1.4E-04

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		2.0E-03	I			Linuron	330-55-2		2.7E+00
		2.0E-03	P			Lithium	7439-93-2		2.7E+00
		2.0E-01	I			Londax	83055-99-6		2.7E+02
		5.0E-04	I			MCPA	94-74-6		6.8E-01
		1.0E-02	I			MCPB	94-81-5		1.4E+01
		1.0E-03	I			MCPP	93-65-2		1.4E+00
		2.0E-02	I			Malathion	121-75-5		2.7E+01
		1.0E-01	I			Maleic Anhydride	108-31-6		1.4E+02
		5.0E-01	I			Maleic Hydrazide	123-33-1		6.8E+02
		1.0E-04	P			Malononitrile	109-77-3		1.4E-01
		3.0E-02	H			Mancozeb	8018-01-7		4.1E+01
		5.0E-03	I			Maneb	12427-38-2		6.8E+00
		1.4E-01	I			Manganese (Diet)	7439-96-5		1.9E+02
		2.4E-02	S			Manganese (Non-diet)	7439-96-5		
		9.0E-05	H			Mephosfolan	950-10-7		1.2E-01
		3.0E-02	I			Mepiquat Chloride	24307-26-4		4.1E+01
						Mercury Compounds			
		3.0E-04	I			~Mercuric Chloride (and other Mercury salts)	7487-94-7		4.1E-01
				V		~Mercury (elemental)	7439-97-6		
		1.0E-04	I			~Methyl Mercury	22967-92-6		1.4E-01
		8.0E-05	I			~Phenylmercuric Acetate	62-38-4		1.1E-01
		3.0E-05	I			Merphos	150-50-5		4.1E-02
		3.0E-05	I			Merphos Oxide	78-48-8		4.1E-02
		6.0E-02	I			Metalaxyl	57837-19-1		8.1E+01
		1.0E-04	I	V		Methacrylonitrile	126-98-7		1.4E-01
		5.0E-05	I			Methamidophos	10265-92-6		6.8E-02
		5.0E-01	I			Methanol	67-56-1		6.8E+02
		1.0E-03	I			Methidathion	950-37-8		1.4E+00
		2.5E-02	I			Methomyl	16752-77-5		3.4E+01
4.9E-02	C					Methoxy-5-nitroaniline, 2-	99-59-2	6.4E-02	
		5.0E-03	I			Methoxychlor	72-43-5		6.8E+00
		8.0E-03	P			Methoxyethanol Acetate, 2-	110-49-6		1.1E+01
		5.0E-03	P			Methoxyethanol, 2-	109-86-4		6.8E+00
		1.0E+00	X	V		Methyl Acetate	79-20-9		1.4E+03
		3.0E-02	H	V		Methyl Acrylate	96-33-3		4.1E+01
		6.0E-01	I	V		Methyl Ethyl Ketone (2-Butanone)	78-93-3		8.1E+02
		1.0E-03	P			Methyl Hydrazine	60-34-4		1.4E+00
		8.0E-02	H	V		Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1		1.1E+02
				V		Methyl Isocyanate	624-83-9		
		1.4E+00	I	V		Methyl Methacrylate	80-62-6		1.9E+03
		2.5E-04	I			Methyl Parathion	298-00-0		3.4E-01
		6.0E-02	X			Methyl Phosphonic Acid	993-13-5		8.1E+01
		6.0E-03	H	V		Methyl Styrene (Mixed Isomers)	25013-15-4		8.1E+00
9.9E-02	C					Methyl methanesulfonate	66-27-3	3.2E-02	
1.8E-03	C			V		Methyl tert-Butyl Ether (MTBE)	1634-04-4	1.8E+00	
		2.0E-04	X			Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2		2.7E-01
9.0E-03	P	2.0E-02	X			Methyl-5-Nitroaniline, 2-	99-55-8	3.5E-01	2.7E+01
8.3E+00	C					Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	3.8E-04	
1.3E-01	C					Methylaniline Hydrochloride, 2-	636-21-5	2.4E-02	
		1.0E-02	A			Methylarsonic acid	124-58-3		1.4E+01
		2.0E-04	X			Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7		2.7E-01
		2.0E-04	X			Methylbenzene-1,4-diamine sulfate, 2-	615-50-9		2.7E-01
2.2E+01	C				M	Methylcholanthrene, 3-	56-49-5	1.4E-04	
2.0E-03	I	6.0E-03	I	V	M	Methylene Chloride	75-09-2	1.6E+00	8.1E+00
1.0E-01	P	2.0E-03	P		M	Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	3.2E-02	2.7E+00
4.6E-02	I					Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	6.9E-02	
1.6E+00	C					Methylenebisbenzenamine, 4,4'-	101-77-9	2.0E-03	
						Methylenediphenyl Diisocyanate	101-68-8		
		7.0E-02	H	V		Methylstyrene, Alpha-	98-83-9		9.5E+01
		1.5E-01	I			Metolachlor	51218-45-2		2.0E+02
		2.5E-02	I			Metribuzin	21087-64-9		3.4E+01
		3.0E+00	P	V		Mineral oils	8012-95-1		4.1E+03
1.8E+01	C	2.0E-04	I			Mirex	2385-85-5	1.8E-04	2.7E-01
		2.0E-03	I			Molinate	2212-67-1		2.7E+00
		5.0E-03	I			Molybdenum	7439-98-7		6.8E+00
		1.0E-01	I			Monochloramine	10599-90-3		1.4E+02
		2.0E-03	P			Monomethylaniline	100-61-8		2.7E+00
		3.0E-04	X			N,N'-Diphenyl-1,4-benzenediamine	74-31-7		4.1E-01
		2.0E-03	I			Naled	300-76-5		2.7E+00
		3.0E-02	X	V		Naphtha, High Flash Aromatic (HFAN)	64724-95-6		4.1E+01
1.8E+00	C					Naphthylamine, 2-	91-59-8	1.8E-03	
		1.0E-01	I			Napropamide	15299-99-7		1.4E+02
		5.0E-02	C			Nickel Carbonyl	13463-39-3		6.8E+01
		5.0E-02	C			Nickel Oxide	1313-99-1		6.8E+01
		5.0E-02	C			Nickel Refinery Dust	NA		6.8E+01
		2.0E-02	I			Nickel Soluble Salts	7440-02-0		2.7E+01
1.7E+00	C	5.0E-02	C			Nickel Subsulfide	12035-72-2	1.9E-03	6.8E+01
		1.6E+00	I			Nitrate	14797-55-8		2.2E+03

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
						Nitrate + Nitrite (as N)	NA		
		1.0E-01	I			Nitrite	14797-65-0		1.4E+02
		1.0E-02	X			Nitroaniline, 2-	88-74-4		1.4E+01
2.0E-02	P	4.0E-03	P			Nitroaniline, 4-	100-01-6	1.6E-01	5.4E+00
		2.0E-03	I	V		Nitrobenzene	98-95-3		2.7E+00
		3.0E+03	P			Nitrocellulose	9004-70-0		4.1E+06
		7.0E-02	H			Nitrofurantoin	67-20-9		9.5E+01
1.3E+00	C					Nitrofurazone	59-87-0	2.4E-03	
1.7E-02	P	1.0E-04	P			Nitroglycerin	55-63-0	1.9E-01	1.4E-01
		1.0E-01	I			Nitroguanidine	556-88-7		1.4E+02
				V		Nitromethane	75-52-5		
				V		Nitropropane, 2-	79-46-9		
2.7E+01	C				M	Nitroso-N-ethylurea, N-	759-73-9	1.2E-04	
1.2E+02	C				M	Nitroso-N-methylurea, N-	684-93-5	2.6E-05	
5.4E+00	I			V		Nitroso-di-N-butylamine, N-	924-16-3	5.8E-04	
7.0E+00	I					Nitroso-di-N-propylamine, N-	621-64-7	4.5E-04	
2.8E+00	I					Nitrosodiethanolamine, N-	1116-54-7	1.1E-03	
1.5E+02	I				M	Nitrosodiethylamine, N-	55-18-5	2.1E-05	
5.1E+01	I	8.0E-06	P		M	Nitrosodimethylamine, N-	62-75-9	6.2E-05	1.1E-02
4.9E-03	I					Nitrosodiphenylamine, N-	86-30-6	6.4E-01	
2.2E+01	I					Nitrosomethylethylamine, N-	10595-95-6	1.4E-04	
6.7E+00	C					Nitrosomorpholine [N-]	59-89-2	4.7E-04	
9.4E+00	C					Nitrosopiperidine [N-]	100-75-4	3.4E-04	
2.1E+00	I					Nitrosopyrrolidine, N-	930-55-2	1.5E-03	
		1.0E-04	X			Nitrotoluene, m-	99-08-1		1.4E-01
2.2E-01	P	9.0E-04	P	V		Nitrotoluene, o-	88-72-2	1.4E-02	1.2E+00
1.6E-02	P	4.0E-03	P			Nitrotoluene, p-	99-99-0	2.0E-01	5.4E+00
		3.0E-04	X	V		Nonane, n-	111-84-2		4.1E-01
		4.0E-02	I			Norflurazon	27314-13-2		5.4E+01
		7.0E-04	I			Nustar	85509-19-9		9.5E-01
		3.0E-03	I			Octabromodiphenyl Ether	32536-52-0		4.1E+00
		5.0E-02	I			Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetra (HMX)	2691-41-0		6.8E+01
		2.0E-03	H			Octamethylpyrophosphoramide	152-16-9		2.7E+00
		1.2E-02	P			Octyl Phthalate, di-N-	117-84-0		1.6E+01
		5.0E-02	I			Oryzalin	19044-88-3		6.8E+01
		5.0E-03	I			Oxadiazon	19666-30-9		6.8E+00
		2.5E-02	I			Oxamyl	23135-22-0		3.4E+01
		1.3E-02	I			Paclobutrazol	76738-62-0		1.8E+01
		4.5E-03	I			Paraquat Dichloride	1910-42-5		6.1E+00
		6.0E-03	H			Parathion	56-38-2		8.1E+00
		5.0E-02	H			Pebulate	1114-71-2		6.8E+01
		4.0E-02	I			Pendimethalin	40487-42-1		5.4E+01
		2.0E-03	I			Pentabromodiphenyl Ether	32534-81-9		2.7E+00
		1.0E-04	I			Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9		1.4E-01
		8.0E-04	I			Pentachlorobenzene	608-93-5		1.1E+00
9.0E-02	P					Pentachloroethane	76-01-7	3.5E-02	
2.6E-01	H	3.0E-03	I			Pentachloronitrobenzene	82-68-8	1.2E-02	4.1E+00
4.0E-01	I	5.0E-03	I			Pentachlorophenol	87-86-5	7.9E-03	6.8E+00
4.0E-03	X	2.0E-03	P			Pentaerythritol tetranitrate (PETN)	78-11-5	7.9E-01	2.7E+00
				V		Pentane, n-	109-66-0		
						Perchlorates			
		7.0E-04	I			~Ammonium Perchlorate	7790-98-9		9.5E-01
		7.0E-04	I			~Lithium Perchlorate	7791-03-9		9.5E-01
		7.0E-04	I			~Perchlorate and Perchlorate Salts	14797-73-0		9.5E-01
		7.0E-04	I			~Potassium Perchlorate	7778-74-7		9.5E-01
		7.0E-04	I			~Sodium Perchlorate	7601-89-0		9.5E-01
		5.0E-02	I			Permethrin	52645-53-1		6.8E+01
2.2E-03	C					Phenacetin	62-44-2	1.4E+00	
		2.5E-01	I			Phenmedipham	13684-63-4		3.4E+02
		3.0E-01	I			Phenol	108-95-2		4.1E+02
		5.0E-04	X			Phenothiazine	92-84-2		6.8E-01
		6.0E-03	I			Phenylenediamine, m-	108-45-2		8.1E+00
4.7E-02	H					Phenylenediamine, o-	95-54-5	6.7E-02	
		1.9E-01	H			Phenylenediamine, p-	106-50-3		2.6E+02
1.9E-03	H					Phenylphenol, 2-	90-43-7	1.6E+00	
		2.0E-04	H			Phorate	298-02-2		2.7E-01
				V		Phosgene	75-44-5		
		2.0E-02	I			Phosmet	732-11-6		2.7E+01
						Phosphates, Inorganic			
		4.9E+01	P			~Aluminum metaphosphate	13776-88-0		6.6E+04
		4.9E+01	P			~Ammonium polyphosphate	68333-79-9		6.6E+04
		4.9E+01	P			~Calcium pyrophosphate	7790-76-3		6.6E+04
		4.9E+01	P			~Diammonium phosphate	7783-28-0		6.6E+04
		4.9E+01	P			~Dicalcium phosphate	7757-93-9		6.6E+04
		4.9E+01	P			~Dimagnesium phosphate	7782-75-4		6.6E+04
		4.9E+01	P			~Dipotassium phosphate	7758-11-4		6.6E+04
		4.9E+01	P			~Disodium phosphate	7558-79-4		6.6E+04
		4.9E+01	P			~Monoaluminum phosphate	13530-50-2		6.6E+04

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		4.9E+01	P			~Monoammonium phosphate	7722-76-1		6.6E+04
		4.9E+01	P			~Monocalcium phosphate	7758-23-8		6.6E+04
		4.9E+01	P			~Monomagnesium phosphate	7757-86-0		6.6E+04
		4.9E+01	P			~Monopotassium phosphate	7778-77-0		6.6E+04
		4.9E+01	P			~Monosodium phosphate	7558-80-7		6.6E+04
		4.9E+01	P			~Polyphosphoric acid	8017-16-1		6.6E+04
		4.9E+01	P			~Potassium tripolyphosphate	13845-36-8		6.6E+04
		4.9E+01	P			~Sodium acid pyrophosphate	7758-16-9		6.6E+04
		4.9E+01	P			~Sodium aluminum phosphate (acidic)	7785-88-8		6.6E+04
		4.9E+01	P			~Sodium aluminum phosphate (anhydrous)	10279-59-1		6.6E+04
		4.9E+01	P			~Sodium aluminum phosphate (tetrahydrate)	10305-76-7		6.6E+04
		4.9E+01	P			~Sodium hexametaphosphate	10124-56-8		6.6E+04
		4.9E+01	P			~Sodium polyphosphate	68915-31-1		6.6E+04
		4.9E+01	P			~Sodium trimetaphosphate	7785-84-4		6.6E+04
		4.9E+01	P			~Sodium tripolyphosphate	7758-29-4		6.6E+04
		4.9E+01	P			~Tetrapotassium phosphate	7320-34-5		6.6E+04
		4.9E+01	P			~Tetrasodium pyrophosphate	7722-88-5		6.6E+04
		4.9E+01	P			~Trialuminum sodium tetra decahydrogenoctaorthophosphate (dihydrate)	15136-87-5		6.6E+04
		4.9E+01	P			~Tricalcium phosphate	7758-87-4		6.6E+04
		4.9E+01	P			~Trimagnesium phosphate	7757-87-1		6.6E+04
		4.9E+01	P			~Tripotassium phosphate	7778-53-2		6.6E+04
		4.9E+01	P			~Trisodium phosphate	7601-54-9		6.6E+04
		3.0E-04	I			Phosphine	7803-51-2		4.1E-01
		4.9E+01	P			Phosphoric Acid	7664-38-2		6.6E+04
		2.0E-05	I			Phosphorus, White	7723-14-0		2.7E-02
		1.0E+00	H			Phthalic Acid, P-	100-21-0		1.4E+03
		2.0E+00	I			Phthalic Anhydride	85-44-9		2.7E+03
		7.0E-02	I			Picloram	1918-02-1		9.5E+01
		1.0E-04	X			Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3		1.4E-01
		1.0E-02	I			Pirimiphos, Methyl	29232-93-7		1.4E+01
3.0E+01	C	7.0E-06	H			Polybrominated Biphenyls	59536-65-1	1.1E-04	9.5E-03
						Polychlorinated Biphenyls (PCBs)			
7.0E-02	S	7.0E-05	I			~Aroclor 1016	12674-11-2	4.5E-02	9.5E-02
2.0E+00	S			V		~Aroclor 1221	11104-28-2	1.6E-03	
2.0E+00	S			V		~Aroclor 1232	11141-16-5	1.6E-03	
2.0E+00	S					~Aroclor 1242	53469-21-9	1.6E-03	
2.0E+00	S					~Aroclor 1248	12672-29-6	1.6E-03	
2.0E+00	S	2.0E-05	I			~Aroclor 1254	11097-69-1	1.6E-03	2.7E-02
2.0E+00	S					~Aroclor 1260	11096-82-5	1.6E-03	
3.9E+00	E	3.3E-05	E			~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Hexachlorobiphenyl, 2,3,3',4,4',5'- (PCB 157)	69782-90-7	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	38380-08-4	8.1E-04	4.5E-02
3.9E+03	E	3.3E-08	E			~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	8.1E-07	4.5E-05
3.9E+00	E	3.3E-05	E			~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	8.1E-04	4.5E-02
3.9E+00	E	3.3E-05	E			~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	8.1E-04	4.5E-02
1.3E+04	E	1.0E-08	E			~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	2.4E-07	1.4E-05
2.0E+00	I					~Polychlorinated Biphenyls (high risk)	1336-36-3	1.6E-03	
4.0E-01	I					~Polychlorinated Biphenyls (low risk)	1336-36-3		
7.0E-02	I					~Polychlorinated Biphenyls (lowest risk)	1336-36-3		
1.3E+01	E	1.0E-05	E			~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	2.4E-04	1.4E-02
3.9E+01	E	3.3E-06	E			~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	8.1E-05	4.5E-03
						Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9		
						Polynuclear Aromatic Hydrocarbons (PAHs)			
		6.0E-02	I	V		~Acenaphthene	83-32-9		8.1E+01
		3.0E-01	I	V		~Anthracene	120-12-7		4.1E+02
7.3E-01	E				M	~Benz[a]anthracene	56-55-3	4.3E-03	
1.2E+00	C					~Benzo(j)fluoranthene	205-82-3	2.6E-03	
7.3E+00	I				M	~Benzo[a]pyrene	50-32-8	4.3E-04	
7.3E-01	E				M	~Benzo[b]fluoranthene	205-99-2	4.3E-03	
7.3E-02	E				M	~Benzo[k]fluoranthene	207-08-9	4.3E-02	
7.3E-03	E				M	~Chrysene	218-01-9	4.3E-01	
7.3E+00	E				M	~Dibenz[a,h]anthracene	53-70-3	4.3E-04	
1.2E+01	C					~Dibenzo(a,e)pyrene	192-65-4	2.6E-04	
2.5E+02	C				M	~Dimethylbenz(a)anthracene, 7,12-	57-97-6	1.3E-05	
		4.0E-02	I			~Fluoranthene	206-44-0		5.4E+01
		4.0E-02	I	V		~Fluorene	86-73-7		5.4E+01
7.3E-01	E				M	~Indeno[1,2,3-cd]pyrene	193-39-5	4.3E-03	
2.9E-02	P	7.0E-02	A	V		~Methylnaphthalene, 1-	90-12-0	1.1E-01	9.5E+01
		4.0E-03	I	V		~Methylnaphthalene, 2-	91-57-6		5.4E+00
		2.0E-02	I	V		~Naphthalene	91-20-3		2.7E+01
1.2E+00	C					~Nitropyrene, 4-	57835-92-4	2.6E-03	
		3.0E-02	I	V		~Pyrene	129-00-0		4.1E+01
1.5E-01	I	9.0E-03	I			Prochloraz	67747-09-5	2.1E-02	1.2E+01
		6.0E-03	H			Profluralin	26399-36-0		8.1E+00
		1.5E-02	I			Prometon	1610-18-0		2.0E+01

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Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 1
SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		4.0E-03	I			Prometryn	7287-19-6		5.4E+00
		1.3E-02	I			Propachlor	1918-16-7		1.8E+01
		5.0E-03	I			Propanil	709-98-8		6.8E+00
		2.0E-02	I			Propargite	2312-35-8		2.7E+01
		2.0E-03	I			Propargyl Alcohol	107-19-7		2.7E+00
		2.0E-02	I			Propazine	139-40-2		2.7E+01
		2.0E-02	I			Propham	122-42-9		2.7E+01
		1.3E-02	I			Propiconazole	60207-90-1		1.8E+01
				V		Propionaldehyde	123-38-6		
		1.0E-01	X	V		Propyl benzene	103-65-1		1.4E+02
				V		Propylene	115-07-1		
		2.0E+01	P			Propylene Glycol	57-55-6		2.7E+04
						Propylene Glycol Dinitrate	6423-43-4		
		7.0E-01	H			Propylene Glycol Monoethyl Ether	1569-02-4		9.5E+02
		7.0E-01	H			Propylene Glycol Monomethyl Ether	107-98-2		9.5E+02
2.4E-01	I			V		Propylene Oxide	75-56-9	1.3E-02	
		2.5E-01	I			Pursuit	81335-77-5		3.4E+02
		2.5E-02	I			Pydrin	51630-58-1		3.4E+01
		1.0E-03	I	V		Pyridine	110-86-1		1.4E+00
		5.0E-04	I			Quinalphos	13593-03-8		6.8E-01
3.0E+00	I					Quinoline	91-22-5	1.1E-03	
						Refractory Ceramic Fibers	NA		
		3.0E-02	I			Resmethrin	10453-86-8		4.1E+01
		5.0E-02	H			Ronnel	299-84-3		6.8E+01
		4.0E-03	I			Rotenone	83-79-4		5.4E+00
2.2E-01	C				M	Safrole	94-59-7	1.4E-02	
		2.5E-02	I			Savey	78587-05-0		3.4E+01
		5.0E-03	I			Selenious Acid	7783-00-8		6.8E+00
		5.0E-03	I			Selenium	7782-49-2		6.8E+00
		5.0E-03	C			Selenium Sulfide	7446-34-6		6.8E+00
		9.0E-02	I			Sethoxydim	74051-80-2		1.2E+02
						Silica (crystalline, respirable)	7631-86-9		
		5.0E-03	I			Silver	7440-22-4		6.8E+00
1.2E-01	H	5.0E-03	I			Simazine	122-34-9	2.6E-02	6.8E+00
		1.3E-02	I			Sodium Acifluorfen	62476-59-9		1.8E+01
		4.0E-03	I			Sodium Azide	26628-22-8		5.4E+00
2.7E-01	H	3.0E-02	I			Sodium Diethyldithiocarbamate	148-18-5	1.2E-02	4.1E+01
		5.0E-02	A			Sodium Fluoride	7681-49-4		6.8E+01
		2.0E-05	I			Sodium Fluoroacetate	62-74-8		2.7E-02
		1.0E-03	H			Sodium Metavanadate	13718-26-8		1.4E+00
2.4E-02	H	3.0E-02	I			Stirofos (Tetrachlorovinphos)	961-11-5	1.3E-01	4.1E+01
		6.0E-01	I			Strontium, Stable	7440-24-6		8.1E+02
		3.0E-04	I			Strychnine	57-24-9		4.1E-01
		2.0E-01	I	V		Styrene	100-42-5		2.7E+02
		1.0E-03	P			Sulfolane	126-33-0		1.4E+00
		8.0E-04	P			Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9		1.1E+00
						Sulfuric Acid	7664-93-9		
		2.5E-02	I			Systhane	88671-89-0		3.4E+01
		3.0E-02	H			TCMTB	21564-17-0		4.1E+01
		7.0E-02	I			Tebuthiuron	34014-18-1		9.5E+01
		2.0E-02	H			Temephos	3383-96-8		2.7E+01
		1.3E-02	I			Terbacil	5902-51-2		1.8E+01
		2.5E-05	H			Terbufos	13071-79-9		3.4E-02
		1.0E-03	I			Terbutryn	886-50-0		1.4E+00
		1.0E-04	I			Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1		1.4E-01
		3.0E-04	I			Tetrachlorobenzene, 1,2,4,5-	95-94-3		4.1E-01
2.6E-02	I	3.0E-02	I	V		Tetrachloroethane, 1,1,1,2-	630-20-6	1.2E-01	4.1E+01
2.0E-01	I	2.0E-02	I	V		Tetrachloroethane, 1,1,2,2-	79-34-5	1.6E-02	2.7E+01
2.1E-03	I	6.0E-03	I	V		Tetrachloroethylene	127-18-4	1.5E+00	8.1E+00
		3.0E-02	I			Tetrachlorophenol, 2,3,4,6-	58-90-2		4.1E+01
2.0E+01	H					Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1	1.6E-04	
		5.0E-04	I			Tetraethyl Dithiopyrophosphate	3689-24-5		6.8E-01
				V		Tetrafluoroethane, 1,1,1,2-	811-97-2		
		4.0E-03	P			Tetryl (Trinitrophenylmethylnitramine)	479-45-8		5.4E+00
		7.0E-06	X			Thallium (I) Nitrate	10102-45-1		9.5E-03
		1.0E-05	X			Thallium (Soluble Salts)	7440-28-0		1.4E-02
		6.0E-06	X			Thallium Acetate	563-68-8		8.1E-03
		2.0E-05	X			Thallium Carbonate	6533-73-9		2.7E-02
		6.0E-06	X			Thallium Chloride	7791-12-0		8.1E-03
		2.0E-05	X			Thallium Sulfate	7446-18-6		2.7E-02
		1.0E-02	I			Thiobencarb	28249-77-6		1.4E+01
		7.0E-02	X			Thiodiglycol	111-48-8		9.5E+01
		3.0E-04	H			Thiofanox	39196-18-4		4.1E-01
		8.0E-02	I			Thiophanate, Methyl	23564-05-8		1.1E+02
		5.0E-03	I			Thiram	137-26-8		6.8E+00
		6.0E-01	H			Tin	7440-31-5		8.1E+02
						Titanium Tetrachloride	7550-45-0		
		8.0E-02	I	V		Toluene	108-88-3		1.1E+02

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SFO (mg/kg-day)$^{-1}$	key	RfD_o (mg/kg-day)	key	voc	mutagen	Analyte	CAS No.	Carcinogenic SL - TR=1.0E-6 (mg/kg)	Noncarcinogenic SL - HI=1 (mg/kg)
		6.0E-01	H			Toluene-2,5-diamine	95-70-5		8.1E+02
3.0E-02	P	4.0E-03	X			Toluidine, p-	106-49-0	1.1E-01	5.4E+00
1.1E+00	I					Toxaphene	8001-35-2	2.9E-03	
		7.5E-03	I			Tralomethrin	66841-25-6		1.0E+01
		3.0E-04	A			Tri-n-butyltin	688-73-3		4.1E-01
		8.0E+01	X		M	Triacetin	102-76-1		1.1E+05
		1.3E-02	I			Triallate	2303-17-5		1.8E+01
		1.0E-02	I			Triasulfuron	82097-50-5		1.4E+01
		5.0E-03	I			Tribromobenzene, 1,2,4-	615-54-3		6.8E+00
9.0E-03	P	1.0E-02	P			Tributyl Phosphate	126-73-8	3.5E-01	1.4E+01
		3.0E-04	P			Tributyltin Compounds	NA		4.1E-01
		3.0E-04	I			Tributyltin Oxide	56-35-9		4.1E-01
		3.0E+01	I	V		Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1		4.1E+04
7.0E-02	I	2.0E-02	I			Trichloroacetic Acid	76-03-9	4.5E-02	2.7E+01
2.9E-02	H					Trichloroaniline HCl, 2,4,6-	33663-50-2	1.1E-01	
7.0E-03	X	3.0E-05	X			Trichloroaniline, 2,4,6-	634-93-5	4.5E-01	4.1E-02
		8.0E-04	X	V		Trichlorobenzene, 1,2,3-	87-61-6		1.1E+00
2.9E-02	P	1.0E-02	I	V		Trichlorobenzene, 1,2,4-	120-82-1	1.1E-01	1.4E+01
		2.0E+00	I	V		Trichloroethane, 1,1,1-	71-55-6		2.7E+03
5.7E-02	I	4.0E-03	I	V		Trichloroethane, 1,1,2-	79-00-5	5.5E-02	5.4E+00
4.6E-02	I	5.0E-04	I	V	M	Trichloroethylene	79-01-6	6.9E-02	6.8E-01
		3.0E-01	I	V		Trichlorofluoromethane	75-69-4		4.1E+02
		1.0E-01	I			Trichlorophenol, 2,4,5-	95-95-4		1.4E+02
1.1E-02	I	1.0E-03	P			Trichlorophenol, 2,4,6-	88-06-2	2.9E-01	1.4E+00
		1.0E-02	I			Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5		1.4E+01
		8.0E-03	I			Trichlorophenoxypropionic acid, -2,4,5	93-72-1		1.1E+01
		5.0E-03	I	V		Trichloropropane, 1,1,2-	598-77-6		6.8E+00
3.0E+01	I	4.0E-03	I	V	M	Trichloropropane, 1,2,3-	96-18-4	1.1E-04	5.4E+00
		3.0E-03	X	V		Trichloropropene, 1,2,3-	96-19-5		4.1E+00
		3.0E-03	I			Tridiphane	58138-08-2		4.1E+00
				V		Triethylamine	121-44-8		
7.7E-03	I	7.5E-03	I			Trifluralin	1582-09-8	4.1E-01	1.0E+01
2.0E-02	P	1.0E-02	P			Trimethyl Phosphate	512-56-1	1.6E-01	1.4E+01
				V		Trimethylbenzene, 1,2,3-	526-73-8		
				V		Trimethylbenzene, 1,2,4-	95-63-6		
		1.0E-02	X	V		Trimethylbenzene, 1,3,5-	108-67-8		1.4E+01
		3.0E-02	I			Trinitrobenzene, 1,3,5-	99-35-4		4.1E+01
3.0E-02	I	5.0E-04	I			Trinitrotoluene, 2,4,6-	118-96-7	1.1E-01	6.8E-01
		2.0E-02	P			Triphenylphosphine Oxide	791-28-6		2.7E+01
		1.0E-02	X		M	Tris(1-chloro-2-propyl)phosphate	13674-84-5		1.4E+01
2.0E-02	P	7.0E-03	P			Tris(2-chloroethyl)phosphate	115-96-8	1.6E-01	9.5E+00
3.2E-03	P	1.0E-01	P			Tris(2-ethylhexyl)phosphate	78-42-2	9.9E-01	1.4E+02
		3.0E-03	I			Uranium (Soluble Salts)	NA		4.1E+00
1.0E+00	C				M	Urethane	51-79-6	3.2E-03	
		9.0E-03	I			Vanadium Pentoxide	1314-62-1		1.2E+01
		5.0E-03	S			Vanadium and Compounds	NA		6.8E+00
		1.0E-03	I			Vernolate	1929-77-7		1.4E+00
		2.5E-02	I			Vinclozolin	50471-44-8		3.4E+01
		1.0E+00	H	V		Vinyl Acetate	108-05-4		1.4E+03
				V		Vinyl Bromide	593-60-2		
7.2E-01	I	3.0E-03	I	V	M	Vinyl Chloride	75-01-4	4.4E-03	4.1E+00
		3.0E-04	I			Warfarin	81-81-2		4.1E-01
		2.0E-01	S	V		Xylene, P-	106-42-3		2.7E+02
		2.0E-01	S	V		Xylene, m-	108-38-3		2.7E+02
		2.0E-01	S	V		Xylene, o-	95-47-6		2.7E+02
		2.0E-01	I	V		Xylenes	1330-20-7		2.7E+02
		3.0E-04	I			Zinc Phosphide	1314-84-7		4.1E-01
		3.0E-01	I			Zinc and Compounds	7440-66-6		4.1E+02
		5.0E-02	I			Zineb	12122-67-7		6.8E+01
		8.0E-05	P			Zirconium	7440-67-7		1.1E-01

Selection of Ecological Screening Values
Additional and Uncharacterized Sites Operable Unit
Crab Orchard National Wildlife Refuge
(Revised May 2011)

SELECTION OF ECOLOGICAL SCREENING VALUES
ADDITIONAL AND UNCHARACTERIZED SITES OPERABLE UNIT
CRAB ORCHARD NATIONAL WILDLIFE REFUGE

(revised May 2011)

Ecological screening values (ESVs) are used as conservative comparison benchmarks with which to identify chemicals of potential ecological concern (COPECs). To develop chemical-specific ESVs, it is necessary to understand the level at which a chemical may affect ecological receptors via direct contact or ingestion. ESVs were selected from a compilation of relevant toxicity reference values (TRVs). TRVs are concentrations or doses above which ecologically relevant effects might occur following chronic exposures. There are generally multiple TRVs available for each chemical for each medium. Following a prioritization scheme, the most appropriate TRV for a chemical in a given medium was selected as the ESV for identifying COPECs. If the maximum concentration of the chemical measured at a specific AUS OU exceeds the ESV, then the constituent will be characterized as a COPEC, and additional evaluation of the AUS OU may be warranted.

The processes for ESV selection for both direct exposures and ingestion pathway exposures are discussed in the following text. This process is generally consistent with the approach applied in the Ecological Problem Formulation (EPF) Report for the AUS OU (FWS 2005).

1.1 DIRECT EXPOSURE ESVS

Direct exposure ESVs for soil, sediments, and surface water are discussed in the following sections.

1.1.1 TRVs for Soil-Associated Organisms

Soil organisms are those organisms in intimate contact with the soil. These include invertebrates such as earthworms and insects, plants such as soil algae or vascular plant roots, and soil microbes (bacteria and fungi).

There are multiple TRVs available for soil-associated organisms as shown in Tables 1a and 1b. The goal is to identify a single ESV from among the many TRVs to apply in the AUS OU ecological screening evaluation of direct exposures to soil-associated organisms. It is recognized that some of the available TRVs within the scientific literature are below typical soil and sediment concentrations considered “natural,” undisturbed, or background levels. Reasons for this include the reliance on laboratory-based “spiking” experiments with soluble salts to derive the TRVs. Still other soil screening concentrations used by various agencies consider ecological ingestion pathway effects (e.g., Region V Ecological Screening Levels [ESLs]) and/or human health (e.g., Canada Environmental Quality Guidelines, Netherlands Intervention Values and EPA Region IV Screening Values), which may be ecologically relevant, but are not specific to direct exposures.

Considering the attributes and limitations of the various sources of TRVs, the following prioritization schemes were developed for selecting a single ESV for direct exposures to soil organisms.

Prioritization Level	Source	Rationale
Level A	USEPA (2003-2007) Ecological Soil Screening Levels	The USEPA ESSL guidance incorporates a rigorous review of available studies on the toxicity in soils of various constituents.
Level B	Environment Canada (1995) NOEC values for seed emergence and worm survival; other sources from published Technical Reports and scientific journals.	The Environment Canada (1995) values are empirically derived no effect levels directly related to plants and invertebrates. Similar endpoints used from published Technical Reports and scientific journals as specifically noted.
Level C	Efroymson *et al*. (1997a) Efroymson *et al*. (1997b)	These sources present screening levels directly relevant to plants, invertebrates and microbial communities. However, they are limited since many of the data relate to added concentrations of often highly soluble forms of chemical. This may be a limitation for inorganics, though should not be significant for organics.
Level D	EPA Region V ESLs	The Region V ESLs are broad screening values that may not be directly relevant to direct exposures in soils because they include ingestion pathway exposures to higher trophic levels.
Level E	Canadian Environmental Quality Guidelines (CCME 2005) Netherlands Intervention Values (MHSPE 1994) EPA Region 4	Values from these sources take into consideration human health, background (for the Netherlands) as well as ecological considerations, and may not be as relevant to direct exposures in soils.

The prioritization scheme for explosive compounds in soils was presented in the Technical Memorandum, Ecological Screening Values for Explosive Compounds, Additional and Uncharacterized Sites Operable Unit, Crab Orchard National Wildlife Refuge (December 2009). The general approach was the same as described above, but tailored to specific sources available for explosives compounds.

Prioritization Level	Source	Rationale
Level A	Draft USEPA Ecological Soil Screening Levels	The USEPA ESSL guidance incorporates a rigorous review of available studies on the toxicity of various constituents in soils. Screening levels for explosive chemicals were selected from the Draft ESSL (Kuperman 2009)
Level B	Talmage et al. (1999) The Technical Cooperation Program – Energetic Materials (TTCP 2009) Los Alamos National Laboratory (LANL) Ecorisk Database (2008)	Talmage et al. (1999) provides toxicity information on explosives compounds. For explosive compounds, environmental tolerance levels were selected from TTCP (2009) and NOECs from the LANL Ecorisk database (2008).
Level C	EPA Region V (2003) ESL	The Region V ESLs are broad screening values that may not be directly relevant to direct exposures in soils because they include ingestion pathway exposures to higher trophic levels.

The approach for selection of a single ESV for direct exposures in soils was to select the lowest value from Level A sources as the ESV. If no value was available from Level A sources, then the lowest level among the reported values in Level B was selected. This process was repeated as necessary for Levels C, D and E, as applicable. Using this approach, the single ESV selected for each chemical from among the multiple potential soil screening concentrations is presented in Tables 1a and 1b.

1.1.2 ESVs for Sediment-Associated Invertebrates, Periphyton and Vascular Plants

TRVs specific to freshwater sediment were obtained from a number of sources and are summarized in Table 2. None of the TRVs are specific to periphyton or vascular plants; therefore, evaluation of these receptor groups represents an uncertainty.

There are a number of potential sources and endpoints for TRVs. For example, threshold effects levels (TELs) as reported by Ingersoll et al. (1996) are the geometric mean of the 15th percentile in the effects data set and the 50th percentile in the no-effects data set. The effects-range low (ERL) and effects-range medium (ERM) are the 15th percentile and 50th percentile values in the effects datasets, respectively. The Probable Effects Level (PEL) is the geometric mean of the 50th percentile in the effects data set and the 85th percentile in the no-effects data set, and the effects range medium is the 50th percentile value of the effects dataset. A TEL or ERL is assumed to represent a concentration below which toxic effects are rarely observed. The range between the TEL and PEL is assumed to represent the range in which effects are occasionally observed. MacDonald et al. (2000) developed “consensus-based” freshwater sediment screening concentrations. Threshold effect concentrations (TECs) were developed as concentrations below which

adverse effects are not expected to occur. Probable effect concentrations (PECs) were levels above which effects are frequently expected to occur. Among other potential screening values, no effect concentrations (NECs – Ingersoll et al. 1996) and upper effect thresholds (UETs – NOAA 2008) are also levels above which effects are frequently or always observed.

In selecting an ESV, preference was given to the TEC, TEL and ERL values since these are the most conservative (i.e., levels below which effects are rarely observed). In addition, preference was also given to freshwater-derived values (MacDonald et al. [2000], Ingersoll et al. [1996], Ontario [1993] and NOAA [2008]) over estuarine or saltwater values (Long et al. 1995).

If screening values were unavailable from the sources noted above, the "equilibrium-partitioning" (EqP) approach was used. This method uses a surface water TRV (e.g., the surface water ESV from Table 3) and the expected partitioning between sediment and sediment pore water to derive effects levels for sediment-dwelling organisms. EqP-based sediment screening values were derived using the following relationship (USEPA 1993):

$$SC = C_w * f_{oc} * K_{oc}$$

where:

SC = EqP based screening concentration in sediment

K_{oc} = organic carbon to water partitioning coefficient (values preferentially used from Illinois Title 35 Part 742 Tiered Approach to Correction Action Objectives; and secondarily from the HSDB and ASTER, in that order of preference, as tabulated in Table 2-2 of the EPF Report [FWS 2005])

f_{oc} = fraction organic carbon (0.01, assuming an organic carbon concentration of 1%)

C_w = surface water ESV (from Table 3)

The equilibrium partitioning approach is applicable to nonionic organic compounds. There is uncertainty associated with application of the equilibrium partitioning approach to organics that may ionize, thereby representing a limitation to the approach.

Region V values were only used in the absence of direct exposure screening concentrations, or EqP-derived values, since the Region V values also consider ingestion pathway exposures. Region IV values were used last in order of priority, since many of the values were based on reporting limit considerations rather than effects levels.

The overall prioritization for selection of an ESV for direct exposures in sediments is summarized in the following table.

Prioritization Level	Source	Rationale
Level A	MacDonald et al. (2000)	The TEC, TEL and ERL represent the most

Prioritization Level	Source	Rationale
	TEC Ingersoll et al. (1996) TEL, ERL	conservative screening values. TECs were selected preferentially, since they represent "consensus"-based values, and are also the most recently published values.
	NOAA (2008)TEL Ontario Low (1993) ECOTOX Threshold Values (USEPA 1996) Long et al. (1995) ERL	The lower of the Ingersoll *et al*. (1996) TELs and ERLs were selected next in priority, as they are based on well-document freshwater data. NOAA TELs were prioritized next; they are for freshwater but lack the derivation documentation of the Ingersoll values. Ontario values are the last among the Level A values that are based solely on freshwater endpoints. The ECOTOX threshold values are recommendations from a compilation of other values (including EqP and Long et al. [1995]). The Long et al. (1995) data were selected last among the Level A sources, since they are based on marine, as opposed to freshwater data.
Level B	Ingersoll et al. (1996) ERM Long et al. (1995) ERM	ERMs are less conservative than the Level A values. Ingersoll *et al*. (1996) values were selected preferentially because they are based on freshwater data.
Level C	MacDonald et al. (2000) PEC Ingersoll et al. (1996) PEL and NEC NOAA (2008) PEL and UET	These values are less conservative than Level A or B data, generally representing concentrations above which effects have been observed in sediments. The PEC was selected in order of preference since it is a "consensus"-based concentration and the most recently published. Ingersoll *et al.* (1996) PELs and NECs were selected next in order of preference since the data are well-documented. NOAA values were selected last in order of preference, since only summary tables are available without derivation documentation.
Level D	Equilibrium Partitioning	Screening concentrations estimated using equilibrium partitioning were selected next since they are based on conservative direct effect screening concentrations in surface water expressed, based on EqP, in sediment.

Prioritization Level	Source	Rationale
Level E	EPA Region V (2003) ESL	EPA Region V ESLs are broad screening values that may not be directly relevant to direct exposures in sediments because they include ingestion pathway exposures to higher trophic levels.
	EPA Region IV (2001)	EPA Region IV values were selected next in preference. Many of these values are based on reporting limit considerations rather than effects levels.

Table 2 is presented in a format consistent with the selection rationale presented in the above table. Values in the left-most columns were selected in preference to values from other sources. Note that this is slightly different from the general approach using for surface water and soils, in which the lowest value within each level was selected. This is because the sources used in sediments, even within a specific level, could be prioritized using the rationale presented in the above table. For example, though both were placed within the Level A category, freshwater-based values were selected in preference to marine values, since only freshwater systems will be encountered at the Refuge.

For equilibrium partitioning calculations, the water ESV and log K_{oc} used to calculate a screening concentration are also presented. For purposes of calculating screening concentrations, the organic carbon concentration was assumed to be 1%.

The single ESV selected from among the multiple potential sediment screening concentrations is presented in Table 2.

1.1.3 TRVs for Direct Water Exposure

TRVs for direct exposure by aquatic organisms in surface water are relevant to invertebrates, fish and larval amphibians. A summary of TRVs for direct exposures to surface water is provided in Table 3. As with soils and sediments, a prioritization scheme was developed to select a single ESV among the many values available. The Illinois water quality standards, including Illinois Derived Water Quality Criteria, were considered the most relevant, followed by National Recommended Ambient Water Quality Criteria. Remaining sources were prioritized based on relevance to the area and professional judgment. The approach for selecting a single ESV from among the multiple sources is presented in the following table.

Prioritization Level	Source	Rationale
Level A	Illinois General Use Water Quality Standards lllinois Derived Water Quality Criteria	The Illinois General Use Water Quality Standards and Illinois Derived Water Quality Criteria were considered the most relevant because they relate directly to Illinois waters. Pursuant to Illinois Title 35 Environmental Protection, Subtitle C Water Pollution, Chapter 1 Pollution Control Board, Part 302.202, the General Use standards will protect the State's water for aquatic life… [and] wildlife.
Level B	National Recommended Water Quality Criteria (USEPA 2009)	A rigorous review and screening of toxicity data are used to develop National Recommended Water Quality Criteria, for which minimum data requirements spanning a number of aquatic families is a requirement.
Level C	Ecotox Thresholds (1996) Suter and Tsao (1996) USEPA Region IV Freshwater Screening Values (USEPA 2001) NOAA (2008) Chronic Values	There is a great deal of overlap among these sources. These include Tier II values developed when there are insufficient data to develop a value using the approach outlined for the national recommended water quality criteria, or lowest reported chronic values.
Level D	EPA Region V (2003) ESL	EPA Region V ESLs are broad screening values that may not be directly relevant to direct exposures in surface water because they include ingestion pathway exposures to higher trophic levels. Therefore, these values were selected only in the absence of information from other sources.

Table 3 is presented in a format consistent with the selection rationale presented in the above table. Illinois Water Quality Standards or Illinois Derived Water Quality Criteria (Level A) were selected first in order of preference, followed by National Recommended Water Quality Criteria (Level B). If no data were available from Levels A or B, the lowest value among the several sources in Level C was selected. If still no data were available, the value from Level D, if available, was selected as the ESV. The single ESV selected from among the multiple potential sediment screening concentrations is presented in Table 3.

1.2 INGESTION PATHWAY ESVS

Sources for ingestion pathway ESVs for soils include ESSL documents, values derived in the EPF Report for the AUS OU (FWS 2005), and for explosive compounds, ESLs for birds and mammals from the LANL Ecorisk database (2008). ESSLs for birds or mammals were given priority, where available. If chemical-specific values were available for both birds and mammals, the lower of the two values was selected as the ESV.

For sediments and surface water, and for other analytes in soils for which there are no ESVs from the sources previously mentioned, a decision as to whether to characterize the chemical as a COPEC will be based on the chemical's bioaccumulation potential. Potentially bioaccumulative chemicals as used herein, include mercury, selenium, or any organic chemical with a log K_{ow} greater than 3.5. The K_{ow} provides an indication of the lipophilicity of an organic chemical, and its potential for sequestration in biological tissue. In the absence of ESVs from the Ecological SSLs, EPF Report, or LANL Ecorisk databae (2008), if a potentially bioaccumulative chemical is detected in soils, surface water or sediment, it will automatically be characterized as a COPEC. A summary of ingestion ESVs is presented in Tables 4a and 4b.

1.3 REFERENCES

See Table footnotes for references.

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Halogenated Methanes/Alkanes													
Bis(2-chloroethoxy) methane									0.302				**0.302**
Bromodichloromethane									0.54				**0.54**
Bromoform									15.9				**15.9**
Bromomethane									0.235				**0.235**
Carbon tetrachloride (Tetrachloromethane)							1000		2.98	0.1	1	0.001[a]	**1000**
Chloroform (Trichloromethane)									1.19	0.1	10	0.001	**1.19**
Chloromethane									10.4				**10.4**
Dibromochloromethane									2.05				**2.05**
Methylene chloride									4.05		20	2	**4.05**
Halogenated Ethanes													
1,1-Dichloroethane									20.1	0.1			**20.1**
1,1,1-Trichloroethane									29.8	0.1			**29.8**
1,1,2-Trichloroethane									28.6	0.1			**28.6**
1,1,1,2-Tetrachloroethane[b]									225	0.1			**225**
1,1,2,2-Tetrachloroethane									0.127	0.1			**0.127**
1,2-Dichloroethane									21.2	0.1		0.4	**21.2**
Chloroethane													**NA**
Hexachloroethane									0.596				**0.596**
Halogenated Propanes													
1,2-Dichloropropane						700			32.7	0.1		700	**700**
1,2-Dibromo-3-chloropropane									0.0352				**0.0352**
2,2'-Oxybis (1-chloropropane)													**NA**
Halogenated Alkenes													
1,1-Dichloroethene									8.28				**8.28**
1,2-Dichloroethene (total) [c]									0.784				**0.784**
1,2-Dichloroethene (cis) [c]									0.784				**0.784**
1,2-Dichloroethene (trans)									0.784				**0.784**
1,3-Dichloropropene (cis)									0.398				**0.398**
1,3-Dichloropropene (trans)									0.398				**0.398**
Tetrachloroethylene			13	84					9.92	0.1	4	0.01	**13**
Trichloroethylene			9	60					12.4	0.01	60	0.001	**9**
Vinyl chloride									0.646		0.1	0.01	**0.646**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Amines													
2-Nitroaniline									74.1				**74.1**
3-Nitroaniline									3.16				**3.16**
3,3'-Dichlorobenzidine									0.646				**0.646**
4-Chloroaniline									1.1				**1.1**
4-Nitroaniline									21.9				**21.9**
4,4'-Methylenebis (2-chloroanaline)													**NA**
N-Nitrosodiphenylamine						20			0.545			20	**20**
N-Nitroso-di-n-propylamine									0.544				**0.544**
Benzene and Derivatives													
Benzene			16	133					0.255	0.0068	1	0.05	**16**
n-Butyl benzene													**NA**
n-Propyl benzene													**NA**
Sec-butyl benzene													**NA**
Tert-butyl benzene													**NA**
Chlorobenzene						40			13.1	0.1	30	0.05	**40**
1,2-Dichlorobenzene									2.96	0.1			**2.96**
1,2,3-Trichlorobenzene[d]										0.05		0.01	**0.01**
1,2,4-Trichlorobenzene[d]						20			11.1	0.05		0.01	**20**
1,3-Dichlorobenzene									37.7	0.1			**37.7**
1,4-Dichlorobenzene						20			0.546	0.1			**20**
Hexachlorobenzene							1000		0.199			0.0025	**1000**
Methylated Benzenes													
Toluene			3	34				200	5.45	0.08	130	0.05	**3**
1,3,5-Trimethylbenzene													**NA**
1,2,4-Trimethylbenzene													**NA**
Xylenes (total)			0.6	33					10	2.4		0.05	**0.6**
Other Substituted Benzenes													
Ethylbenzene			5	73					5.16	0.018	50	0.05	**5**
Styrene								300	4.69	0.1	100	0.1	**300**
Chlorinated Dienes													
Hexachlorobutadiene									0.0398				**0.0398**
Hexachlorocyclopentadiene								10	0.755			10	**10**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Ethers													
4-Bromophenyl phenyl ether													**NA**
4-Chlorophenyl phenyl ether													**NA**
Bis (2-chloroethyl) ether									23.7				**23.7**
MTBE (Methyl tert-butyl ether)													**NA**
Phenols and Substituted Phenols													
2-Chlorophenol									0.243	0.05			**0.243**
2-Methylphenol									40.4				**40.4**
2-Nitrophenol									1.6	0.1			**1.6**
2,4-Dichlorophenol[e]									87.5	0.05		0.003	**87.5**
2,4-Dimethylphenol									0.01	0.1			**0.01**
2,4-Dinitrophenol								20	0.0609	0.1		20	**20**
2,4,5-Trichlorophenol						9		4	14.1	0.05		4	**4**
2,4,6-Trichlorophenol						10			9.94	0.05		10	**10**
4-Chloro-3-methylphenol									7.95				**7.95**
3-Methylphenol (m-cresol)									3.49	0.1			**3.49**
4-Methylphenol									163				**163**
4-Nitrophenol						7			5.12	0.1		7	**7**
4,6-Dinitro-2-Methylphenol									0.144				**0.144**
Pentachlorophenol	5	31	6	17		6	400	3	0.119	7.6		0.002	**5**
Phenol			40	160		30	100	70	120	3.8	40	0.05	**40**
Ketones (Carbonyl Compounds)													
Acetophenone									300				**300**
2-Butanone (methyl ethyl ketone)									89.6				**89.6**
2-Hexanone									12.6				**12.6**
4-Methyl-2-pentanone (MIBK)									443				**443**
Acetone									2.5				**2.5**
Isophorone									139				**139**
Polynuclear Aromatic Hydrocarbons (PAHs)													
PAH (Total)													**NA**
Low Molecular Weight PAHs		29											**29**
1-Methylnaphthalene		29											**29**
2-Methylnaphthalene		29							3.24				**29**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Acenaphthene		29							682			20	**29**
Acenaphthylene		29							682				**29**
Anthracene		29							1480			0.1	**29**
Fluoranthene		29							122			0.1	**29**
Fluorene		29				30			122			30	**29**
Naphthalene		29	430	249					0.09939	0.6		0.1	**29**
Phenanthrene		29							45.7	0.1		0.1	**29**
High Molecular Weight PAHs		18											**18**
Benzo(a)anthracene		18							5.21	0.1			**18**
Benzo(a)pyrene		18	4400	26000					1.52	0.1		0.1	**18**
Benzo(ghi)perylene		18							119				**18**
Benzo(b)fluoranthene		18							59.8	0.1			**18**
Benzo(k)fluoranthene		18							148	0.1			**18**
Chrysene		18							4.73				**18**
Dibenzo(a,h)anthracene		18							18.4	0.1			**18**
Indeno(1,2,3-cd)pyrene		18							109	0.1			**18**
Pyrene		18							78.5	0.1		0.1	**18**
Phthalates													
Bis (2-ethylhexyl) phthalate									0.925				**0.925**
Butylbenzylphthalate									0.239				**0.239**
Diethyl phthalate								100	24.8			100	**100**
Dimethyl phthalate						200			734			200	**200**
Di-n-butyl phthalate								200	0.15				**200**
Di-n-octyl phthalate									709				**709**
Miscellaneous Analytes													
2-Chloronaphthalene									0.0122			1	**0.0122**
Atrazine													**NA**
Benzaldehyde													**NA**
Benzoic Acid													**NA**
Benzyl Alcohol									65.8				**65.8**
Carbazole					19[12]								**19**
Carbon disulfide									0.0941				**0.0941**
1,4-Dioxane									2.05				**2.05**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Dibenzofuran					36[12]								**36**
n-hexane													**NA**
Indene													**NA**
Pyridine									1.03			0.1	**1.03**
Vinyl acetate									12.7				**12.7**
Pesticides													
2,4,5-T									0.596				**0.596**
2,4,5-TP									0.109				**0.109**
2,4-D									0.0272				**0.0272**
4-(2,4-Dichlorophenoxy)Butyric Acid													**NA**
4,4'-DDD[f]									0.758	0.7	4	0.0025	**0.758**
4,4'-DDE[f]									0.596	0.7	4	0.0025	**0.596**
4,4'-DDT[f]									0.0035	0.7	4	0.0025	**0.0035**
DDT (Total)										0.7	4	0.0025	**0.0025**
Alachlor													**NA**
Aldrin									0.00332			0.0025	**0.00332**
Azinphos-Methyl													**NA**
a-BHC									0.0994			0.0025	**0.0994**
b-BHC									0.00398			0.001	**0.00398**
d-BHC									9.94				**9.94**
g-BHC (Lindane)					0.032[9]				0.005			0.00005	**0.032**
Bidrin													**NA**
Carbofuran													**NA**
a-Chlordane[g]									0.224				**0.224**
g-Chlordane[g]									0.224				**0.224**
Chlordane (Technical)									0.224				**0.224**
Chlorfenvinfos													**NA**
Chlorpyrifos													**NA**
Coumaphos													**NA**
Crotoxyphos													**NA**
Dementon-S													**NA**
Diazinon													**NA**
Dieldrin					50[10]				0.00238			0.0005	**50**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Dimethoate									0.218				**0.218**
Disulfoton									0.0199				**0.0199**
alpha Endosulfan									0.119				**0.119**
beta Endosulfan									0.119				**0.119**
Endosulfan									0.119				**0.119**
Endosulfan sulfate									0.0358				**0.0358**
Endothall													**NA**
Endrin									0.0101				**0.0101**
Endrin aldehyde									0.0105				**0.0105**
Endrin ketone													**NA**
Ethion													**NA**
Ethoprophos													**NA**
Ethyl P-Nitrophenyl Phenylphosphorothioate													**NA**
Fensulfothion													**NA**
Fenthion													**NA**
Heptachlor									0.00598				**0.00598**
Heptachlor epoxide									0.152				**0.152**
Isodrin									0.00332				**0.00332**
Malathion													**NA**
Methoxychlor									0.0199				**0.0199**
Methyl parathion[h]									0.000292				**0.000292**
Mevinphos													**NA**
Parathion									0.00034				**0.00034**
Toxaphene									0.119				**0.119**
PCBs													
PCB(total)								40	0.000332	0.5	1	0.02	**40**
Aroclor 1016[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1221[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1232[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1242[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1248[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1254[h]								40	0.000332	0.5	1	0.02	**40**
Aroclor 1260[h]								40	0.000332	0.5	1	0.02	**40**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	
Dioxins/Furans													
2,3,7,8-TCDD					5[11]				1.99E-07				**5**
Metals													
Aluminum	soil pH < 5.5	soil pH < 5.5					600	50				50	**soil pH < 5.4**
Antimony		78						5	0.142	20		3.5	**78**
Arsenic	18		9	83		60	100	10	5.7	12	34	10	**18**
Barium		330					3000	500	1.04	500	165	165	**330**
Beryllium		40						10	1.06	4	1.1	1.1	**40**
Boron							20	0.5		2		0.5	**0.5**
Cadmium	32	140	44	433		20	20	4	0.00222	1.4	1.6	1.6	**32**
Calcium													**NA**
Chromium (Total)			56	323		0.4	10	1	0.4	64	100	0.4	**56**
Chromium VI			117	900						0.4			**117**
Cobalt	13						1000	20	0.14033	40	33	20	**13**
Copper	70	80	31	210		50	100	100	5.4	63	40	40	**70**
Iron	pH dependent											200	**pH dependent**
Lead	120	1700	433	1433		500	900	50	0.0537	70	140	50	**120**
Magnesium													**NA**
Manganese	220	450					100	500				100	**220**
Mercury			7	96		0.1	30	0.3	0.1	6.6	2.2	0.1	**7**
Nickel	38	280				200	90	30	13.6	50	38	30	**38**
Potassium													**NA**
Selenium	0.52	4.1				70	100	1	0.0276	1	0.81	0.81	**0.52**
Silver	560						50		4.04	20		2	**560**
Sodium													**NA**
Thallium								1	0.0569	1		1	**1**
Vanadium			46	207			20	2	1.59	130	43	2	**46**
Zinc	160	120	153	400		200	100	50	6.62	200	160	50	**120**
Total Cyanide			0.9	12					1.33	0.9	50	5	**0.9**

TABLE 1a
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES IN SOILS

Constituent (mg/kg)	A		B			C			D	E			Selected ESV
	EPA ECO-SSL Plants[1]	EPA ECO-SSL Soil Invertabrates[1]	Environment Canada (1995) Seed Emergence NOEC[2]	Environment Canada (1995) Worm Survival NOEC[2]	Soil Invertebrate Screening Values from Other Literature Sources[9, 10, 11, 12]	Efroymson et al. (1997a) Earthworm Screening Concentration[3]	Efroymson et al. (1997a) Micro-organism Screening Concentration[3]	Efroymson et al. (1997b) Terrestrial Plant Screening Concentration[4]	EPA Region V Ecological Screening Levels[5]	Canadian Environmental Quality Guidelines[6]	Netherlands Intervention Values (MHSPE 1994)[7]	EPA Region 4 Screening Values[8]	

Notes:

ESVs for direct exposure of explosive compounds in soil are presented in Table 1b

ESV- Ecological Screening Value

NA- Screening concentration not available.

a - The smaller of the carbon tetrachloride and tetrachloromenthane ESVs taken.

b - ESV for 1,1,1,2-Tetrachloroethane based on 1,1,2,2-Tetrachloroethane for Canadian Environmental Quality Guidelines values.

c - ESVs for 1,2-Dichloroethene (total) and 1,2-Dichloroethene (cis) based on 1,2-Dichloroethene (trans).

d - ESVs for 1,2,3-Trichlorobenzene and 1,2,4-Trichlorobenzenebased on trichlorobenzene for USEPA Region IV.

e - ESV for 2,4-Dichlorophenol based on total dichlorophenol for USEPA Region IV.

f - ESVs for DDT metabolites based on total DDT in references.

g - ESVs for a-Chlordane and g-chlordane based on chlordane (Technical).

h - ESVs for individual Aroclors based on total PCB in references.

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2 Environment Canada. 1995. Toxicity testing of NCSRP Priority Substances for Development of Soil Quality Guidelines for Contaminated Sites. Prepared by HydroQual Laboratories, Calgary, Alberta for Guidelines Division, Evaluation and Interpretation Branch

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TABLE 1b
SELECTION OF ECOLOGICAL SCREENING VALUES (DIRECT EXPOSURES) FOR EXPLOSIVES IN SOILS

Explosive Compounds (ug/kg)	A		B										C	Selected ESV
	Draft Eco-SSL Plant[1] (weathered soil)	Draft Eco-SSL Soil Invertebrate[1] (weathered soil)	Talmage et al. (1999) Earthworm Screening Concentration[2]	Talmage et al. (1999) Soil Invertebrate Screening Concentration[2]	Talmage et al. (1999) Soil Microbial Processes Screening Concentration[2]	Talmage et al. (1999) Terrestrial Plant Screening Concentration[2]	Earthworm Screening Values from Other Literature	Plant Screening Values from Other Literature	TTCP Plant ETV[3] (weathered soil)	TTCP Soil Invertebrate ETV[3] (weathered soil)	LANL[4] Plant ESL	LANL[4] Earthworm ESL	Region V[5] ESL	
1,3,5-Trinitrobenzene	8600	18100					400[6]	4300[7]	9000	18000			376	**8600**
1,3-Dinitrobenzene													655	**655**
2,4,6-Trinitrotoluene			140000	200000		30000	55000[8]		14000	15000	62000	32000		**14000**
2,4-Dinitrotoluene	5300	19800					1000[6]		6000	21000			1280	**5300**
2,6-Dinitrotoluene	4500	6900					160[6]		5000	7000			32.8	**4500**
2-Amino-4,6-Dinitrotoluene					80000	80000			19000	43000	80000			**19000**
4-Amino-2,6-Dinitrotoluene									31000	18000	80000			**18000**
2-Nitrotoluene														**NA**
3-Nitrotoluene														**NA**
4-Nitrotoluene														**NA**
HMX									NT	17000	2700000	140000		**17000**
Nitrobenzene												2200	1310	**2200**
Nitroglycerin									30000	13000				**13000**
Pentaerythritol Tetranitrate														**NA**
Perchlorate														**NA**
RDX		98600				100000			36000	51000	100000	7500		**36000[a]**
Tetryl						25000					25000			**25000**

Notes: http://www.em-guidelines.org/ecot.htm

Eco-SSL - Ecological soil screening level
TTCP - The Technical Cooperation Program
ETV - Ecological tolerance value
LANL - Los Alamos National Laboratory

ESL - Ecological Screening Level
ESV - Ecological Screening Value
NA - Not Available
NT - Not toxic up to 10,000,000 µg/kg

a - Although a draft Eco-SSL was available for invertebrates, none was available for plants. As other plant data were available, an ESV of 36,000 ug/kg was selected.

1 Draft Ecological Soil Screening Levels (Eco-SSLs) for Explosive Compounds, provided by Roman Kuperman, PhD – US Army Edgewood Chemical Biological Center

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TABLE 2
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SEDIMENTS

Constituent (mg/kg)	A							B		C					D			E		Selected ESV
	Threshold / Lowest Effect Levels							Effects Range Median		No Effect/Probable Effects Levels					Equilibrium Partitioning			EPA Regional		
	Consensus-Based TEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. TEL (1996)[2]	Ingersoll et.al. ERL (1996)[2]	NOAA TEL (2008)[3]	Ontario Low (1993)[4]	ECOTOX Threshold SQB (USEPA 1996)[5]	Long et.al. ERL (1995)[6]	Ingersoll et.al. ERM (1996)[2]	Long et.al. ERM (1995)[6]	Consensus-Based PEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. PEL (1996)[2]	Ingersoll et.al. NEC (1996)[2]	NOAA PEL (2008)[3]	NOAA UET (2008)[3]	log K_{oc}[9]	Water Screening ESV (ug/L) (from Table 3)	Equilibrium Partitioning Screening Value[a]	EPA Region V ESLs[7]	EPA Region 4 Sediment Sreening Value[8]	
Halogenated Methanes/Alkanes																				
Bis(2-chloroethoxy) methane															1.32	NA	NA			**NA**
Bromodichloromethane															1.74	1	0.00055			**0.00055**
Bromoform (Tribromomethane)						0.65									1.94	293	0.26	0.492		**0.65**
Bromomethane															1.02	16	0.0017	0.00137		**0.0017**
Carbon tetrachloride (Tetrachloromethane)						1.2									2.24	280	0.49	1.45		**1.2**
Chloroform (Trichloromethane)															1.60	150	0.06	0.121		**0.06**
Chloromethane															1.85	1300	0.92			**0.92**
Dibromochloromethane															1.80	NA	NA			**NA**
Methylene chloride															1.07	1400	0.16	0.159		**0.16**
Halogenated Ethanes																				
1,1-Dichloroethane															1.50	2000	0.63	0.000575		**0.63**
1,1,1-Trichloroethane						0.17									2.04	390	0.43	0.213		**0.17**
1,1,2-Trichloroethane															1.70	4400	2.2	0.518		**2.2**
1,1,2,2-Tetrachloroethane						0.94									2.78	140	0.84	0.85		**0.94**
1,2-Dichloroethane															1.24	4500	0.78	0.26		**0.78**
Chloroethane															1.84	1000	0.69			**0.69**
Hexachloroethane						1									3.25	31	0.55	0.584		**1**
Halogenated Propanes																				
1,2-Dichloropropane															1.64	380	0.17	0.333		**0.17**
2,2'-Oxybis (1-chloropropane)															1.75	NA	NA			**NA**
Halogenated Alkenes																				
1,1-Dichloroethene															1.77	240	0.14	0.0194		**0.14**
1,2-Dichloroethene (total)															1.62	1100	0.46	0.654		**0.46**
1,2-Dichloroethene (cis)															1.55	1100	0.39	0.654		**0.39**
1,2-Dichloroethene (trans)															1.72	1100	0.58	0.654		**0.58**
1,3-Dichloropropene (total)[b]															1.66	7.9	0.0036			**0.0036**
1,3-Dichloropropene (cis)															2.65	7.9	0.036			**0.036**
1,3-Dichloropropene (trans)															2.30	7.9	0.016			**0.016**
Tetrachloroethylene						0.53									2.19	150	0.23	0.99		**0.53**
Trichloroethylene						1.6									2.22	940	1.6	0.112		**1.6**
Vinyl chloride															1.27	1700	0.32	0.202		**0.32**
Amines																				
2-Nitroaniline															2.32	200	0.42			**0.42**
3-Nitroaniline															1.94	NA	NA			**NA**
3,3'-Dichlorobenzidine															2.86	4.5	0.033	0.127		**0.033**
4-Chloroaniline															1.82	0.2	0.00013	0.146		**0.00013**
4-Nitroaniline															1.89	120	0.094			**0.094**
4,4'-Methylenebis (2-chloroanaline)															3.68	NA	NA			**NA**
N-Nitrosodiphenylamine															3.11	58.5	0.75			**0.75**
N-Nitroso-di-n-propylamine															1.38	NA	NA			**NA**

TABLE 2
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SEDIMENTS

Constituent (mg/kg)	A							B		C					D			E		Selected ESV
	Threshold / Lowest Effect Levels							Effects Range Median		No Effect/Probable Effects Levels					Equilibrium Partitioning			EPA Regional		
	Consensus-Based TEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. TEL (1996)[2]	Ingersoll et.al. ERL (1996)[2]	NOAA TEL (2008)[3]	Ontario Low (1993)[4]	ECOTOX Threshold SQB (USEPA 1996)[5]	Long et.al. ERL (1995)[6]	Ingersoll et.al. ERM (1996)[2]	Long et.al. ERM (1995)[6]	Consensus-Based PEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. PEL (1996)[2]	Ingersoll et.al. NEC (1996)[2]	NOAA PEL (2008)[3]	NOAA UET (2008)[3]	log K_{oc}[9]	Water Screening ESV (ug/L) (from Table 3)	Equilibrium Partitioning Screening Value[a]	EPA Region V ESLs[7]	EPA Region 4 Sediment Sreening Value[8]	
Benzene and Derivatives																				
Benzene						0.057									1.77	860	0.51	0.142		**0.057**
Chlorobenzene						0.82									2.34	79	0.17	0.291		**0.82**
1,2-Dichlorobenzene						0.34									2.79	170	1	0.294		**0.34**
1,2,4-Trichlorobenzene						9.2									3.25	72	1.3	5.062		**9.2**
1,3-Dichlorobenzene						1.7									2.48	200	0.6	1.315		**1.7**
1,4-Dichlorobenzene						0.35									2.79	620	3.8	0.318		**0.35**
Hexachlorobenzene														0.1	4.74	0.0003	0.00017	0.02		**0.1**
Methylated Benzenes																				
Toluene						0.67									2.26	600	1.1	1.22		**0.67**
Xylenes (total)						0.025									2.41	360	0.94	0.433		**0.025**
Other Substituted Benzenes																				
Ethylbenzene						3.6									2.56	14	0.051	0.175		**3.6**
Styrene															2.89	200	1.6	0.254		**1.6**
Nitrobenzene															1.81	8500	5.5	0.145		**5.5**
Arenes																				
2,4-Dinitrotoluene															1.98	320	0.31	0.0144		**0.31**
2,6-Dinitrotoluene															1.84	150	0.1	0.0398		**0.1**
Chlorinated Dienes																				
Hexachlorobutadiene															3.71	2.8	0.14	0.0265		**0.14**
Hexachlorocyclopentadiene															5.30	0.1	0.2	0.901		**0.2**
Ethers																				
4-Bromophenyl phenyl ether						1.3									4.28	2.9	0.55	1.55		**1.3**
4-Chlorophenyl phenyl ether															3.48	NA	NA			**NA**
Bis (2-chloroethyl) ether															1.19	1900	0.29	3.52		**0.29**
Phenols and Substituted Phenols																				
2-Chlorophenol															2.59	41	0.16	0.0319		**0.16**
2-Methylphenol															1.96	370	0.34	0.0554		**0.34**
2-Nitrophenol															1.97	540	0.5			**0.5**
2,4-Dichlorophenol															2.17	83	0.12	0.0817		**0.12**
2,4-Dimethylphenol															2.32	220	0.46	0.304		**0.46**
2,4-Dinitrophenol															-2.00	4.1	0.00000041	0.00621		**0.00000041**
2,4,5-Trichlorophenol															3.20	63	1			**1**
2,4,6-Trichlorophenol															2.58	6.3	0.024	0.208		**0.024**
4-Chloro-3-methylphenol															1.70	25	0.013	0.388		**0.013**
4-Methylphenol															2.25	120	0.21	0.0202		**0.21**
4-Nitrophenol															1.70	1900	0.95	0.0133		**0.95**
4,6-Dinitro-2-Methylphenol															2.56	2.3	0.0084	0.104		**0.0084**
Pentachlorophenol															2.77	13	0.077	23		**0.077**
Phenol														0.048	1.46	100	0.029	0.0491		**0.048**

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	Threshold / Lowest Effect Levels							Effects Range Median		No Effect/Probable Effects Levels					Equilibrium Partitioning			EPA Regional		
	Consensus-Based TEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. TEL (1996)[2]	Ingersoll et.al. ERL (1996)[2]	NOAA TEL (2008)[3]	Ontario Low (1993)[4]	ECOTOX Threshold SQB (USEPA 1996)[5]	Long et.al. ERL (1995)[6]	Ingersoll et.al. ERM (1996)[2]	Long et.al. ERM (1995)[6]	Consensus-Based PEC (MacDonald, et.al. 2000)[1]	Ingersoll et.al. PEL (1996)[2]	Ingersoll et.al. NEC (1996)[2]	NOAA PEL (2008)[3]	NOAA UET (2008)[3]	log K_{oc}[9]	Water Screening ESV (ug/L) (from Table 3)	Equilibrium Partitioning Screening Value[a]	EPA Region V ESLs[7]	EPA Region 4 Sediment Sreening Value[8]	
Ketones (Carbonyl Compounds)																				
2-Butanone															1.50	26000	8.2	0.0424		**8.2**
2-Hexanone															2.13	950	1.3	0.0582		**1.3**
4-Methyl-2-pentanone (MIBK)															2.09	1400	1.7	0.0251		**1.7**
Acetone															-0.24	120000	0.69	0.0099		**0.69**
Isophorone															1.67	960	0.45	0.432		**0.45**
Polynuclear Aromatic Hydrocarbons (PAHs)																				
PAH Total	1.61	0.26	0.24		4		4.022	2.2	44.792	22.8	3.4	62		12					1.684	**1.61**
Low Molecular Weight PAHs																				
LMW PAH Total		0.076	0.08				0.552	0.65	3.16		1.2	29		5.3					0.33	**0.076**
1-Methylnaphthalene[c]							0.07													**0.07**
2-Methylnaphthalene							0.07								3.93	12	1	0.0202	0.33	**0.07**
Acenaphthene				0.00671			0.016		0.5				0.0889	0.29	3.85	62	4.4	0.00671	0.33	**0.00671**
Acenaphthylene				0.00587			0.044		0.64				0.128	0.16	3.25	15	0.27	0.00587	0.33	**0.00587**
Anthracene	0.0572	0.01	0.01	0.0469	0.22		0.0853	0.14	1.1	0.845	0.17	2	0.245	0.26	4.47	0.53	0.16	0.0572	0.33	**0.0572**
Fluoranthene	0.423	0.031	0.033	0.111	0.75		0.6	0.18	5.1	2.23	0.32	10	2.355	1.5	5.03	1.8	1.9	0.423	0.33	**0.423**
Fluorene	0.0774	0.01	0.01	0.0212	0.19	0.54	0.019	0.14	0.54	0.536	0.15	3	0.144	0.3	4.14	16	2.2	0.0774	0.33	**0.0774**
Naphthalene	0.176	0.015	0.013	0.0346		0.48	0.16	0.098	2.1	0.561	0.14	1.4	0.391	0.6	3.30	68	1.4	0.176	0.33	**0.176**
Phenanthrene	0.204	0.019	0.027	0.0419	0.56		0.24	0.35	1.5	1.17	0.41	20	0.515	0.8	4.36	3.7	0.85	0.204	0.33	**0.204**
High Molecular Weight PAHs																				
HMW PAH Total		0.19	0.17				1.7	1.7	9.6		2.3	33		6.5					0.655	**0.17**
Benzo(a)anthracene	0.108	0.016	0.019	0.0317	0.32		0.261	0.3	1.6	1.05	0.28	3	0.385	0.5	5.60	0.027	0.11	0.108	0.33	**0.108**
Benzo(a)pyrene	0.15	0.032	0.084	0.0319	0.37		0.43	0.47	1.6	1.45	0.32	1	0.782	0.7	6.01	0.014	0.14	0.15	0.33	**0.15**
Benzo(ghi)perylene		0.016	0.013		0.17			0.28			0.25	1.2		0.3	4.98	7.64	7.3	0.17		**0.013**
Benzo(b)fluoranthene		0.027	0.037					0.071			0.16	4			6.09	9.07	110	10.4		**0.027**
Benzo(k)fluoranthene		0.027	0.037		0.24			0.071			0.16	4		13.4	6.09	9.07	110	0.24		**0.027**
Chrysene	0.166	0.027	0.03	0.0571	0.34		0.384	0.5	2.8	1.29	0.41	3	0.862	0.8	5.60	2	8	0.166	0.33	**0.166**
Dibenzo(a,h)anthracene	0.033	0.01	0.01	0.00622	0.06		0.0634	0.015	0.26		0.028	0.87	0.135	0.1	6.58	NA	NA	0.033	0.33	**0.033**
Indeno(1,2,3-cd)pyrene		0.017	0.03		0.2			0.25			0.24	0.77		0.33	6.54	4.31	150	0.2		**0.017**
Pyrene	0.195	0.044	0.04	0.053	0.49		0.665	0.35	2.6	1.52	0.49	9	0.875	1	5.02	0.025	0.026	0.195	0.33	**0.195**
Phthalates																				
Bis (2-ethylhexyl) phthalate														0.75	7.18	380	57000	0.182	0.182	**0.75**
Butylbenzylphthalate						11									4.76	23000	13000	1.97		**11**
Diethyl phthalate						0.63									2.46	250	0.72	0.295		**0.63**
Dimethyl phthalate															5.20	260	410			**410**
Di-n-butyl phthalate						11								0.11	4.53	48	16	1.114		**11**
Di-n-octyl phthalate															7.92	708	590000	40.6		**590000**
Miscellaneous Analytess																				
2-Chloronaphthalene															3.05	30	0.34	0.417		**0.34**
Carbazole															3.53	7.4	0.25			**0.25**
Carbon disulfide															1.66	20	0.0091	0.0239		**0.0091**
Dibenzofuran						2								5.1	3.67	15	0.7	0.449		**2**

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Pesticides																				
2,4,5-T															NA	36	NA	58.7		**NA**
2,4,5-TP															3.74	30	1.6	0.675		**1.6**
2,4-D															2.65	8	0.036	1.273		**0.036**
4-(2,4-Dichlorophenoxy)Butyric Acid															NA	NA	NA			**NA**
4,4'-DDD	0.00488			0.00354	0.008					0.028			0.00851	0.06	6.00	0.0064	0.064	0.00488	0.0033	**0.00488**
4,4'-DDE	0.00316			0.00142	0.005		0.0022		0.027	0.0313			0.00675	0.05	6.65	10.5	470	0.00316	0.0033	**0.00316**
4,4'-DDT	0.00416			0.00119	0.008		0.00158		0.0461	0.0629			0.00477	0.05	6.42	0.000001	0.000026	0.00416	0.0033	**0.00416**
DDT (total)	0.00528			0.007	0.007		0.00158		0.0461	0.572			4.45	0.05	NA	NA	NA			**0.00528**
Alachlor															2.60	100	0.39			**0.39**
Aldrin					0.002									0.04	6.39	0.017	0.42	0.002		**0.002**
Azinphos-Methyl															NA	0.01	NA			**NA**
a-BHC					0.006										3.09	2.5	0.031	0.006		**0.006**
b-BHC					0.005										3.75	2.2	0.12	0.005		**0.005**
d-BHC															3.14	2.2	0.03	71.5		**0.03**
g-BHC (Lindane)	0.00237			0.00094	0.003	0.0037				0.00499			0.00138	0.009	3.03	0.08	0.00086	0.00237	0.0033	**0.00237**
Bidrin															NA	NA	NA			**NA**
Carbofuran															1.57	0.3	0.00011			**0.00011**
a-Chlordane															5.08	0.0043	0.0052	0.00324		**0.0052**
g-Chlordane															5.08	0.0043	0.0052	0.00324		**0.0052**
Chlordane (Technical)	0.00324			0.0045	0.007					0.0176			0.0089	0.03	5.08	0.0043	0.0052	0.00324	0.0017	**0.00324**
Chlorfenvinfos															NA	0.1	NA			**NA**
Chlorpyrifos															NA	0.041	NA			**NA**
Coumaphos															NA	NA	NA			**NA**
Crotoxyphos															NA	NA	NA			**NA**
Dementon-S															NA	NA	NA			**NA**
Diazinon															NA	0.17	NA			**NA**
Dieldrin	0.0019			0.00285	0.002					0.0618			0.00667	0.3	4.33	0.056	0.012	0.0019	0.0033	**0.0019**
Dimethoate															NA	0.15	NA			**NA**
Disulfoton															NA	0.0402	NA	0.324		**NA**
alpha Endosulfan						0.0029									NA	0.0056	NA	0.00326		**0.0029**
beta Endosulfan						0.014									NA	0.0056	NA	0.00194		**0.014**
Endosulfan						0.0054									3.33	0.0056	0.00012	0.00194		**0.0054**
Endosulfan sufate															3.76	0.0056	0.00032	0.0346		**0.00032**
Endothall															-0.54	1000	0.0029			**0.0029**
Endrin	0.00222			0.00267	0.003					0.207			0.0624	0.5	4.09	0.033	0.0041	0.00222	0.0033	**0.00222**
Endrin aldehyde															4.29	0.15	0.029	0.48		**0.029**
Endrin ketone															NA	NA	NA			**NA**
Ethion															NA	NA	NA			**NA**
Ethoprophos															NA	NA	NA			**NA**
Ethyl P-Nitrophenyl Phenylphosphorothioate															NA	NA	NA			**NA**

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Fensulfothion															NA	NA	NA			**NA**
Fenthion															NA	NA	NA			**NA**
Heptachlor														0.01	6.15	0.0038	0.054	0.0006		**0.01**
Heptachlor epoxide	0.00247			0.0006	0.005					0.016			0.00274	0.03	4.92	0.0038	0.0032	0.00247		**0.00247**
Isodrin															3.52	0.1	0.0033	0.0552		**0.0033**
Malathion															NA	0.04	NA			**NA**
Methoxychlor						0.019									4.99	0.02	0.02	0.0136		**0.019**
Methyl parathion[h]															NA	0.013	NA			**NA**
Mevinphos															NA	NA	NA			**NA**
Parathion															NA	0.013	NA	0.000757		**NA**
Toxaphene						0.028									5.41	0.0002	0.00051	0.000077		**0.028**
PCBs																				
Aroclor 1016					0.007										4.97	0.014	0.013			**0.007**
Aroclor 1221															4.46	0.014	0.004		0.067	**0.004**
Aroclor 1232															NA	NA	NA			**NA**
Aroclor 1242															NA	NA	NA			**NA**
Aroclor 1248					0.03										NA	0.014	NA			**0.03**
Aroclor 1254				0.06	0.06								0.34		5.58	0.014	0.054			**0.06**
Aroclor 1260					0.005										5.83	0.014	0.094			**0.005**
PCBs (total)	0.0598	0.032	0.05	0.0341	0.07		0.0227	0.73	0.18	0.676	0.24	0.19	0.277	0.026				0.0598	0.033	**0.0598**
Explosives																				
1,3-Dinitrobenzene (DNB)															1.39	4	0.00098	0.00861		**0.00098**
1,3,5-Trinitrobenzene (TNB)															2.13	15	0.02			**0.02**
2-Amino-4,6-Dinitrotoluene (2-ADNT)															NA	7.9	NA			**NA**
2-Nitrotoluene (ONT)															2.36	62	0.14			**0.14**
2,4,6-Trinitrotoluene (TNT)															3.16	75	1.1			**1.1**
3-Nitrotoluene															2.16	830	1.2			**1.2**
4-Amino-2,6-Dinitrotoluene															NA	14	NA			**NA**
4-Nitrotoluene (PNT)															2.43	700	1.9			**1.9**
Cyclonite (RDX)												1.08[10]			1.92	500	0.42			**1.08**
Cyclotetramethylenetetranitramine (HMX)												0.36[10]			0.54	260	0.009			**0.36**
Nitroglycerin (NG)															2.22	200	0.33			**0.33**
Pentaerythritol tetranitrate (PETN)															2.74	85000	470			**470**
Tetryl															2.61	NA	NA			**NA**
Dioxins/Furans																				
2,3,7,8-TCDD				0.00000085									0.0000215	0.0000088	7.39	NA	NA	1.2E-07		**0.00000085**
Metals																				
Aluminum		26000	14000					58000			60000	73000								**26000**
Antimony														3					12	**3**
Arsenic	9.79	11	13	5.9	6		8.2	50	70	33	48	100	17	17				9.79	7.24	**9.79**
Barium																				**NA**
Beryllium																				**NA**

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Boron																				**NA**
Cadmium	0.99	0.58	0.7	0.596	0.6		1.2	3.9	9.6	4.98	3.2	8	3.53	3				0.99	1	**0.99**
Calcium																				**NA**
Chromium (Total)	43.4	36	39	37.3	26		81	270	370	111	120	95	90	95				43.4	52.3	**43.4**
Chromium VI																				**NA**
Cobalt																		50		**50**
Copper	31.6	28	41	35.7	16		34	190	270	149	100	580	197	86				31.6	18.7	**31.6**
Iron		190000	200000		20000			280000			250000	290000		40000						**190000**
Lead	35.8	37	55	35	31		46.7	99	218	128	82	130	91.3	127				35.8	30.2	**35.8**
Magnesium																				**NA**
Manganese		630	730		460			1700			1200	4500		1100						**630**
Mercury	0.18			0.174	0.2		0.15		0.71	1.06			0.486	0.56				0.174	0.13	**0.18**
Nickel	22.7	20	24	18	16		20.9	45	51.6	48.6	33	43	36	43				22.7	15.9	**22.7**
Potassium																				**NA**
Selenium																				**2.5[11]**
Silver							1		3.7					4.5				0.5	2	**1**
Sodium																				**NA**
Thallium																				**NA**
Vanadium																				**NA**
Zinc	121	98	110	123	120		150	550	410	459	540	1300	315	520				121	124	**121**
Total Cyanide					0.1													0.1[d]		**0.1**

Notes:

ESV - Ecological Screening Value
TEC - Threshold Effect Concentration
PEC - Probable Effect Concentration
TEL - Threshold Effect Level
PEL - Probable Effect Level
ERL - Effects Range Low
ERM - Effects Range Medium
Low - Ontario Lowest effect level
NEC - No Effect Concentration

AET - Apparent Effects Threshold
UET - NOAA Upper Effects Threshold
BTAG - Biological Technical Assistance Group
NA - Not Available
a - Based on 1% organic carbon and surface water ESV as presented in Table 3
b - For 1,3 dichloropropene (total), the lower value for the cis and trans isomers was selected as the ESV.
c - 2-methylnaphthalene used as a surrogate for 1-methylnaphthalene ESV Long et.al. ERL.
d - Units in reference (µg/kg) are incorrect. The units should be mg/kg (ppm) as in the original reference, Ontario Ministry of the Environment and Energy, 1993.
Shaded values are those used to derive Equilibrium Partitioning Screening Values - assuming 1% organic carbon

References:

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TABLE 3
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Halogenated Methanes/Alkanes											
Bis(2-chloroethoxy) methane											**NA**
Bromodichloromethane		1									**1**
Bromoform (Tribromomethane)					320		293		320	230	**293**
Bromomethane										16	**16**
Carbon tetrachloride (Tetrachloromethane)		280			240	9.8	352	1970	9.8	240	**280**
Chloroform (Trichloromethane)		150				28	289	1240	1.8	140	**150**
Chloromethane		1300									**1300**
Dibromochloromethane											**NA**
Methylene chloride		1400				2200	1930	42667	98.1	940	**1400**
Halogenated Ethanes											
1,1-Dichloroethane		2000			47	47		14680	47	47	**2000**
1,1,1-Trichloroethane		390			62	11	528	3493	11	76	**390**
1,1,2-Trichloroethane		4400				1200	940	9400	500	500	**4400**
1,1,1,2-Tetrachloroethane											**NA**
1,1,2,2-Tetrachloroethane		140			420	610	240	2400	111	380	**140**
1,2-Dichloroethane		4500				910	2000	15200	100	910	**4500**
Chloroethane		1000									**1000**
Hexachloroethane		31			12	12	9.8		8	8	**31**
Halogenated Propanes											
1,2-Dichloropropane		380					525		5700	360	**380**
1,2-Dibromo-3-chloropropane		190									**190**
2,2'-Oxybis (1-chloropropane)											**NA**
Halogenated Alkenes											
1,1-Dichloroethene		240				25	303	2800	25	65	**240**
1,2-Dichloroethene (total)		1100				590		9538	590	970	**1100**
1,2-Dichloroethene (cis)[a]		1100				590		9538	590	970	**1100**
1,2-Dichloroethene (trans)[a]		1100				590	1350	9538	116	970	**1100**
1,3-Dichloropropene (total)		7.9				0.055		244	0.055		**7.9**
1,3-Dichloropropene (cis)[b]		7.9				0.055	24.4	244	0.055		**7.9**
1,3-Dichloropropene (trans)[b]		7.9				0.055	24.4	244	0.055		**7.9**

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Tetrachloroethylene		150			120	98	84	750	45	45	**150**
Trichloroethylene		940			350	47		7257	21	47	**940**
Vinyl chloride		1700							930	930	**1700**
Amines											
2-Nitroaniline		200									**200**
3-Nitroaniline											**NA**
3,3'-Dichlorobenzidine									4.5	4.5	**4.5**
4-Chloroaniline		0.2							50	232	**0.2**
4-Nitroaniline		120									**120**
4,4'-Methylenebis (2-chloroanaline)											**NA**
N-Nitrosodiphenylamine						210	58.5	332	210		**58.5**
N-Nitroso-di-n-propylamine											**NA**
Benzene and Derivatives											
Benzene	860				46	130	53	525000	46	114	**860**
n-Butyl benzene		3.1									**3.1**
n-Propyl benzene		10									**10**
sec-Butyl benzene		6.6									**6.6**
tert-Butyl benzene		7.7									**7.7**
Chlorobenzene		79			130	64	195	1203	47	47	**79**
1,2-Dichlorobenzene		170			14	14	15.8		0.7	14	**170**
1,2,3-Trichlorobenzene		2.8							8		**2.8**
1,2,4-Trichlorobenzene		72			110	110	44.9		24	30	**72**
1,3-Dichlorobenzene		200			71	71	50.2		38	38	**200**
1,4-Dichlorobenzene		620			15	15	11.2		9.4	9.4	**620**
Hexachlorobenzene									0.0003	0.0003	**0.0003**
Methylated Benzenes											
Toluene	600				130	9.8	175	1269	2	253	**600**
1,3,5-Trimethylbenzene		11									**11**
1,2,4-Trimethylbenzene		29									**29**
Xylenes (total)	360				1.8	13		62308		27	**360**
Other Substituted Benzenes											
Ethylbenzene	14				290	7.3	453	440	7.3	14	**14**
Styrene		200							32	32	**200**

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Nitrobenzene		8500					270		220	220	**8500**
Arenes											
2,4-Dinitrotoluene		320					310		44	44	**320**
2,6-Dinitrotoluene		150								81	**150**
Chlorinated Dienes											
Hexachlorobutadiene		2.8					0.93		0.053	0.053	**2.8**
Hexachlorocyclopentadiene		0.1					0.07		5.2	77	**0.1**
Ethers											
4-Bromophenyl phenyl ether		2.9			1.5		12.2	1.5		1.5	**2.9**
4-Chlorophenyl phenyl ether											**NA**
Bis (2-chloroethyl) ether		1900					2380		1900	19000	**1900**
MTBE (Methyl tert-butyl ether)		5400							10000		**5400**
Phenols and Substituted Phenols											
2-Chlorophenol		41					43.8		24	24	**41**
2-Methylphenol		370				13		489	13	67	**370**
2-Nitrophenol		540					3500				**540**
2,4-Dichlorophenol		83					36.5		11	11	**83**
2,4-Dimethylphenol		220					21.2		100	100	**220**
2,4-Dinitrophenol		4.1					6.2		19	19	**4.1**
2,4,5-Trichlorophenol									63		**63**
2,4,6-Trichlorophenol		6.3					3.2		4.9	4.9	**6.3**
4-Chloro-3-methylphenol		25					0.3			34.8	**25**
3-Methylphenol (m-cresol)		130								62	**130**
4-Methylphenol		120								25	**120**
4-Nitrophenol		1900				300	82.8	481	60	60	**1900**
4,6-Dinitro-2-Methylphenol		2.3					2.3			23	**2.3**
Pentachlorophenol[c]		13	15	13			13		15	4	**13**
Phenol	100						256	200	180	180	**100**
Ketones (Carbonyl Compounds)											
Acetophenone											**NA**
2-Butanone		26000				14000		282170	14000	2200	**26000**
2-Hexanone		950				99		32783	99	99	**950**
4-Methyl-2-pentanone (MIBK)		1400				170		77400	170	170	**1400**

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Acetone		120000				1500		1560	1500	1700	**120000**
Isophorone		960					1170		920	920	**960**
Polycyclic Aromatic Hydrocarbons											
Low Molecular Weight PAHs											
1-Methylnaphthalene[d]		12				2.1		526	2.1		**12**
2-Methylnaphthalene		12							330	330	**12**
Acenaphthene		62		23			17	74	5.8	38	**62**
Acenaphthylene		15							4840	4840	**15**
Anthracene		0.53				0.73		0.09	0.012	0.035	**0.53**
Fluoranthene		1.8		8.1			39.8	15	0.04	1.9	**1.8**
Fluorene		16			3.9	3.9			3.9	19	**16**
Naphthalene		68			24	12	62	620	1.1	13	**68**
Phenanthrene		3.7		6.3				200	3.6	3.6	**3.7**
High Molecular Weight PAHs											
Benzo(a)anthracene						0.027		0.65	0.027	0.025	**0.027**
Benzo(a)pyrene					0.014	0.014		0.3	0.014	0.014	**0.014**
Benzo(ghi)perylene									7.64	7.64	**7.64**
Benzo(b)fluoranthene									9.07	9.07	**9.07**
Benzo(k)fluoranthene											**NA**
Chrysene								2			**2**
Dibenzo(a,h)anthracene											**NA**
Indeno(1,2,3-cd)pyrene									4.31	4.31	**4.31**
Pyrene									0.025	0.3	**0.025**
Phthalates											
Bis (2-ethylhexyl) phthalate[e]		380			32	3	0.3	912	0.3	0.3	**380**
Butylbenzylphthalate		23000			19	19	22		19	23	**23000**
Diethyl phthalate		250			220	210	521	85600	110	110	**250**
Dimethyl phthalate		260					330		3		**260**
Di-n-butyl phthalate		48			33	35	9.4	697	9.7	9.7	**48**
Di-n-octyl phthalate								708		30	**708**
Miscellaneous Analytes											
2-Chloronaphthalene		30							0.396	0.396	**30**

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Atrazine		9							1.8		**9**
Benzaldehyde		14000									**14000**
Benzoic Acid		1400				42		12976	42		**1400**
Benzyl Alcohol		80				8.6		589	8.6	8.6	**80**
Carbazole		7.4									**7.4**
Carbon disulfide		20				0.92		244	0.92	15	**20**
1,4-Dioxane		36000								22000	**36000**
Dibenzofuran		15			20	3.7		1003	3.7	4	**15**
n-Hexane		20				0.58		65712	0.58		**20**
Indene		110									**110**
Pyridine										2380	**2380**
Vinyl acetate		140				16		810	16	248	**140**
Pesticides											
2,4,5-T									36	686	**36**
2,4,5-TP										30	**30**
2,4-D		8							4.0	220	**8**
4-(2,4-Dichlorophenoxy)Butyric Acid											**NA**
4,4'-DDD						0.011	0.0064	1.69	0.011		**0.0064**
4,4'-DDE							10.5		10.5	4.51E-09	**10.5**
4,4'-DDT		0.000001	0.001		0.013	0.013	0.001	0.3	0.0005	0.000011	**0.000001**
Alachlor		100									**100**
Aldrin							0.3		0.017	0.017	**0.017**
Azinphos-Methyl		0.01							0.02		**0.01**
a-BHC		2.5				2.2	500	95	2.2	12.4	**2.5**
b-BHC						2.2	5000	95	2.2	0.495	**2.2**
d-BHC						2.2		95	2.2	667	**2.2**
g-BHC (Lindane)				0.08			0.08	3.3	0.08	0.026	**0.08**
Bidrin											**NA**
Carbofuran		0.3							1.8		**0.3**
a-Chlordane[f]		0.0043	0.0043				0.0043	1.09	0.00215	0.0043	**0.0043**
g-Chlordane[f]		0.0043	0.0043				0.0043	1.09	0.00215	0.0043	**0.0043**
Chlordane (Technical)[f]		0.0043	0.0043				0.0043	1.09	0.00215	0.0043	**0.0043**

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Chlorfenvinfos									0.1		**0.1**
Chlorpyrifos									0.041		**0.041**
Coumaphos											**NA**
Crotoxyphos											**NA**
Dementon-S											**NA**
Diazinon									0.17		**0.17**
Dieldrin		0.056	0.056	0.062			0.0019		0.056	0.000071	**0.056**
Dimethoate									0.15		**0.15**
Disulfoton										0.0402	**0.0402**
alpha Endosulfan		0.0056	0.056		0.051	0.051	0.056		0.028	0.056	**0.0056**
beta Endosulfan		0.0056	0.056		0.051	0.051	0.056		0.028	0.056	**0.0056**
Endosulfan[g]		0.0056	0.056		0.051	0.051	0.056		0.028	0.056	**0.0056**
Endosulfan sulfate		0.0056							2.22	2.22	**0.0056**
Endothall		1000									**1000**
Endrin		0.033	0.036	0.061			0.0023		0.036	0.036	**0.033**
Endrin aldehyde									0.15	0.15	**0.15**
Endrin ketone											**NA**
Ethion											**NA**
Ethoprophos											**NA**
Ethyl P-Nitrophenyl Phenylphosphorothioate											**NA**
Fensulfothion											**NA**
Fenthion											**NA**
Heptachlor		0.0038	0.0038		0.0069	0.0069	0.0038	1.26	0.0019	0.0038	**0.0038**
Heptachlor epoxide		0.0038	0.0038				0.0038		0.0019	0.0038	**0.0038**
Isodrin		0.1								0.0309	**0.1**
Malathion		0.04							0.1		**0.04**
Methoxychlor		0.02	0.03		0.019	0.019	0.03		0.03	0.019	**0.02**
Methyl parathion[h]		0.013									**0.013**
Mevinphos											**NA**
Parathion		0.013	0.013				0.013		0.013	0.013	**0.013**
Toxaphene		0.0002	0.0002		0.011		0.0002		0.0002	0.00014	**0.0002**

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PCBs											
Aroclor 1016[i]			0.014				0.014				**0.014**
Aroclor 1221[i]			0.014			0.28	0.014	60			**0.014**
Aroclor 1232[i]			0.014			0.58	0.014	124			**0.014**
Aroclor 1242[i]			0.014			0.053	0.014	4.9			**0.014**
Aroclor 1248[i]			0.014			0.081	0.014				**0.014**
Aroclor 1254[i]			0.014			0.033	0.014	0.1			**0.014**
Aroclor 1260[i]			0.014			94	0.014	2.3			**0.014**
PCBs (Total)			0.014		0.19	0.014[v]		0.1		0.00012	**0.014**
Explosives											
1,3-Dinitrobenzene (DNB)		4						20[9]		22	**4**
1,3,5-Trinitrobenzene (TNB)		15						10[9]			**15**
2-Amino-4,6-Dinitrotoluene (2-ADNT)		7.9									**7.9**
2-Nitrotoluene (ONT)		62						730b			**62**
2,4,6-Trinitrotoluene (TNT)		75						90[9]	140		**75**
3-Nitrotoluene								830[10]			**830**
4-Amino-2,6-Dinitrotoluene		14						540[11]			**14**
4-Nitrotoluene (PNT)								700[10]			**700**
Cyclonite (RDX)		500						190[9]			**500**
Cyclotetramethylenetetranitramine (HMX)		260						330[9]			**260**
Nitroglycerin (NG)								200[12]			**200**
Pentaerythritol tetranitrate (PETN)								85000[10]			**85000**
Tetryl											**NA**
Metals/Inorganics											
Aluminum			87				87	460	87		**87**
Antimony		320				30	160	610	30	80	**320**
Arsenic*	190		150	190			190	914.1	190	148	**190**
Barium	5000				3.9	4			3.9	220	**5000**
Beryllium					5.1	0.66	0.53	5.3	0.66	3.6	**0.53**
Boron	1000					1.6	750	8830	1.6		**1000**
Cadmium*[j]	1		0.25	1			0.66	0.15	0.25	0.15	**1**
Calcium								116000			**116000**

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Chromium (Total)*[j]	180		74	180			117.32	44	74	42	**180**
Chromium VI	11		11	10			11	2	11		**11**
Cobalt*[k]					3	23		5.1	3	24	**23**
Copper*[j]	11		1.45	11			6.54	0.23	9	1.58	**11**
Fluoride	1400										**1400**
Iron*	1000		1000	1000			1000	158	1000		**1000**
Lead*[j]	16		2.5	2.5			1.32	12.26	2.5	1.17	**16**
Magnesium								82000			**82000**
Manganese	1000				80	120		1100	80		**1000**
Mercury*	1.1		0.77	1.3		1.3	0.012	0.23	0.77	0.0013	**1.1**
Nickel*[j]	5		52	160			87.71	5	52	28.9	**5**
Nitrogen, Ammonia (As N)[l]	1100							1.7			**1100**
Potassium								53000			**53000**
Selenium*	5		5	5			5	88.32	5	5	**5**
Silver	5					0.36	0.012	0.12	0.36	0.12	**5**
Sodium								680000			**680000**
Thallium		11				12	4	57	0.03	10	**11**
Vanadium*[k]					19	20		80	19	12	**20**
Zinc*[j]	22		120	100			58.91	30	120	65.7	**22**
Total Cyanide	5.2		5.2	5.2			5.2	7.8	5.2	5.2	**5.2**

Notes:
ESV - Ecological Screening Value
AWQC - Ambient Water Quality Criterion
ORNL - Oak Ridge National Laboratory
ESL - Ecological Screening Level
FCV - Final Chronic Value
NA - Not Available
* - Based on dissolved fraction.
a - Total dichloroethene used as a surrogate for *cis- and trans* -dichloroethene.
b - Total dichloropropene used as a surrogate for *cis-* and *trans* -dichloropropene.
c - Water quality standard is pH-dependent.

TABLE 3
SELECTION OF ECOLOGICAL SCREENING VALUES FOR DIRECT EXPOSURES TO SURFACE WATER

Constituent (µg/L)	A		B	C						D	Selected ESV
	Illinois General Use Water Quality Standards[1]	Illinois General Use Derived Water Quality Criteria[2]	National Recommended Water Quality Criteria (Chronic)[3]	ECOTOX AWQC/FCV[4]	ECOTOX Tier II Chronic[4]	Suter and Tsao (1996) Tier II Chronic[5]	EPA Region IV Freshwater Screening Values[6]	Suter and Tsao (1996) Lowest Reported Chronic[5] (or other as noted)	NOAA Chronic[7]	EPA Region V ESL[8]	

d - 2-methylnaphthalene used as a surrogate for 1-methylnaphthalene.

e - There is also a Region IV FWSV for bis(2-ethylhexyl)phthalate (DEHP) of <0.3 ug/L. However, this is apparently a typo, since the source referenced is the national ambient water quality criterion, for

f - Alpha, gamma, and technical chlordane based on chlordane.

g - Derived Illinois value for endosulfan sulfate used as a surrogate for endosulfan.

h - Parathion used as a surrogate for methyl parathion.

i - Total PCBs used as a surragate for individual Aroclors for The National Recommended Water Quality Criterion and Region IV ESVs

j - Water quality standard is hardness-dependent; assumed H = 100 mg/L. For region IV, values are based on a hardness of 50 mg/L.

k - SW ESVs for cobalt and vanadium based on Suter and Tsao (1996) superceding the original source reference, Suter and Mabrey (1994), used by ORNL. The Suter and Tsao value was chosen because it is based on multiple studies and GLWQI procedures.

l - Value for Ammonia based on IL Water Quality Standards for early life stages present; temperature 20°C and pH of 8.3. A pH of 8.3 is the 90th percentile value among water samples from the PA/SI and Phase I RI evaluations.

References:

1 Illinois EPA. 2008. Title 35 of the Illinois Administrative Code, Part 302, Subpart B: General Use Water Quality Standards. Available at: http://www.ipcb.state.il.us/documents/dsweb/Get/Document-33354/

2 Illinois EPA. 2009. Derived Water Water Quality Standards. Available at: http://www.epa.state.il.us/water/water-quality-standards/water-quality-criteria-list.pdf

3 USEPA. 2009. National Recommended Water Quality Criteria. Available at: http://water.epa.gov/scitech/swguidance/standards/current/index.cfm

4 USEPA. 1996. ECO Update: Ecotox Thresholds. EPA-540/F-95/038. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. 12pp. Available at: http://www.epa.gov/oswer/riskassessment/ecoup/pdf/v3no2.pdf

5 Suter and Tsao. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Cancer for Effect on Aquatic Biota. Oak Ridge National Laboratory. Oak Ridge, TN. ES/ER/TM-96/R2.

6 Freshwater ecotox screening values USEPA Region 4 1999.

7 Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoriation Division, National Oceanic and Atmospheric Administration, 34 pages. Does not include values categorized by general chemical class.

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12 Rosenblatt, D.H., Burrows, E.P., Mitchell, W.R., and Parmer, D.L. 1991. Organic Explosives and Related Compounds in The Handbook of Environmental Chemistry. Edited by O. Hutzinger. Springer-Verlag Berlin Heidelberg, Germany. 195-234.

TABLE 4a
INGESTION PATHWAY ECOLOGICAL SCREENING VALUES IN SOILS

Analyte	Soil ESV (mg/kg)	Source
LOW MOLECULAR WEIGHT PAHs	100	b
1- Methylnaphthalene	100	b
2- Methylnaphthalene	100	b
Acenaphthene	100	b
Acenaphthylene	100	b
Anthracene	100	b
Fluoranthene	100	b
Fluorene	100	b
Naphthalene	100	b
Phenanthrene	100	b
HIGH MOLECULAR WEIGHT PAHs	1.1	b
Benzo(a)anthracene	1.1	b
Benzo(a)pyrene	1.1	b
Benzo(b)fluoranthene	1.1	b
Benzo(g,h,i)perylene	1.1	b
Benzo(k)fluoranthene	1.1	b
Chrysene	1.1	b
Dibenzo(a,h)anthracene	1.1	b
Indeno(1,2,3-cd)pyrene	1.1	b
Pyrene	1.1	b
Carbazole	13	a
Dibenzofuran	25	a
PCBs total	0.034	a
PCB-1016 (Aroclor 1016)	0.034	a
PCB-1221 (Aroclor 1221)	0.034	a
PCB-1232 (Aroclor 1232)	0.034	a
PCB-1242 (Aroclor 1242)	0.034	a
PCB-1248 (Aroclor 1248)	0.034	a
PCB-1254 (Aroclor 1254)	0.034	a
PCB-1260 (Aroclor 1260)	0.034	a
bis(2-ethylhexyl)phthalate	4.4	a
butyl benzyl phthalate	860	a
di-n-butylphthalate	0.71	a
di-n-octylphthalate	610	a
TCDD	8.1E-07	a
Pentachlorophenol	2.1	b
Dieldrin	0.0049	b
4,4'-DDD	0.021	b
4,4'-DDE	0.021	b
4,4'-DDT	0.021	b
Inorganics		
Arsenic	43	b
Antimony	0.27	b
Barium	2000	b
Beryllium	21	b
Cadmium	0.36	b
Chromium (Total)	26	b
Cobalt	120	b
Copper	28	b
Lead	11	b
Manganese	4000	b
Mercury	0.15	a
Nickel	130	b
Selenium	0.63	b
Silver	4.2	b
Vanadium	7.8	b
Zinc	46	b

a - Ecological Problem Formulation Document for AUS OU (FWS 2005)
b - USEPA Ecological Soil Screening Levels (lower of avian or mammal ESSL)

TABLE 4b
ECOLOGICAL SCREENING VALUES (INGESTION) FOR EXPLOSIVES IN SOILS

Explosives (µg/kg)	LANL Ingestion ESL Mammals	LANL Ingestion ESL Birds	Proposed Ingestion ESV
1,3,5-Trinitrobenzene	6600		6600
1,3-Dinitrobenzene	73	79	73
2,4,6-Trinitrotoluene	80000	6400	6400
2,4-Dinitrotoluene	520		520
2,6-Dinitrotoluene	370		370
2-Amino-4,6-Dinitrotoluene	2100		2100
4-Amino-2,6-Dinitrotoluene	730		730
2-Nitrotoluene	2000		2000
3-Nitrotoluene	2400		2400
4-Nitrotoluene	4400		4400
HMX	27000		27000
Nitrobenzene	5800		5800
Nitroglycerin	71000		71000
Pentaerythritol Tetranitrate	8600000		8600000
Perchlorate			NA
RDX	130000	12000	12000
Tetryl	990		990

Notes:

ESV - Ecological screening value

LANL - Los Alamos National Laboratory

ESL - Ecological screening level

NA - Not available

Reference:

Los Alamos National Laboratory (LANL). 2008. Ecorisk Database, Release 2.3 (October). ER package #186. environmental Programs Directorate, Waste and Environmentla Services Division, Los Alamos, NM. ER ID 103352. LA-UR-08-06673.

ECOLOGICAL SCREENING VALUE SUMMARY TABLE - APRIL 2011

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
1,1,1,2-TETRACHLOROETHANE	UG/KG				225000		
1,1,1-TRICHLOROETHANE	UG/KG	UG/KG	UG/L		29800	170	390
1,1,2,2-TETRACHLOROETHANE	UG/KG	UG/KG	UG/L		127	940	140
1,1,2-TRICHLOROETHANE	UG/KG	UG/KG	UG/L		28600	2200	4400
1,1-DICHLOROETHANE	UG/KG	UG/KG	UG/L		20100	630	2000
1,1-DICHLOROETHENE	UG/KG	UG/KG	UG/L		8280	140	240
1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN (OCDF)							
1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN (OCDD)							
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN (HpCDF)							
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN (HpCDD)							
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN (HpCDF)							
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN (HxCDF)							
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN (HxCDD)							
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN (HxCDF)							
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN (HxCDD)							
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN (HxCDF)							
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN (HxCDD)							
1,2,3,7,8-PENTACHLORODIBENZOFURAN (PeCDF)							
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN (PeCDD)							
1,2,3-TRICHLOROBENZENE	UG/KG		UG/L		10		2.8
1,2,3-TRICHLOROPROPANE	UG/KG						
1,2,4-TRICHLOROBENZENE	UG/KG	UG/KG	UG/L		20000	9200	72
1,2,4-TRIMETHYLBENZENE	UG/KG		UG/L				29
1,2-DIBROMO-3-CHLOROPROPANE	UG/KG		UG/L		35.2		190
1,2-DIBROMOETHANE							
1,2-DICHLOROBENZENE	UG/KG	UG/KG	UG/L		2960	340	170
1,2-DICHLOROETHANE	UG/KG	UG/KG	UG/L		21200	780	4500
1,2-DICHLOROPROPANE	UG/KG	UG/KG	UG/L		700000	170	380
1,3,5-TRIMETHYLBENZENE			UG/L				11
1,3,5-TRINITROBENZENE	UG/KG	UG/KG	UG/L	6600	8600	20	15
1,3-DICHLOROBENZENE	UG/KG	UG/KG	UG/L		37700	1700	200
1,3-DINITROBENZENE	UG/KG	UG/KG	UG/L	73	655	0.98	4
1,4-DICHLOROBENZENE	UG/KG	UG/KG	UG/L		20000	350	620
1,4-DIOXANE	UG/KG		UG/L		2050		36000
1-BUTANOL							
1-METHYLNAPHTHALENE	UG/KG	UG/KG	UG/L	100000	29000	70	12
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN (HxCDF)							
2,3,4,7,8-PENTACHLORODIBENZOFURAN (PeCDF)							
2,3,7,8-TCDD	UG/KG	UG/KG		0.00081	5000	0.00085	
2,3,7,8-TETRACHLORODIBENZOFURAN (TCDF)							
2,4,5-T	UG/KG		UG/L		596		36
2,4,5-TP	UG/KG	UG/KG	UG/L		109	1600	30
2,4,5-TRICHLOROPHENOL	UG/KG	UG/KG	UG/L		4000	1000	63
2,4,6-TRICHLOROPHENOL	UG/KG	UG/KG	UG/L		10000	24	6.3
2,4,6-TRINITROTOLUENE	UG/KG	UG/KG	UG/L	6400	14000	1100	75
2,4-D	UG/KG	UG/KG	UG/L		27.2	36	8
2,4-DICHLOROPHENOL	UG/KG	UG/KG	UG/L		87500	120	83
2,4-DIMETHYLPHENOL	UG/KG	UG/KG	UG/L		10	460	220

ECOLOGICAL SCREENING VALUE SUMMARY TABLE - APRIL 2011

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
2,4-DINITROPHENOL	UG/KG	UG/KG	UG/L		20000	0.00041	4.1
2,4-DINITROTOLUENE	UG/KG	UG/KG	UG/L	520	5300	310	320
2,6-DINITROTOLUENE	UG/KG	UG/KG	UG/L	370	4500	100	150
2-AMINO-4,6-DINITROTOLUENE	UG/KG		UG/L	2100	19000		7.9
2-CHLORONAPHTHALENE	UG/KG	UG/KG	UG/L		12.2	340	30
2-CHLOROPHENOL	UG/KG	UG/KG	UG/L		243	160	41
2-HEXANONE	UG/KG	UG/KG	UG/L		12600	1300	950
2-METHYLNAPHTHALENE	UG/KG	UG/KG	UG/L	100000	29000	70	12
2-METHYLPHENOL (O-CRESOL)	UG/KG	UG/KG	UG/L		40400	340	370
2-NITROANILINE	UG/KG	UG/KG	UG/L		74100	420	200
2-NITROPHENOL	UG/KG	UG/KG	UG/L		1600	500	540
2-NITROTOLUENE	UG/KG	UG/KG	UG/L	2000		140	62
3,3'-DICHLOROBENZIDINE	UG/KG	UG/KG	UG/L		646	33	4.5
3-METHYLPHENOL (M-CRESOL)	UG/KG		UG/L		3490		130
3-NITROANILINE	UG/KG	UG/KG	UG/L		3160		
3-NITROTOLUENE	UG/KG	UG/KG	UG/L	2400		1200	830
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID							
4,4'-DDD	UG/KG	UG/KG	UG/L	21	758	4.88	0.0064
4,4'-DDE	UG/KG	UG/KG	UG/L	21	596	3.16	10.5
4,4'-DDT	UG/KG	UG/KG	UG/L	21	3.5	4.16	0.000001
4,4'-METHYLENE-BIS(2-CHLOROANILINE)							
4,6-DINITRO-2-METHYLPHENOL	UG/KG	UG/KG	UG/L		144	8.4	2.3
4-AMINO-2,6-DINITROTOLUENE	UG/KG		UG/L	730	18000		14
4-BROMOPHENYL PHENYL ETHER	UG/KG	UG/KG	UG/L			1300	2.9
4-CHLORO-3-METHYLPHENOL	UG/KG	UG/KG	UG/L		7950	13	25
4-CHLOROANILINE	UG/KG	UG/KG	UG/L		1100	0.13	0.2
4-CHLOROPHENYL PHENYL ETHER	UG/KG	UG/KG	UG/L				
4-METHYLPHENOL (P-CRESOL)	UG/KG	UG/KG	UG/L		163000	210	120
4-NITROANILINE	UG/KG	UG/KG	UG/L		21900	94	120
4-NITROPHENOL	UG/KG	UG/KG	UG/L		7000	950	1900
4-NITROTOLUENE	UG/KG	UG/KG	UG/L	4400		1900	700
ACENAPHTHENE	UG/KG	UG/KG	UG/L	100000	29000	6.71	62
ACENAPHTHYLENE	UG/KG	UG/KG	UG/L	100000	29000	5.87	15
ACETONE	UG/KG	UG/KG	UG/L		2500	690	120000
ACETOPHENONE	UG/KG				300000		
ALACHLOR		UG/KG	UG/L			390	100
ALDICARB							
ALDRIN	UG/KG	UG/KG	UG/L		3.32	2	0.017
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/KG	UG/L		99.4	6	2.5
ALPHA ENDOSULFAN	UG/KG	UG/KG	UG/L		119	2.9	0.0056
ALPHA-CHLORDANE	UG/KG	UG/KG	UG/L		224	5.2	0.0043
ALUMINUM	MG/KG	MG/KG	UG/L		soil pH < 5.4	26000	87
ANTHRACENE	UG/KG	UG/KG	UG/L	100000	29000	57.2	0.53
ANTIMONY	MG/KG	MG/KG	UG/L	0.27	78	3	320
ARSENIC	MG/KG	MG/KG	UG/L	43	18	9.79	190
ATRAZINE	UG/KG		UG/L				9
AZINPHOS-METHYL	UG/KG		UG/L				0.01
BARIUM	MG/KG		UG/L	2000	330		5000

ECOLOGICAL SCREENING VALUE SUMMARY TABLE - APRIL 2011

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
BENZALDEHYDE	UG/KG		UG/L				14000
BENZENE	UG/KG	UG/KG	UG/L		16000	57	860
BENZIDINE							
BENZO(A)ANTHRACENE	UG/KG	UG/KG	UG/L	1100	18000	108	0.027
BENZO(A)PYRENE	UG/KG	UG/KG	UG/L	1100	18000	150	0.014
BENZO(B)FLUORANTHENE	UG/KG	UG/KG	UG/L	1100	18000	27	9.07
BENZO(G,H,I)PERYLENE	UG/KG	UG/KG	UG/L	1100	18000	13	7.64
BENZO(K)FLUORANTHENE	UG/KG	UG/KG	UG/L	1100	18000	27	
BENZOIC ACID	UG/KG		UG/L				1400
BENZYL ALCOHOL	UG/KG		UG/L		65800		80
BENZYL BUTYL PHTHALATE	UG/KG	UG/KG	UG/L	860000	239	11000	23000
BERYLLIUM	MG/KG		UG/L	21	40		0.53
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/KG	UG/L		3.98	5	2.2
BETA ENDOSULFAN	UG/KG	UG/KG	UG/L		119	14	0.0056
BIDRIN							
BIPHENYL	UG/KG						
BIS(2-CHLOROETHOXY) METHANE	UG/KG	UG/KG	UG/L		302		
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	UG/KG	UG/L		23700	290	1900
BIS(2-CHLOROISOPROPYL) ETHER							
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	UG/KG	UG/L	4400	925	750	380
BORON	MG/KG		UG/L		0.5		1000
BROMOBENZENE							
BROMODICHLOROMETHANE	UG/KG	UG/KG	UG/L		540	0.55	1
BROMOFORM	UG/KG	UG/KG	UG/L		15900	650	293
BROMOMETHANE	UG/KG	UG/KG	UG/L		235	1.7	16
CADMIUM	MG/KG	MG/KG	UG/L	0.36	32	0.99	1
CALCIUM			UG/L				116000
CAPROLACTAM	UG/KG						
CARBAZOLE	UG/KG	UG/KG	UG/L	13000	19000	250	7.4
CARBOFURAN		UG/KG	UG/L			0.11	0.3
CARBON DISULFIDE	UG/KG	UG/KG	UG/L		94.1	9.1	20
CARBON TETRACHLORIDE	UG/KG	UG/KG	UG/L		1000000	1200	280
CHLORDANE	UG/KG	UG/KG	UG/L		224	3.24	0.0043
CHLORFENVINFOS			UG/L				0.1
CHLORIDE							
CHLOROBENZENE	UG/KG	UG/KG	UG/L		40000	820	79
CHLOROETHANE		UG/KG	UG/L			690	1000
CHLOROFORM	UG/KG	UG/KG	UG/L		1190	60	150
CHLOROMETHANE	UG/KG	UG/KG	UG/L		10400	920	1300
CHLORPYRIFOS			UG/L				0.041
CHROMIUM VI	MG/KG		UG/L		117		11
CHROMIUM, TOTAL	MG/KG	MG/KG	UG/L	26	56	43.4	180
CHRYSENE	UG/KG	UG/KG	UG/L	1100	18000	166	2
CIS-1,2-DICHLOROETHYLENE	UG/KG	UG/KG	UG/L		784	390	1100
CIS-1,3-DICHLOROPROPENE	UG/KG	UG/KG	UG/L		398	36	7.9
COBALT	MG/KG	MG/KG	UG/L	120	13	50	23
COPPER	MG/KG	MG/KG	UG/L	28	70	31.6	11
COUMAPHOS							

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
CROTOXYPHOS							
CYANIDE	MG/KG	MG/KG	UG/L		0.9	0.1	5.2
CYCLOHEXANE							
DALAPON							
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	UG/KG	UG/L		9940	30	2.2
DEMENTON-S			UG/L				
DIAZINON	UG/KG		UG/L				0.17
DIBENZ(A,H)ACRIDINE							
DIBENZ(A,H)ANTHRACENE	UG/KG	UG/KG	UG/L	1100	18000	33	
DIBENZOFURAN	UG/KG	UG/KG	UG/L	25000	36000	2000	15
DIBROMOCHLOROMETHANE	UG/KG	UG/KG	UG/L		2050		
DICHLORODIFLUOROMETHANE							
DIELDRIN	UG/KG	UG/KG	UG/L	4.9	50000	1.9	0.056
DIETHYL PHTHALATE	UG/KG	UG/KG	UG/L		100000	630	250
DIMETHOATE	UG/KG		UG/L		218		0.15
DIMETHYL PHTHALATE	UG/KG	UG/KG	UG/L		200000	410000	260
DI-N-BUTYL PHTHALATE	UG/KG	UG/KG	UG/L	710	200000	11000	48
DI-N-OCTYL PHTHALATE	UG/KG	UG/KG	UG/L	610000	709000	590000000	708
DINOSEB							
DISULFOTON	UG/KG		UG/L		19.9		0.0402
ENDOSULFAN	UG/KG	UG/KG	UG/L		119	5.4	0.0056
ENDOSULFAN SULFATE	UG/KG	UG/KG	UG/L		35.8	0.32	0.0056
ENDOTHALL		UG/KG	UG/L			2.9	1000
ENDRIN	UG/KG	UG/KG	UG/L		10.1	2.22	0.033
ENDRIN ALDEHYDE	UG/KG	UG/KG	UG/L		10.5	29	0.15
ENDRIN KETONE							
ETHION							
ETHOPROPHOS							
ETHYL P-NITROPHENYL PHENYLPHOSPHOROTHIOATE							
ETHYLBENZENE	UG/KG	UG/KG	UG/L		5000	3600	14
FENSULFOTHION							
FENTHION							
FLUORANTHENE	UG/KG	UG/KG	UG/L	100000	29000	423	1.8
FLUORENE	UG/KG	UG/KG	UG/L	100000	29000	77.4	16
FLUORIDE			UG/L				1400
GAMMA BHC (LINDANE)	UG/KG	UG/KG	UG/L		32	2.37	0.08
GAMMA-CHLORDANE	UG/KG	UG/KG	UG/L		224	5.2	0.0043
HEPTACHLOR	UG/KG	UG/KG	UG/L		5.98	10	0.0038
HEPTACHLOR EPOXIDE	UG/KG	UG/KG	UG/L		152	2.47	0.0038
HEXACHLOROBENZENE	UG/KG	UG/KG	UG/L		1000000	100	0.0003
HEXACHLOROBUTADIENE	UG/KG	UG/KG	UG/L		39.8	140	2.8
HEXACHLOROCYCLOPENTADIENE	UG/KG	UG/KG	UG/L		10000	200	0.1
HEXACHLOROETHANE	UG/KG	UG/KG	UG/L		596	1000	31
HMX	UG/KG	UG/KG	UG/L	27000	17000	360	260
INDENE			UG/L				110
INDENO(1,2,3-C,D)PYRENE	UG/KG	UG/KG	UG/L	1100	18000	17	4.31
IRON	MG/KG	MG/KG	UG/L		pH dependent	190000	1000
ISODRIN	UG/KG	UG/KG	UG/L		3.32	3.3	0.1

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
ISOPHORONE	UG/KG	UG/KG	UG/L		139000	450	960
ISOPROPYLBENZENE	UG/KG						
LEAD	MG/KG	MG/KG	UG/L	11	120	35.8	16
MAGNESIUM			UG/L				82000
MALATHION	UG/KG		UG/L				0.04
MANGANESE	MG/KG	MG/KG	UG/L	4000	220	630	1000
MERCURY	MG/KG	MG/KG	UG/L	0.15	7	0.18	1.1
METHOXYCHLOR	UG/KG	UG/KG	UG/L		19.9	19	0.02
METHYL ACETATE							
METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	UG/KG	UG/L		89600	8200	26000
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	UG/KG	UG/L		443000	1700	1400
METHYL PARATHION	UG/KG		UG/L		0.292		0.013
METHYLCYCLOHEXANE							
METHYLENE BROMIDE							
METHYLENE CHLORIDE	UG/KG	UG/KG	UG/L		4050	160	1400
MEVINPHOS							
MTBE (METHYL TERT-BUTYL ETHER)			UG/L				5400
NAPHTHALENE	UG/KG	UG/KG	UG/L	100000	29000	176	68
N-BUTYL BENZENE	UG/KG		UG/L				3.1
N-HEXANE			UG/L				20
NICKEL	MG/KG	MG/KG	UG/L	130	38	22.7	5
NITROBENZENE	UG/KG	UG/KG	UG/L	5800	2200	5500	8500
NITROGEN, AMMONIA (AS N)			UG/L				1100
NITROGLYCERIN	UG/KG	UG/KG	UG/L	71000	13000	330	200
N-NITROSODIMETHYLAMINE							
N-NITROSODI-N-PROPYLAMINE	UG/KG				544		
N-NITROSODIPHENYLAMINE	UG/KG	UG/KG	UG/L		20000	750	58.5
N-PROPYL BENZENE	UG/KG		UG/L				10
PARATHION	UG/KG		UG/L		0.34		0.013
PCB (total)	UG/KG	UG/KG	UG/L	34	40000	59.8	0.014
PCB-1016 (AROCLOR 1016)	UG/KG	UG/KG	UG/L	34	40000	7	0.014
PCB-1221 (AROCLOR 1221)	UG/KG	UG/KG	UG/L	34	40000	4	0.014
PCB-1232 (AROCLOR 1232)	UG/KG	UG/KG	UG/L	34	40000		0.014
PCB-1242 (AROCLOR 1242)	UG/KG		UG/L	34	40000		0.014
PCB-1248 (AROCLOR 1248)	UG/KG	UG/KG	UG/L	34	40000	30	0.014
PCB-1254 (AROCLOR 1254)	UG/KG	UG/KG	UG/L	34	40000	60	0.014
PCB-1260 (AROCLOR 1260)	UG/KG	UG/KG	UG/L	34	40000	5	0.014
PENTACHLOROPHENOL	UG/KG	UG/KG	UG/L	2100	5000	77	13
PENTAERYTHRITOL TETRANITRATE	UG/KG	UG/KG	UG/L	8600000		470000	85000
PERCHLORATE							
PHENANTHRENE	UG/KG	UG/KG	UG/L	100000	29000	204	3.7
PHENOL	UG/KG	UG/KG	UG/L		40000	48	100
PHENYLMERCAPTAN							
PHORATE							
PHOSPHORUS, TOTAL (AS P)							
PICLORAM							
PICRIC ACID							
P-ISOPROPYLTOLUENE							

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
POTASSIUM			UG/L				53000
PYRENE	UG/KG	UG/KG	UG/L	1100	18000	195	0.025
PYRIDINE	UG/KG		UG/L		1030		2380
QUINOLINE							
RDX	UG/KG	UG/KG	UG/L	12000	36000	1080	500
RONNEL							
SEC-BUTYL BENZENE			UG/L				6.6
SELENIUM	MG/KG	MG/KG	UG/L	0.63	0.52	2.5	5
SILVER	MG/KG	MG/KG	UG/L	4.2	560	1	5
SIMAZINE							
SODIUM			UG/L				680000
STYRENE	UG/KG	UG/KG	UG/L		300000	1600	200
SULFATE (AS SO4)							
SULFOTEPP (TETRAETHYLDITHIOPYROPHOSPHATE)							
SULPROFOS							
TERT-BUTYL BENZENE			UG/L				7.7
TETRACHLOROETHYLENE(PCE)	UG/KG	UG/KG	UG/L		13000	530	150
TETRACHLOROVINPHOS							
TETRYL	UG/KG			990	25000		
THALLIUM	MG/KG		UG/L		1		11
TOKUTHION (PROTOTHIOFOS)							
TOLUENE	UG/KG	UG/KG	UG/L		3000	670	600
TOTAL 1,2-DICHLOROETHENE	UG/KG	UG/KG	UG/L		784	460	1100
TOTAL HpCDD							
TOTAL HpCDF							
TOTAL HxCDD							
TOTAL HxCDF							
TOTAL PeCDD							
TOTAL PeCDF							
TOTAL TCDD							
TOTAL TCDF							
TOXAPHENE	UG/KG	UG/KG	UG/L		119	28	0.0002
TRANS-1,2-DICHLOROETHENE	UG/KG	UG/KG	UG/L		784	580	1100
TRANS-1,3-DICHLOROPROPENE	UG/KG	UG/KG	UG/L		398	16	7.9
TRICHLOROETHYLENE (TCE)	UG/KG	UG/KG	UG/L		9000	1600	940
TRICHLOROFLUOROMETHANE							
TRICHLOROTRIFLUOROETHANE							
VANADIUM	MG/KG		UG/L	7.8	46		20
VINYL ACETATE	UG/KG		UG/L		12700		140
VINYL CHLORIDE	UG/KG	UG/KG	UG/L		646	320	1700
XYLENES, TOTAL	UG/KG	UG/KG	UG/L		600	25	360
ZINC	MG/KG	MG/KG	UG/L	46	120	121	22
DICHLORVOS/NALED							
MERPHOS OXONE							
NITROGEN, NITRATE-NITRITE							
PHOSPHORUS, TOTAL ORTHOPHOSPHATE (AS P)							
PAH total		UG/KG				1610	
PAHs (LMW)	UG/KG	UG/KG		100000	29000	760	

ECOLOGICAL SCREENING VALUE SUMMARY TABLE - APRIL 2011

Analyte Name	Soil Units	Sediment Units	Water Units	Ecological Screening Values			
				Soil ESV (ingestion)	Soil ESV (direct)	Sediment ESV (direct)	Surface Water ESV (direct)
PAHs (HMW)	UG/KG	UG/KG		1100	18000	1700	
pH							
PERCENT SOLIDS							
TOTAL DISSOLVED SOLIDS (RESIDUE, FILTERABLE)							
TOTAL ORGANIC CARBON							
SUSPENDED SOLIDS (RESIDUE, NON-FILTERABLE)							

Last revised: BAL 05/05/10

Final Preliminary Screening Analysis Report
Lake Monitoring Operable Unit
Crab Orchard National Wildlife Refuge Superfund Site
US Fish and Wildlife Service – April 2001

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FISH & WILDLIFE
SERVICE

DEPARTMENT OF THE INTERIOR

Final Preliminary Screening Analysis Report

Lake Monitoring Operable Unit

Crab Orchard National Wildlife Refuge Superfund Site
Marion, Illinois (Williamson County)

April 2001

20416-1/1
00059875

TABLE 4-8
SCREENING QUOTIENTS FOR FISH (CRITICAL TISSUE RESIDUE)

Lake Monitoring Operable Unit
Crab Orchard National Wildlife Refuge - Marion, Illinois

CHEMICAL	Fish TRVs (mg/kg)	CRAB ORCHARD LAKE						REND LAKE
		FHA	FHB	FHC	FHD	FHE	FHF	
		Screening Quotients for Fish (unitless)						
PESTICIDES								
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA
Alpha BHC (alpha Hexachlorocyclohexane)	25	<0.01	*<0.01*	*<0.01*	<0.01	<0.01	<0.01	<0.01
Alpha Endosulfan	0.195	0.13	0.05	0.33	0.34	0.03	0.01	*<0.01*
Alpha-chlordane	0.6	0.04	0.01	0.02	0.14	<0.01	*<0.01*	*<0.01*
Beta BHC (beta Hexachlorocyclohexane)	6.13	<0.01	*<0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Beta Endosulfan	0.195	0.09	0.04	*0.02*	0.11	0.03	0.02	0.03
Delta BHC (delta Hexachlorocyclohexane)	6.13	*<0.01*	<0.01	<0.01	*<0.01*	*<0.01*	<0.01	*<0.01*
Dieldrin	2.13	<0.01	0.02	0.02	0.19	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.195	0.02	*0.02*	0.02	0.13	0.02	0.02	*0.02*
Endrin	0.23	0.04	0.03	0.08	1.00	0.02	*0.01*	0.02
Endrin Aldehyde	0.23	0.10	0.04	1.00	0.83	0.09	0.04	0.02
Endrin Ketone	0.23	*0.01*	*0.01*	0.05	*0.01*	0.02	*0.01*	0.03
Gamma BHC (lindane)	6.13	<0.01	*<0.01*	<0.01	<0.01	<0.01	<0.01	<0.01
Gamma-chlordane	0.6	0.04	<0.01	0.06	0.04	0.01	<0.01	0.01
Heptachlor	17.73	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor Epoxide	17.73	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	2.5	*<0.01*	<0.01	*<0.01*	*<0.01*	*<0.01*	*<0.01*	<0.01
4,4'-DDD	0.12	0.05	0.03	0.13	0.18	0.04	*0.03*	*0.03*
4,4'-DDE	0.058	0.78	0.45	**1.90**	**2.41**	0.98	0.36	0.67
4,4'-DDT	0.76	0.02	0.01	0.03	0.24	<0.01	*<0.01*	<0.01
Toxaphene	0.2	*0.85*	*0.85*	*0.85*	*0.85*	*0.85*	*0.85*	*0.85*
Polychlorinated Biphenyls (PCBs)								
PCB-1016 (Aroclor 1016)	2.86	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
PCB-1221 (Aroclor 1221)	2.86	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
PCB-1232 (Aroclor 1232)	2.86	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
PCB-1242 (Aroclor 1242)	2.86	0.03	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
PCB-1248 (Aroclor 1248)	2.86	0.06	*0.01*	*0.01*	0.45	*0.01*	*0.01*	*0.01*
PCB-1254 (Aroclor 1254)	2.86	0.22	0.23	0.91	**4.55**	0.25	0.03	0.12
PCB-1260 (Aroclor 1260)	2.86	0.19	0.07	0.16	0.56	0.10	0.03	0.12
Total PCB[1,2]	2.86	0.47	0.31	**1.08**	**5.56**	0.36	0.07	0.25
METALS								
Mercury	3	0.07	0.02	0.03	0.04	**1.17**	0.18	0.05
Selenium	4	**1.13**	**1.13**	**1.13**	**1.13**	**1.13**	**1.13**	**1.13**
DIOXINS / FURANS								
TCDD equivalents - mammals	NA	NA	NA	NA	NA	NA	NA	NA
TCDD equivalents - birds	NA	NA	NA	NA	NA	NA	NA	NA
TCDD equivalents - fish	0.0002	0.02	0.01	0.02	0.02	<0.01	<0.01	NA

NA - Not available or not applicable

ND - Not detected

Bold - Indicates quotient >1

Italics - Chemical not detected, results based on RL.

[1] The total PCB conentration in fish tissue was calculated as the sum of PCB-1248, PCB-1254, and PCB-1260.

[2] Total PCB conentrations were all non-detects in sediment except for cell D in which the sum of the congeners was used.

Reference Appendix A, Section 3.5.1.2 (fish TRV discussion) for calculation of TRVs.

Attachment 4
Laboratory Standard Operating Procedures

Attachment 4
Summary of Analytical Services

MATRIX	ANALYTICAL GROUP	ANALYTICAL LABORATORY	ANALYTICAL SOP REFERENCE
Solid (soil/sediment)	Pesticides VOCs PAHs	Environmental Chemistry Consulting Services (ECCS) 2525 Advance Road Madison, WI 53718 (608) 221-8700	ECCS-LAM-003 ECCS-LAM-004 ECCS-LAM-030
Aqueous (surface water/groundwater)	Pesticides VOCs	ECCS (as above)	ECCS-LAM-003 ECCS-LAM-004
Wipes	Pesticides	ECCS (as above)	ECCS-LAM-003
Solid (soil/sediment)	TOC	ECCS Subcontract to: Pace Analytical Laboratory 1241 Bellevue St. #9 Green Bay, WI 54302 (920) 469-2436	PACE-01
Fish Tissue	Necropsy Histopathology	To be determined	SOP-10
Fish Tissue	Pesticides Lipids	ALS Environmental 1317 S. 13th Avenue Kelso, WA 98626 (360) 577-7222	ALS-MET-TISP ALS-SOC-8081 ALS-EXT-LIPID

Notes:
VOCs = Volatile Organic Compounds
PAHs = Polycyclic Aromatic Hydrocarbons
TOC = Total Organic Carbon

Environmental Chemistry Consulting Services, Inc.
2525 Advance Road
Madison, WI 53718
608-221-8700 (phone)
608-221-4889 (fax)

CHAIN OF CUSTODY

Lab Work Order #:

Mail Report To:
Company:
Address:
E-mail Address:
Invoice To:
Company:
Address:

Project Number:
Project Name:
Project Location:
Turn Around (check one): ☐ Normal ☐ 5 BDs ☐ 3 BDs ☐ 2 BDs ☐ 24 hrs
If Rush, Report Due Date:
Sampled By (Print):

Preservation Codes
Analyses Requested

Sample Description	Collection Date	Collection Time	Matrix	Total # of Containers							Comments	Lab ID	Lab Receipt Time
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			
					☐	☐	☐	☐	☐	☐			

Preservation Codes
A=None B=HCL C=H_2SO_4
D=HNO_3 E=EnCore F=Methanol
G=NaOH O=Other (Indicate)

Matrix Codes
A=Air S=Soil W=Water O=Other

Rush TAT Multipliers
5 Business Days = 1.5x
3 Business Days = 2x
2 Business Days = 2.25x
24 Hours = 2.5x
must be pre-arranged

Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

Custody Seal: ☐ Present ☐ Absent ☐ Intact ☐ Not Intact
Seal #s:
Shipped Via:
Receipt Temp:
Temp Blank: ☐ Y ☐ N

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ALS Environmental

CHAIN OF CUSTODY

SR# _____

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE _____ OF _____ COC# _____

PROJECT NAME
PROJECT NUMBER
PROJECT MANAGER
COMPANY NAME
ADDRESS
CITY/STATE/ZIP
E-MAIL ADDRESS
PHONE # FAX #
SAMPLER'S SIGNATURE

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 524☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity ☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐				REMARKS

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
___ IV. Data Validation Report
___ V. EDD

INVOICE INFORMATION

P.O. # _____
Bill To: _____

TURNAROUND REQUIREMENTS

_____ 24 hr. _____ 48 hr.
_____ 5 day
_____ Standard (15 working days)
_____ Provide FAX Results

_____
Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature / Date/Time	Signature / Date/Time	Signature / Date/Time	Signature / Date/Time
Printed Name / Firm	Printed Name / Firm	Printed Name / Firm	Printed Name / Firm

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TRC Addendum to SOP ALS-MET-TISP
Revision 8, February 20, 2012

This addendum summarizes modifications to the ALS laboratory SOP MET-TISP *Standard Operating Procedure for Tissue Sample Preparation* that will be incorporated into the fish tissue analysis performed in support of the Work Plan for an Engineering Evaluation/Cost Analysis (EE/CA) for the Pesticide Contamination at Area 7 Pesticides Area, Additional and Uncharacterized Sites Operable Unit.

Appendix A (Entire Appendix) – This Appendix is not applicable, as the fish will be filleted prior to shipping to ALS.

Appendix B (Entire Appendix) – This Appendix is not applicable, as shellfish are not a target species of this investigation.

STANDARD OPERATING PROCEDURE

for

TISSUE SAMPLE PREPARATION

SOP Code: MET-TISP
Revision: 8

Effective Date: February 20, 2012

Approved By: _____ Supervisor — 1/23/12 Date

_____ QA Manager — 1/23/12 Date

_____ Laboratory Director — 1/23/12 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

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DOCUMENT CONTROL	
NUMBER:	
Initials:	Date:

Standard Operating Procedure for Tissue Sample Preparation

1. PURPOSE

This standard operating procedure describes procedures for the initial preparation of tissue samples prior to sample analysis. Customer-specific contracts or statement of works (SOWs) with alternate procedures will take precedence over this SOP.

2. APPLICABILITY

This SOP is intended to provide guidance for the preliminary preparation of tissue samples prior to the sample aliquoting and analytical preparation described in individual analytical SOPs. The procedures described in this SOP also apply to compositing and subsampling of tissue samples for analyses to be subcontracted.

3. DEFINITIONS

3.1. Sample: The material presented to the laboratory for analysis or testing.

3.2. Sample Aliquot: A representative part or portion of a sample for analysis which is a fraction of the whole sample. See subsampling also.

3.3. Compositing: The process by which sample aliquots from two or more samples are united to form a combined sample which is subsequently analyzed.

3.4. Subsampling: The process by which a representative portion is obtained from a whole sample.

3.5. Service Request: The service request (SR) is a document prepared at the time of sample receipt and summarizes sample analysis and reporting instructions about a customer's sample(s).

3.6. QAPP: Quality Assurance Project Plan document provided by the client specifically written for their project.

3.7. VOC Analyses: Volatile organic compounds (VOC) analyses, including halogenated and aromatic volatile organic compounds and gasoline range organics (GRO) analyses.

3.8. Non-VOC Analyses: Any analysis other than a VOC analysis.

4. DISCUSSION

Confidential Proprietary

4.1. Tissue samples are inherently heterogeneous requiring special considerations in order to obtain a truly representative sample aliquot for analysis. This SOP provides guidance for handling tissue samples prior to the sample preparation steps described in analytical SOPs. This SOP applies to samples delivered to the lab in whole body form or in the form of pre-dissected tissues.

4.2. The sample handling strategy must consider:

- what analyses are to be performed (metals, organics, or both, and VOC or non-VOC),
- how much sample is available
- are the analyses to be performed on individual samples or composite homogenates,
- are the analyses to be performed on whole body, edible portions or specific organs, and
- are any of the analyses going to be subcontracted which may require subsampling.

4.3. Proper preparation and handling of tissue samples is required to obtain a representative sample, avoid contamination, and to ensure loss of sample and target constituents is minimized.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

Refer to the determinative method.

7. REAGENTS AND STANDARDS

7.1. Not applicable to this procedure

8. APPARATUS AND EQUIPMENT

Note: Refer to the Procedure section for specific equipment used based on the determinative analysis to be performed. The use of implements and surfaces may vary depending on the analyses to be performed.

8.1. Hobart Food Chopper, or comparable device.

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8.2. Tissumizer.

8.3. Waring blender, or similar device.

8.4. Freeze-drier, Labonco or equivalent.

8.5. Glass or PTFE cutting boards.

8.6. Knives and cutting implements – refer to Procedure section.

8.7. Standard laboratory glassware (beakers, scintillation vials, etc.)

8.8. VOA vial – pre-cleaned, 40ml with Teflon-lined cap.

8.9. Pre-cleaned glass jars with PTFE lined lids, various sizes.

8.10. Gloves: Should be talc free and of non-contaminating materials.

8.11. Heavy duty aluminum foil.

9. RESPONSIBILITIES

9.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

9.2. Sample custodians, together with project chemists and department supervisors, are responsible for documenting any required sample preparation (including the percent solids or percent lipids determination if required) on the service request. All personnel preparing tissue samples should be familiar with the contents of this document prior to commencing work.

9.3. Tissue sample preparation is to be performed only by lab analysts instructed in the proper handling techniques outlined in this SOP. It is the responsibility of the analyst to perform this procedure to complete all documentation required for data review.

10. PREVENTIVE MAINTENANCE

10.1. No specific maintenance steps are needed other than normal cleaning and inspection of apparatus.

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10.2. For organics samples, polypropylene and polyethylene (plastic) surfaces, implements, and containers are a potential source of adsorption and contamination and should not be used. Gloves should be talc free and of non-contaminating materials.

11. PROCEDURE

11.1. Sample Login

Any special sample handling must be noted on the service request and on a label attached to the sample itself. During sample receiving, a sample custodian must follow the procedures described in Section 11.1.1.

11.1.1. Tissue Samples with Limited Quantity

An assessment of the required sample quantity should be made by the project chemist when taking delivery of the sample. This assessment must take into consideration the tests, the required detection limits and the necessary quality assurance samples. If the quantity of sample given to the laboratory is insufficient for the analyses requested, the sample custodian will, along with the project chemist estimate the total amount of sample available. A "LIMITED SAMPLE VOLUME" tag is attached to the sample on which is recorded the estimated sample quantity.

In some cases it may be beneficial to perform sample preparations as described in this SOP prior to estimating the sample amount. In this case, the analyst prepring the sample will provide the project chemist with an estimate of the amount available.

The project chemist must determine if limited sample quantity exists and set the priorities for the analyses and, if possible, estimate the quantity of sample to be *used for each test*. This information is to be documented and placed in the project file and on the service request to communicate to the laboratory staff. For example, 8081 use 10 g; metals use 1g.

NOTE. Samples that are quantity limited and require multiple analyses must be identified as soon as possible. Optimally, this should happen during sample login; however, discovery at any time should trigger appropriate actions as described in Section 11.1.1.

11.2. Sample Homogenization

This section outlines the steps for preparing homogenous samples of whole fish, edible fish (fillets), edible shellfish, worm composite homogenates, eggs, and plant tissues.

11.2.1. Samples for Organics Analyses:

Equipment used for the processing of tissue samples for organics analyses should be of stainless steel, anodized aluminum, glass or polytetrafluorethylene (PTFE). Polypropylene and polyethylene (plastic) surfaces, implements, and containers are a potential source of adsorption and contamination and should not be used. Gloves should be talc free and of non-contaminating materials. Filleting should be done on glass or PTFE cutting boards that are cleaned properly between samples or on cutting boards that are covered with heavy duty aluminum foil (hexane rinsed) that is changed between samples. Tissue should be handled with precleaned, high quality, corrosion-resistant stainless steel instruments. Fillets or homogenate should be stored in cleaned glass jars of suitable dimensions with PTFE lined lids. If the sample is to be analyzed for VOCs, the homogenization steps should be performed on sample tissue that is partially frozen or chilled. An aliquot of the homogenate should be placed in a clean 40ml voa vial and labelled "FOR VOA ANALYSIS ONLY".

Prior to handling each sample, utensils, cutting boards and containers should be washed in a detergent hot water solution and rinsed with tap water, hexane, and DI water. Precleaned, certified sample containers may be used without further cleaning. If the sample is to be analyzed for VOCs, methanol is substituted for the rinsing of implements with acetone and the hexane rinsing of the aluminum foil. Exposure to solvent vapors must be minimized.

11.2.2. Samples for Metals Analyses:

Equipment used in the processing of samples for metals analyses should be of PTFE, ceramic, polypropylene or polyethylene. Filleting should be performed on PTFE cutting boards which are cleaned after each sample. Knives with titanium or high quality stainless steel blades may be used for tissue resections. Tissue should be stored in glass jars with PTFE lined lids.

Prior to sample handling, utensils, cutting boards and containers should be washed in a detergent hot water solution, rinsed with tap water, 25% HCL (except metal utensils), and DI water. Precleaned, certified sample containers may be used without further cleaning.

11.2.3. Samples for both Metals and Organics Analyses:

If the sample is to be prepared for both organics and metals, care must be taken to use equipment and cleaning procedures that are non-contaminating for both. Quartz, ceramic, glass and PTFE are recommended materials for sample processing equipment. Knives with titanium or high quality stainless steel blades may be used for tissue resections. Glass or PTFE cutting boards should be used. If the sample is to be analyzed for VOC's, the homogenization steps should be performed on sample tissue that is partially frozen or chilled. An aliquot of the homogenate

should be placed in a clean 40ml voa vial and labeled "FOR VOA ANALYSIS ONLY".

Prior to handling each sample, utensils, cutting boards and containers should be washed in a detergent hot water solution and rinsed with tap water, acetone, methanol, or hexane (as appropriate), and DI water. Precleaned, certified sample containers may be used without further cleaning. Non-metallic surfaces and utensils should also be rinsed with 25% HCL followed by DI water. If the sample is to be analyzed for VOCs, methanol is substituted for the rinsing of implements with acetone. Exposure to solvent vapors must be minimized.

11.2.4. Sample Preparation

Each tissue sample may be homogenized in the original glass bottle container if there is sufficient space to allow thorough mixing. If homogenization is not achievable in the original container, place the entire sample contents into a clean glass jar. Generally, liquids contained in the container are to be considered part of the sample. If the sample requires size reduction prior to homogenization, chop the sample into the 1-2" chunks using a titanium or stainless steel bladed knife. Large samples may require the use of industrial food processors such as a Hobart Food Chopper, or comparable device. Size-reduced chunks of tissue are thoroughly homogenized to a paste-like consistency using a Tissumizer, Waring blender, or similar device until it reaches a paste-like consistency. Transfer the sample paste to a glass jar for storage and freeze until ready for sample extraction. The new sample container is labeled with the sample I.D., the word "homogenized", initialed, and dated.

11.2.4.1. Whole Fish Tissue

Samples may be frozen in the field or in the laboratory. While still partially frozen, rinse the fish with DI water to remove extraneous materials and liquids. Cut the fish into appropriate size chunks and mechanically macerate the sample using cutting tools appropriate for the size of the sample and the analysis type. If necessary, process fish tissue chunks through the Hobart Food Chopper. To ensure thorough mixing, divide the ground sample into quarters, mix opposite quarters and then mix halves. Homogenize sample using a Tissumizer or Waring blender until it reaches a paste-like consistency. Transfer the sample paste to a glass jar for storage and freeze until ready for sample extraction. The new sample container is labeled with the sample I.D., the word "homogenized", initialed, and dated.

11.2.4.2. Edible Fish Tissue

If the client or QAPP indicates that only edible tissue be analyzed, the fish must be filleted. If the sample arrives prefilleted, the sample tissue may be frozen before processing. If the sample is not yet filleted, the sample should

remain chilled until the filleting is completed. Freezing can result in the contamination of edible tissues from the bursting of internal organs. Fish having ruptured internal organs should be noted on the prep benchsheet and the Project Chemist consulted. Rinse the fish with DI water to remove extraneous materials and liquids. Remove scales from scaled fish or skin from non-scaled fish. Rinse the fish again prior to filleting. A separate or clean cutting board should be used for filleting. Gloves should be changed between samples. Carefully remove the fillets from the carcass by following the steps outlined in Appendix A. Care should be taken to avoid contaminating fillet with inadvertent puncture of internal organs. Cut the fillet tissue into appropriate size chunks and mechanically macerate the sample using cutting and grinding tools appropriate for the size of the sample and the analysis type. Proper selection of maceration equipment must consider the potential contaminants, sample size/volume and amount of tissue likely to be lost in using the equipment.

Divide the ground sample into quarters, mix opposite quarters and then mix halves. Again homogenize the sample using an appropriate blending mixer. Continue repeating this process until the sample is truly homogenous and no chunks of tissue remain. Freeze sample until ready for extraction.

11.2.4.3. Shellfish Tissue

Shellfish should be frozen as soon as possible after receipt by the laboratory unless samples can be prepared within 48 hours of sampling. Edible portions of various shellfish are described below and resection described in Appendix B. Thawing of frozen shellfish samples should be kept to a minimum during tissue removal to avoid loss of liquids. Shellfish should be rinsed with DI water prior to tissue removal to dislodge external debris. When multiple organisms constitute a single sample, the edible tissues are collected, composited and homogenized.

11.2.4.3.1. Bivalve mollusks (oysters, clams, mussels, and scallops).

Bivalves are typically prepared by severing the adductor muscle, prying open the shell, and removing all of the soft tissue. The soft tissue includes viscera, meat, and body fluids.

11.2.4.3.2. Crabs

Edible tissue includes all leg and claw meat, back shell meat and body cavity meat. Internal organs generally are removed. If the crab is soft shelled, the entire crab is used in the sample.

11.2.4.3.3. Shrimp and Crayfish - Edible tissue includes the tail meat.

11.2.4.3.4. Lobster - Edible tissue includes the tail and claw meat.

11.2.4.4. Worms

Samples are typically supplied to the lab in sample jars containing multiple organisms. Liquid and specimens constitute the entire sample and are blended together typically in the sample container. When a worm sample containing dirt particles or significant amounts of water is encountered, the technician should contact the project chemist to seek guidance from the client.

11.2.4.5. Eggs

Avian eggs are typically removed from the shell and blended. Aquatic eggs are blended including the soft shell.

11.2.4.6. Internal Organs Extraction

Organs such as livers or kidneys must be identified and removed by an experienced sample technician following clear written resection procedures or other guidance provided by the client.

11.2.4.7. Plant Tissue

Plant tissue should be handled using the size reduction, homogenization and implement cleaning steps outlined in Sections 11.2.1, 11.2.2, 11.2.3, and 11.2.4. Where these procedures are inappropriate, specific written procedures or guidance from the client is recommended.

If drying is requested by the client or is project-specified, a subsample for mercury analysis is taken from the wet sample, and then the plant tissue is dried at 60°C prior to homogenization.

11.2.4.8. Small Mammals and Rodents

11.2.4.8.1. There are two primary concerns in working with small mammals and rodents: safety and sample homogenization.

11.2.4.8.2. Small mammals are potential carriers of lethal viruses, such as hantavirus and rabies, and bacteria that can be contracted through inhalation or direct contact. Typically, these organisms are excreted in the feces and distributed on the air as the fecal matter dries. During the sample preparation process, tissue is typically freeze-dried in order to calculate a percent solids value and to analyze for metals. As such, it is possible to increase the potential for dispersion

of the bacteria or viruses after the sample is homogenized and processed. Prior to processing, all samples should be stored frozen.

11.2.4.8.3. Prior to sample homogenization, instructions should be received from the client regarding the processing of the hide. For organics, it is recommended that the hides be left on the carcass and the entire sample be homogenized. For metals, there is a potential for accumulation in the hair. As a non-digestible portion of the rodent, inclusion of the hair may result in a high bias if the data is to be used in estimating bioaccumulation up the food chain. Skinning may be a preferred alternative when metals are the primary chemicals of concern.

11.2.4.8.4. Homogenization should be done while the carcass is still partially frozen.

11.2.4.8.5. If the hide is to be included in the homogenization, snip the feet from the animal using stainless steel scissors.

11.2.4.8.5.1. The tail should be removed if it will prevent complete homogenization of the sample (e.g., the tail of a mouse or rat may result in incomplete homogenization and should not be included with the sample). Remove seeds, grasses, and mud from the hide.

11.2.4.8.6. If the hide is to be removed from the carcass, make an incision through the skin on the back of the neck (do not cut into the muscle). In most cases, the hide can be removed by pulling the incision horizontally along the back in one direction, and over the ears, head and snout in the opposite direction. The eyes are usually lost during this procedure. Continue to skin the animal by peeling the hide over the hind legs, off the underside of the animal, and around the front legs. The hide is removed at the hind legs and the snout. Care should be taken not to tear the connective tissue under the hide. Fat should be scraped from the hide when possible and included with the sample. Rinse the skinned carcass with DI water to remove any hair or dirt that has accumulated during the skinning procedure.

11.2.4.8.7. Homogenize the sample using a stainless steel Waring blender. Select a blender cup that is sized in accordance with the amount of sample to be homogenized. That is, small samples should be homogenized using small blender cups. This will improve the overall homogenization and recovery of the sample. Continue to mix the sample into a paste like consistency. Make sure no chunks of muscle, hide, or bone are distributed in the sample. Transfer the

sample paste to a glass jar for storage and freeze. The new sample container is labeled "homogenized", initialed, and dated.

11.2.5. General Provision for Handling Large Sample Mass

In some cases, large specimens will be received by the laboratory for homogenization prior to chemical analysis. For the purpose of this SOP, 'large' is defined as requiring preliminary size reduction to allow sequential processing of the sample. Sub-samples of the whole specimen should be cut to a size appropriate for the blender, mixer, or grinder that will be used. After each individual fraction is processed, the homogenized material is added to a reservoir large enough to hold all fractions as they accumulate. The reservoir will be constructed of a material suitable for the analytical application as defined under Section 10.2.3. For very large specimens (i.e. >20 pounds), high grade stainless steel containers are used (large bowls or small drums).

Blending of the combined fractions to achieve a whole homogenous material is achieved via manual mixing. In general, this is accomplished using a high grade stainless steel paddle or spoon of appropriate size (i.e. relative to the whole homogenate). Very large specimens (i.e. >20 pounds) generally require secondary processing through the grinder, particularly when large amounts of skin, bone, and/or cartilage is present. In these cases, the Hobart grinder is generally used.

11.3. Compositing

Each sample is to be logged in and receive a lab code. Additionally, the sample composite also is assigned a lab code. The compositing process is to be performed by trained staff. It is to be performed in an area free of contamination. It is imperative that the samples are treated in a manner consistent with the requirements of the tests to be performed on the composited sample. Compositing of homogenates should be performed according to this SOP or specific instructions provided by the client.

11.3.1. Documentation

The analyst preparing the composite will document

- that homogenization was done before removing an aliquot,
- the quantity of each (field or discrete) sample used for the composite,
- the date and time of compositing, and
- any other pertinent observations.
- An example of a data sheet that can be used for this purpose is given in Appendix C.

11.3.2. Tissue Samples with Limited Quantity

Samples and sample composites that are quantity limited will be handled by the same procedure as described in Section 10.1.1

11.3.3. Compositing Procedure

11.3.3.1. Each tissue sample is first homogenized as per instructions in Section 11.2.

11.3.3.2. An equal weight of sample aliquot from each of the homogenized samples is weighed into a clean glass sample bottle. The amount to be weighed of each sample will depend upon the number of analyses to be performed on the composite and if the quantity of any individual sample is limited.

11.3.3.3. The mixture of the individual sample aliquots is thoroughly homogenized in the glass container. The composite sample bottle is labeled with:

- the name of the composite,
- the lab code of the composite,
- the analyst's initials
- the date of composite preparation
- The composite sample and the remaining (individual, discrete) samples are stored frozen until analysis.

11.3.4. Tissue Samples Requiring VOC Analyses

A separate aliquot of the composite homogenate should be placed in 40ml voa vial container for later analysis by the VOA department. Each container should be labelled with the lab identifier, date, initials, and "FOR VOA ANALYSIS ONLY". To minimize losses of volatile constituents, the sample should be kept as cold as possible, the work should be completed as quickly as possible, and the VOA vial filled to the top to minimize head space.

11.4. Subsampling

The sample is first thoroughly homogenized as per Section 11.2. A sample aliquot is removed and placed into a clean glass container of appropriate size and labeled as follows:

- the name of the sample,
- the lab code of the sample,
- "homogenized" written on the label,
- the purpose of the sub-sample (e.g. "dioxin subsample")
- the analyst's initials
- the date.

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11.5. Freeze-Drying

11.5.1. Depending on project specifications, samples may require freeze-drying. Freeze-drying may be performed on a separate portion of sample to determine % Freeze-Dried Solids, or may be done on the analytical subsample for certain tests. The analyst should obtain direction from the supervisor and/or Project Chemist.

11.5.2. Weigh 5-8 g of sample (wet weight) into a scintillation vial. Freeze the sample for at least 2 hours.

11.5.3. Remove the sample from the freezer and place in the freeze drier for at least 24 hours or longer if necessary for the particular sample matrix.

11.5.4. Record the measurements on the benchsheet in Appendix C.

12. QA/QC REQUIREMENTS

12.1. A rinsate blank should be prepared to accompany each batch of tissue samples. The blank is comprised of a collection of DI water rinses of cleaned equipment (knives, cutting boards and mixers/grinders) **prior** to the commencement of sample batch preparation. If contamination of the samples is suspected, the rinsate blank is extracted and analyzed for contaminants. The rinsate blank should be labeled with the extraction date and the associated SR numbers and stored at 4 C. In the event that contamination is suspected, the rinsate blank can be analyzed to confirm the presence of contaminants in the tissue preparation process.

12.2. A homogenization blanks are prepared to determine if the homogenization equipment was effectively cleaned between samples. Unless a project plan specifies otherwise, the laboratory prepares two homogenizations blanks with each shift of sample preparation. One is a 500 mL aliquot for Metals testing and the other is a 1000 mL aliquot for Organics testing. Any requirements other than the labs default procedure must be defined in the project plan and communicated to the laboratory.

12.2.1. Some project quality plans may require homogenization blanks between each sample. Following the blending of a tissue sample decontaminate the Hobart mixer (model HCM62) by following these steps:

- Wash the bowl, blade assembly, and lid with soap and hot water.
- Rinse all parts with dionized water.
- Move to fume hood and hexane rinse all parts.
- Allow excess hexane to evaporate.

12.2.2. Reassemble the mixer and make ready for the next sample.

12.2.3. Fill the bowl with dionized water and turn the mixer on for the approximately average time used for the type of samples being processed.

12.2.4. Aliquot the dionized water to bottles appropriate for the testing being conducted and preserve accordingly. If insufficient sample volume is produced for the required testing, repeat the procedure after the next tissue sample is homogenized.

13. RECORDS

Sample handling documentation must include information about sample homogenization (was it done or not), compositing, and subsampling. The data benchsheets in Appendix C provide a means for recording this information. This sample handling information is to be filed in the project file with the raw data.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for Corrective Action (ADM-CA) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15. TRAINING

15.1. Training outline – Training Plan

15.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

15.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst until the supervisor feels lthe new employee can work independently. During this period, the analyst is expected to transition from a role

of assisting, to performing the procedure with minimal oversight from an experienced analyst.

15.2. Training is documented following the SOP *for Documentation of Training*.

15.2.1. When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

16. REFERENCES

Kateman and L. Buydens, *Quality Control in Analytical Chemistry*, Second Edition, John Wiley & Sons, Inc., New York, NY, 1993: Chapter 2 on Sampling and especially sections 2.5 (Sample Quality) and 2.7 (Handling of Samples).

Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories; Volume 1; Fish Sampling and Analysis, 3rd Edition; USEPA Office of Water; EPA 823-B-00-007; Nov 2000.

Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound; Tetra Tech, Inc.; final report TC-3991-04 Recommended Guidelines for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples Revision April 1996.

PCB's and Mirex In Fish Tissue and Clams New York State Department of Health Wadsworth Center For Laboratories and Research; Albany, N.Y. 10/6/81

Draft Method 1613-Tissue; Determination of PCDDs and PCDFs in Fish and Other Tissue Using Method 1613; USEPA Office of Water June 1993.

17. CHANGES SINCE THE LAST REVISION

17.1. Sec 7, 14 and 15 are new
17.2. Sec 8.1 is new
17.3. Sec 11.2.4.8.2 –removed last sentence describing irradiation procedure

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APPENDIX A

Fish Filleting Procedure

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APPENDIX B

General Procedure for Removing Edible Tissues From Shellfish

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APPENDIX C

Compositing and Freeze-Drying Bench Sheets

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COLUMBIA ANALYTICAL SERVICES, INC.

Service Request #: _____

Analysis For: Freeze Dried Solids

Lab Code	Wet Weight (g)	Tare (g)	Tare + Dry Wt.(g)	Dry Weight (g)	% Total Solids

Date/Time in Freeze Dryer:_____ Date/Time out of Freeze Dryer:_____

Balance ID:_____ Date Balance checked:_____

Comments:_____

_____

_____

_____

_____

x = RPD

Analyst:	Date:
Reviewed By:	Date:

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Columbia Analytical Services, Inc.

Service Request Number(s):

TISSUE HOMOGENIZATION DATA

Laboratory ID	Weight of Sample* (g)	Tare of Jar (g)		Matrix	Number per Sample	

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Comments:

* The weight of sample is after homogenization.

Balance ID: Date Balance Checked:

Analyst:	Date:
Reviewed:	Date:

R\:ICP\misc\digforms\TISSUEBENCHSHT1.xls

Columbia Analytical Services, Inc.

Service Request Number(s):

TISSUE WHOLE BODY WEIGHT, LENGTH, and HOMOGENIZATION

Laboratory ID	Weight of Sample* (g)	Tare of Jar (g)		Length of Sample (in)	Matrix	

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Comments:

* The weight of sample is after homogenization.

Balance ID: Date Balance Checked:

Analyst:	Date:
Reviewed:	Date:

R\:ICP\misc\digforms\TISSUEBENCHSHT1.xls

Columbia Analytical Services, Inc.

Service Request Number(s):

Analysis for:
Pesticides PCB's Lipids SVO PAH Butyltins Dioxins SUB

ALIQUOT DATA

Service Request #		Wet Wt. (g)		Tare Wt. (g)		Matrix

Comments:

Balance ID: Date Balance Checked:

Analyst: Date:

Reviewed: Date:

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R\:ICP\misc\digforms\TISSUEBENCHSHT1.xls

Columbia Analytical Services, Inc.

Service Request Number(s):
Analysis for:

EQUIPMENT BLANKS

Service Request #		Bottle Type		Preservatives

Comments:

Analyst:	DATE:
Reviewed:	

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Proprietary

R\:ICP\misc\digforms\K1101065

Columbia Analytical Services, Inc.

Service Request #: _____

Analysis For: Freeze Dried Solids

Lab Code	Wet Weight (g)	Tare (g)	Tare + Dry Wt.(g)	Dry Weight (g)	% Total Solids
NRCC DORM-3	(If Applicable)				96.1%
NRCC TORT-2	(If Applicable)				94.7%

Date/Time in Freeze Dryer:_____ Date/Time out of Freeze Dryer:_____

Balance ID:_____ Date Balance checked:_____

Comments:_____

High - Low / Average = RPD

x = RPD

Analyst:	Date:
Reviewed By:	Date:

R\:ICP\misc\digforms\K1101065

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STANDARD OPERATING PROCEDURE

AUTOMATED SOXHLET EXTRACTION

EXT-3541
Revision 7
Effective date: January 27, 2012

ALS-CAS

Approved By: Elissa Erickson — Supervisor — 12-27-11 Date

QA Manager — 12-27-11 Date

Laboratory Manager — 12/27/11 Date

PROPRIETARY

AND

COLUMBIA ANALYTICAL SERVICES, INC.
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DOCUMENT CONTROL	
NUMBER:	
Initials:	Date:

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AUTOMATED SOXHLET EXTRACTION

1. SCOPE AND APPLICATION

1.1. This procedure uses techniques described in EPA Method 3541 for extracting nonvolatile and semi-volatile organic compounds from solids such as soils, sediments, sludges, wastes, and tissues.

1.2. This method is applicable to the isolation and concentration of water insoluble and slightly water soluble organics in preparation for a variety of chromatographic procedures.

2. SUMMARY OF METHOD

2.1. This procedure describes the automated Soxhlet extraction process. The Soxhlet extraction ensures intimate contact of the sample matrix with the extraction solvent over a period of time. The solid sample is mixed with anhydrous sodium sulfate, placed in an extraction thimble above a plug of glass wool, and extracted using an appropriate solvent on a Soxtherm extractor for a prescribed amount of time.

2.2. Following the extraction period, the resulting extract is then dried if necessary, concentrated, and as necessary, exchanged into a solvent compatible with the cleanup or determinative step being employed.

3. DEFINITIONS

3.1. **Batch** - A batch of samples is a group of environmental samples that are prepared and/or analyzed together as a unit with the same process and personnel using the same lot(s) of reagents. It is the basic unit for analytical quality control.

3.1.1. Preparation Batch - A preparation batch is composed of one to twenty field samples, all of the same matrix, meeting the criteria in Section 3.3 and with a maximum time between the start of processing of the first and last samples in the batch to be 24 hours.

3.2. **Sample**

3.2.1. Field Sample - An environmental sample collected and delivered to the laboratory for analysis; a.k.a., client's sample.

3.2.2. Laboratory Sample - A representative portion, aliquot, or subsample of a field sample upon which laboratory analyses are made and results generated.

3.3. **Quality System Matrix** - The *matrix* of an environmental sample is distinguished by its physical and/or chemical state and by the program for which the results are intended. The

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following sections describe the matrix distinctions. These matrices shall be used for purpose of batch and quality control requirements.

3.3.1. Animal tissue - Any tissue sample of an animal, invertebrate, marine organism, or other origin; such as fish tissue/organs, shellfish, worms, or animal material.

3.3.2. Solids - Any solid sample such as soil, sediment, sludge, and other materials with >15% settleable solids.

3.3.3. Chemical waste - Any sample of a product or by-product of an industrial process that results in a matrix not described in one of the matrices in Sections 3.3.1 through 3.3.6. These can be such matrices as non-aqueous liquids, solvents, oil, etc.

3.3.4. Miscellaneous matrices – Samples of any composition not listed in 3.3.1 – 3.3.4. These can be such matrices as plant material, paper/paperboard, wood, auto fluff, mechanical parts, filters, wipes, etc. Such samples shall be batched/grouped according to their specific matrix.

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3.4. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Duplicate samples are spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision. The concentration of the spike should be at the mid-point of the calibration range or at levels specified by a project analysis plan.

3.5. Laboratory Duplicates (DUP) – Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. The relative percent difference (RPD) between the sample and its duplicate is calculated and used to assess analytical precision.

3.6. Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to extraction and analysis. Percent recoveries are calculated for each surrogate.

3.7. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

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3.8. Laboratory Control Samples (LCS) – The LCS is an aliquot of analyte free water or analyte free solid to which known amounts target analytes are added. The LCS is prepared and analyzed in exactly the same manner as the samples. The percent recovery is compared to established limits and assists in determining whether the batch is in control.

4. INTERFERENCES

4.1. Phthalate esters can pose difficulties when performing sample extractions for organochlorine pesticides, PCBs, and other semi-volatile organics. Phthalates are easily extracted or leached from materials containing plastics during laboratory operations. Interferences from phthalates can best be minimized by avoiding contact with any plastic materials.

4.2. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. All apparatus must be cleaned prior to use on individual samples.

4.3. Soap residue, which results in a basic pH on glassware surfaces, may cause degradation of certain analytes. Specifically, Aldrin, Heptachlor, and most OP pesticides will degrade in this situation. All glassware must be rinsed very carefully to avoid this problem.

4.4. Refer to SW-846 Method 3500 for additional discussion of interferences. Additional cleanup procedures are described in the applicable CAS SOP.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents, and samples must be taken when performing this procedure. This includes the use of protective equipment (safety glasses, lab coats, gloves, etc.) and use of correct glassware handling practices.

5.2. Chemicals, reagents, standards, and samples must be handled as described in CAS safety policies, approved methods, and in MSDSs where available. Refer to the specific analytical method and the CAS Safety Manual for guidance.

6. RESPONSIBILITIES

6.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

6.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in the determinative method, is also the responsibility of the department supervisor/manager.

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7. APPARATUS AND MATERIALS

7.1. Soxtherm automated extraction system

7.1.1. Extraction unit controller

7.1.2. Beakers, 54 x 130mm

7.1.3. Thimbles, 33mm inner diameter, glass or cellulose

7.1.4. Metal thimble holder

7.2. Chiller unit

7.3. Boiling chips – Teflon, pre-cleaned by rinsing or extraction.

7.4. Water bath - Heated, with concentric ring cover, capable of temperature control (± 5°C). The bath should be used in a hood.

7.5. Vials - Glass, 2 ml capacity, with Teflon lined screw or crimp top.

7.6. Glass wool - contaminant free.

7.7. Disposable glass Pasteur pipet and bulb.

7.8. Apparatus for grinding.

7.9. Analytical balance - 0.01 g.

7.10. Test tubes

7.11. N-Evap concentrator with nitrogen source

7.12. Graduated pipets, 0.5, 1, 2 and 5 mL. Pipets are pre-tested by lot for accuracy.

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8. REAGENTS

8.1. Pesticide grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to the SOP *Reagent/Standards Login and Tracking (ADM-RTL)* for the complete procedure and documentation requirements.

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8.2. Organic-free reagent water. All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW-846.

8.3. Sodium sulfate (granular or powder, anhydrous), Na_2SO_4. Purify by heating at 400°C for 4 hours.

8.4. Matrix sand. Purify by heating at 400°C for 4 hours.

8.5. Corn oil

8.6. Blank tissue matrix. Analyte free ground turkey or equivalent

8.7. Extraction Solvents - Samples are extracted using one of the following solvent systems:

8.7.1. Acetone/Hexane (1:1) (v/v), CH_3COCH_3/C_6H_{14}. Pesticide quality or equivalent. Soil, sediment, and aqueous sludge samples.

8.7.2. Dichloromethane/Acetone (1:1 v/v), CH_2Cl_2/CH_3COCH_3. Pesticide quality or equivalent. Soil, sediment, and aqueous sludge samples.

8.7.3. Dichloromethane (DCM), CH_2Cl_2. Pesticide quality or equivalent. Other miscellaneous sample matrices.

9. SAMPLE COLLECTION, PRESERVATION, AND HANDLING

9.1. Refer to the applicable section in the determinative SOP for sample collection, preservation, and holding times.

9.2. The extract holding time is 40 days from sample preparation to analysis.

10. PREVENTIVE MAINTENANCE

10.1. Routine cleaning of the extraction apparatus is necessary, including all parts exposed to contact with samples, especially extraction thimbles and the Soxtherm apparatus.

10.2. The operating temperature of the soxtherm is monitored every quarter (March, June, September, and December) with a NIST traceable digital thermometer and probe. The soxtherm temperature is set at the controller to heat up to the extraction temperature of 140° C. Once the control box reads 140° C the probe is placed directly on each individual heating surface and the temperature is recorded in the soxtherm maintenance logbook (SVMP-SOX-01).

10.3. The extraction time on the controller is verified quarterly by recording the start and stop times of an extraction and recording in the soxtherm maintenance logbook.

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11. RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

12. PROCEDURE

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12.1. Record all extraction and sample information on the applicable benchsheet. To assist the analyst, a brief description of the procedure is given on the backside of the benchsheet. See Attachment A.

12.2. Sample Handling

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12.2.1. Sediment/soil samples - Mix the sample thoroughly, especially composited samples. Discard any foreign objects such as sticks, leaves, and rocks.

12.2.2. Waste samples - Samples consisting of multi phases have each phase extracted separately. If sample contains a significant portion of water, water is pulled off and extracted. Oil phases are pulled off, usually diluted in hexane or iso-octane and extracted. This procedure is for solids only.

12.2.3. Dry waste samples amenable to grinding - Grind or otherwise subdivide the waste so that it passes through a 1 mm sieve.

AND

12.2.4. Gummy, fibrous, or oily materials not amenable to grinding should be cut, shredded, or otherwise broken up to allow mixing, and maximum exposure of the sample surfaces for extraction. The professional judgment of the analyst is required for handling these difficult matrices.

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12.2.5. Tissue samples need to be ground or cut to allow mixing and improve exposure of the sample to the solvent.

12.3. Determinations of sample % dry weight - In certain cases, sample results are desired based on dry weight basis. Refer to the *SOP for Total Solids* GEN-160.3). If the determination is performed by the organics preparation personnel, a portion of the sample for this determination should be weighed out at the same time as the portion used for analytical determination.

12.4. Sample extraction and extract concentration

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12.4.1. Pre-rinse glassware (beaker, thimble with glass wool, and metal clip) before use. To clean the glassware place 50mls of dichloromethane in beaker and run a short extraction program. Example 10 min. boil time, 1 reduction A, 10 min. extraction, 1 reduction B, 30 min. solvent cooling, temp. 140° C.

12.4.2. Refer to the determinative SOP (see Table 1 for a list of applicable SOPs) for the preparation, concentration, storage, and expiration for the surrogate, LCS, and MS spiking solutions. These SOPs also list the resulting final spike concentrations.

12.4.3. Weigh out the specified amount (see test-specific benchsheets attached) of the solid sample to be extracted. Be careful not to weigh out more sample than what can fit into a maximum of 2 thimbles.

12.4.4. Blend the specified sample amount with as little sodium sulfate as possible, so as not to overload the extraction thimble, but still achieve sample drying. The type of sodium sulfate used is dependent upon the method. See Table 2 for further details on which type of sulfate to use.

12.4.5. The composition of the MB and LCS is prepared is dependent upon the method. See Table 2 for further details.

12.4.6. The MB and LCS is handled in the same manner as the client samples (i.e. drying in hood or any other temporary storage location).

12.4.7. Transfer the dry sample into the thimble that contains a plug of glass wool to prevent the sample from dropping into the beaker. Use a second thimble to prevent overfilling or over packing the thimble.

12.4.8. Rinse each sample beaker with a small amount of dichloromethane and transfer rinsate to thimble. Perform rinse three times to ensure quantitative transfer.

12.4.9. Add the surrogate standard spiking solution onto the samples. For the sample(s) in each analytical batch selected for QC spiking (LCS and MS samples), add the appropriate volume of the appropriate spiking standard. Each standard should be brought to room temperature before using. Addition of surrogate and spike is routinely witnessed by a second analyst to assure completeness. Also, the witness should immediately follow the spiking of each sample with the addition of a small amount of dichloromethane.

12.4.10. Add enough dichloromethane or appropriate extraction solvent to cover each sample. This will allow sample to remain covered by solvent during the entire boiling step. If the samples do not equally fill the thimbles feel free to mix and match sample and dichloromethane amounts so that all samples on a single extraction unit have about the same solvent level. Each unit can run a separate

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program, but a single unit does not allow multiple programs. In the program this step is referred to as boiling time.

12.4.11. The boiling step is set to be an hour. During this time the solvent will boil through and over the sample. The majority of the extraction will occur in this step. The temperature of the hot plates should be set for 140°C for dichloromethane and DCM/ACE. When the boiling time is completed the soxtherm needs to be programmed for the proper number of solvent reductions. Solvent reductions happen in 15mL increments as the calibrated cup is filled by the condensing solvent. When programming the number of reductions the original amount of solvent needs to be taken into consideration. The aim of this step is to bring the solvent level below the tip of the thimble with 50mls of being the desired amount. In the soxtherm program this is referred to as solvent reduction A.

12.4.12. Once the solvent level is below the thimble the extraction time can start. This lasts 1 hour. During this step the solvent drips through the sample to rinse through any remaining analytes. When this is done reduction B can begin. This step should take the solvent level to the desired amount of ≥ 10 mL. Care should be taken during this step, since each beaker seals differently. Some beakers seal very well and others allow more solvent losses. Also all samples are not created equal. Some samples will trap more solvent than others.

12.4.13. If the solvent level has reached the desired stopping point before the programmed numbers of reductions are completed, remove the beaker and immediately cover with foil until cooled. Conversely, if the solvent level of the samples on an instrument is higher than desired, additional solvent reductions can be programmed. Once the desired solvent amount has been reached, remove the beaker and immediately cover with foil.

12.4.14. Nitrogen blowdown is used to further concentrate the extract and to adjust the extract to the final volume. If solvent exchange is required (e.g. GC-ECD analyses) it is done at this point.

12.4.14.1. Using the N-Evap, place the concentrator tube in a warm water bath (approximately 35°C) and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen (filtered through a column of activated carbon).

CAUTION: Do not use plasticized tubing between the carbon trap and the sample.

12.4.14.2. The internal wall of the tube must be rinsed down several times with the appropriate final solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level

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of the water bath). The volume of extract in the tube must be monitored during blowdown to avoid loss of more volatile analytes. Under normal operating conditions, the extract should not be allowed to become dry.

CAUTION: When the volume of solvent is reduced below 1 ml, semivolatile analytes may be lost.

12.4.14.3. Adjust the extract final volume to the prescribed volume with the solvent last used. Measure the final extract volume using a 0.5, 1, or 2 mL graduated pipet, depending on the test.

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12.4.15. If extract cleanup is to be performed, concentrate the extract to the appropriate volume. Proceed to the applicable cleanup procedure and SOP.

12.4.16. During the final volume step, transfer the extracts to an appropriate storage or autosampler vial. Label the vial with the sample or QC identification and store in the extract storage area. The extracts obtained may now be analyzed for the target analytes using the appropriate determinative technique. The extract holding time is 40 days from sample preparation to analysis.

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13. QUALITY CONTROL

13.1. Refer to the SOP for the determinative method and *SOP for Sample Batches* for minimum QC requirements. Project-specific batching protocols may also be required.

13.2. The QC solutions required by the method must be added as described in the analytical method. The amount and identification of QC solutions added must be documented on the bench sheet. Any reagent blanks, laboratory control samples, or matrix spike samples should be subjected to exactly the same analytical procedures as those used on actual samples.

AND

14. DATA REPORTING AND REVIEW

14.1. Preparation of all samples must be documented on a bench sheet. All information regarding the sample(s) extracted, aliquoting, QC spiking, extraction steps, etc. must be documented by the person(s) performing the extraction.

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14.2. The bench sheet must be reviewed by the extraction lead, supervisor, or instrument lab analyst. The instrument lab analyst should sign-off on the bench sheet, thus accepting custody of the extracts.

15. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

15.1. Refer to the SOP for *Corrective Action (ADM-CA)* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

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15.2. Handling out-of-control or unacceptable data

15.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

15.2.2. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

16. METHOD PERFORMANCE

Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in the determinative procedures.

17. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

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18. WASTE MANAGEMENT

18.1. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS EH&S Manual.

18.2. This method uses Dichloromethane and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and recycled off site.

18.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

18.4. All extracted soil samples are collected in a labeled waste container for disposal in accordance with applicable state and federal regulations governing waste management.

19. TRAINING

19.1. Training outline

19.1.1. Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

19.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

19.1.3. Perform an initial precision and recovery (IPR) study as described above for solid samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file.

19.2. Training is documented following the SOP *for Documentation of Training*.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

20. METHOD MODIFICATIONS

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20.1. Reference method 3541 uses 1:1 Acetone:Hexane for the extraction of 8081 and 8082 analytes. This procedure uses 100% Methylene chloride

20.2. Reference method 3541 uses 1:1 Acetone:Methylene chloride for the extraction of semi-volatile organics. This procedure uses 100% Methylene chloride

21. REFERENCES

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21.1. EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update II, September 1994, Method 3541, Revision 0.

21.2. EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, Update IV, February 2007, Method 3500C, Revision 3

22. CHANGES SINCE THE LAST REVISION

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22.1. Definitions section 3 is new
22.2. Sec 7 added powder sulfate, matrix sand, corn oil, blank tissue matrix
22.3. Sec 8.1 updated language
22.4. Sec 12.3 updated sop reference
22.5. Sec 12.4.4 – 12.4.7 re-written for clarity and added quantitative transfer directions
22.6. Sec 12.4.11 changed 5-15mL to >10mL
22.7. Sec 18.4 is new
22.8. Sec 21.2 – updated reference
22.9. Added new table 2

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TABLE 1

APPLICABLE DETERMINATIVE SOPs

POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-8270D
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS – LOW LEVEL PROCEDURE	SVM-8270L
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081
PCBS AS AROCLORS	SOC-8082Ar
CONGENER SPECIFIC DETERMINATION OF PCB BY GC/ECD	SOC-8082Co
CHLORINATED PHENOLICS BY IN-SITU ACETYLATION AND GC/MS	SVM-1653A
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SVM-NONLY
CHLORINATED PESTICIDES BY GC/MS/MS, EPA METHOD 1699 MODIFIED	SVM-PESTMS2

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TABLE 2
Soxtherm Method Aid

Method	Matrix	Target amount	MB	LCS
8081	Tissue	20g	Granular Sulfate	Blank Tissue + Granular Sulfate
8082	Tissue	20g	Granular Sulfate	Blank Tissue + Granular Sulfate
8082-Con	Tissue	20g	Granular Sulfate	Blank Tissue + Granular Sulfate
8081	Soil	10g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8082	Soil	10g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8081-L	Soil	20g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8082-L	Soil	20g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8082-Con	Soil	20g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8015	Soil	20g	Powder Sulfate*	Matrix sand + Powder Sulfate*
8015 co-extract	Soil	20g	Powder Sulfate*	Matrix sand + Powder Sulfate*
Lipids	Tissue	10g	Granular Sulfate	Blank Tissue + Granular Sulfate
8270 Pest OP	Soil	10g	Granular Sulfate	Granular Sulfate
8270 Pest OP	Tissue	5g	Granular Sulfate	Granular Sulfate
8270 OC Pest	Soil	10g	Granular Sulfate	Granular Sulfate
8270 OC Pest	Tissue	2g	Granular Sulfate	Granular Sulfate
PAH ALK	Soil	10g	Granular Sulfate	Granular Sulfate
PAH ALK co-extract	Soil	20g	Granular Sulfate	Granular Sulfate

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TABLE 2-cont.

Method	Matrix	Target amount	MB	LCS
PAH ALK	Tissue	10g	Granular Sulfate + Corn oil	Granular Sulfate + Oil
SIM PAH	Soil/ Paperboard	10g	Granular Sulfate	Granular Sulfate
SIM PAH ULL	Solids	20g	Granular Sulfate	Granular Sulfate
SIM PAH	Tissue	10g	Granular Sulfate + Corn oil	Granular Sulfate + Oil
SIM PAH ULL	Tissue	10g	Granular Sulfate + Corn oil	Granular Sulfate + Oil
SIM PAH PCP	Soil/Tissue	10g	Granular Sulfate	Granular Sulfate
Nonylphenols	Solids	10g	Granular Sulfate	Granular Sulfate
Nonylphenols	Paperboard	1g	Granular Sulfate	Granular Sulfate
PBDE/PBB	Soil/Tissue	10g	Granular Sulfate	Granular Sulfate
PBDE/PBB	Paperboard	1g	Granular Sulfate	Granular Sulfate
8270	Soil/ Paperboard	20g	Granular Sulfate	Granular Sulfate
8270 LL	Soil	30g	Granular Sulfate	Granular Sulfate
8270 SIM	Tissue	5g	Granular Sulfate	Granular Sulfate

* If sample has high water content a mixture of Granular and Powder sulfate can be used. The same mixture is then used in the MB and LCS.

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Attachments

Test-Specific Bench Sheets

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Additional Prep Information For Hydrocarbon in Soils by EPA 3541

Service Request #_____ **Work Group #** _____

Solvents/Reagents used:

Date/Time/Initials Weighed:_____ **Balance ID:**_____ **Calibration Verified** ☐

Storage Location (if not extracted same day):_____

DCM Lot #_____**Sulfate Lot #**_____**Matrix Sand Lot #**_____

Soxtherm Start (Time/Date/Initial):_____

Soxtherm Stop (Time/Date/Initial):_____

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Cleanups: (Check paperwork to see if cleanups are necessary)

N-Evap Date/Time/Initial:_____ **Temp/Thermometer ID:**_____

Sulfuric Acid Clean-up (3665) (Date/Time/Initials):_____ **Acid Lot #**_____

Silica Gel Clean-up (3630) (Date/Time/Initials):_____ **Silica Gel Lot #**_____

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Archive:

Vial:_____ **Vial Storage:**_____

Archived Extract Storage:_____

AND

Comments/Observations:_____

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Bench Sheet Review Check List

- ☐ Hold Times Met (if no, Reason: _____)
- ☐ Prep date, dept, method, product code correct in stealth
- ☐ Spike Information correct
- ☐ Weights/Volumes and units correct on raw and final bench sheets
- ☐ Sample IDs have been checked—Bottle numbers appended if required
- ☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
- ☐ Training has been circled
- ☐ Extract Storage recorded
- ☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
- ☐ All clean-ups have been noted on additional prep sheet
- ☐ Signed service request with Form V, if applicable, has been attached

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Procedure for extraction of Hydrocarbons by EPA Method 3541 (8015/NWTPH/AK102/103)

QC Requirements:

DX/HCID: DUP every 10 samples, LCS, MB (DLCS required if insufficient sample for DUPs)

8015B DRO: MS, DMS, LCS, MB

AK DRO: MS, DMS, LCS, DLCS, MB

Note: AKs must be extracted separately, cannot be batched with the tests above.

1. **Mix the sample thoroughly. Weigh appropriate amount into a beaker. Record the weight to the nearest 0.01 grams. Use muffled matrix sand for the LCS and muffled sodium sulfate for the Method Blank.**
2. **Mix the samples with a sufficient amount of muffled sodium sulfate to completely dry the sample.**
3. **Transfer samples to Soxtherm thimbles that have been cycled with DCM.**
4. **Add surrogates and spikes as necessary.**
5. **Add 150mL of DCM to the extraction beaker.**
6. **Extract using the extraction method.**
7. **Take extract to appropriate final volume in DCM.**
8. **Do acid silica gel cleanup (3665/3630) if requested.**
9. **Place extract into white autosampler vial for analysis.**
10. **Archive any remaining extract and record location on benchsheet.**

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Additional Prep Information For Pest/PCB Soils by EPA 3541

Service Request #_____ Work Group # _____

Solvents/Reagents used:

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

DCM Lot #_____Sulfate Lot #_____Matrix Sand Lot #_____

Soxtherm Start (Time/Date/Initial):_____

Soxtherm Stop (Time/Date/Initial):_____

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Cleanups:

N-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

GPC Clean-up (3640) (Time/Date/Initial):_____ (all samples)

Solvent Exchanged To Hexane (Time/Date/Initial):_____

PROPRIETARY

S-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

N-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

Sulfuric Acid Clean-up (3665) (Time/Date/Initial):_____ Acid Lot #:_____

Clean-up #3:_____ ☐ all samples ☐ some samples:_____

Pest Vial:_____ Vial Storage:_____

PCB Vial:_____ Vial Storage:_____

AND

Archived Extract Storage:_____

Comments/Observations:_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

Procedure for extraction of Pesticides and PCB's by EPA Method 3541 (8081/8082)

1. Mix the sample thoroughly. Weigh appropriate amount into a beaker. Record the weight to the nearest 0.01 grams. Use muffled matrix sand for the LCS and muffled sodium sulfate for the Method Blank.
2. Mix the samples with a sufficient amount of muffled sodium sulfate to completely dry the sample.
3. Transfer samples to Soxtherm thimbles that have been cycled with DCM.
4. Add surrogates and spikes as necessary.
5. Add 150mL of DCM to the extraction beaker.
6. Extract using the extraction method.
7. Take extract to 10mL intermediate volume in DCM.
8. Do GPC cleanup (3640). Refer to CAS SOP for GPC clean-up.
9. Evaporate on the S-evap, keeping temperature between 70-75°C. Solvent exchange into Hexane when extracts reach approximately 10mL.
10. Concentrate extracts and do additional cleanups as necessary.
11. Place exactly 1mL of extract into a yellow vial for the pesticide analysis.
12. Perform a sulfuric acid cleanup (3665) on the remaining PCB extract according to CAS SOP.
13. Place PCB extract into green vial for analysis.

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Test	Amount to Weigh (g)	Surr. Amount (uL)	Spike Amount (uL)	Final Volume (mL)
8081	10	500	250	10
8082	10	500	250	10
8081-L	20	200	100	4
8082-L	20	200	100	4
8082-CON	20	200 (Con)	200 (Con)	4

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Additional Prep Information For Pest/PCB Tissues by 3541

Service Request #_____ Work Group # _____

Solvents/Reagents used:

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

DCM Lot #_____Sulfate Lot #_____

Soxtherm Start (Time/Date/Initial):_____

Soxtherm Stop (Time/Date/Initial):_____

Cleanups:

N-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

GPC Clean-up (3640) (Time/Date/Initial):_____ (all samples)

Solvent Exchanged To Hexane (Time/Date/Initial):_____ Hexane Lot #:_____

S-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

N-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

Florisil Clean-up (3620) (Time/Date/Initial): _____Florisil Lot #:_____

1:1 Hexane:Acetone Lot #:_____ 9:1 Hexane:Acetone Lot #:_____

N-Evap Date/Time/Initial:_____ Temp/Thermometer ID:_____

Sulfuric Acid Clean-up (3665) (Time/Date/Initial):_____Acid Lot #:_____

Archive:

Pest Vial:_____ Vial Storage:_____

PCB Vial:_____ Vial Storage:_____

Archived Extract Storage:_____

Comments/Observations:_____

_____

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Bench Sheet Review Check List

- ☐ Hold Times Met (if no, Reason: _____)
- ☐ Prep date, dept, method, product code correct in stealth
- ☐ Spike Information correct
- ☐ Weights/Volumes and units correct on raw and final bench sheets
- ☐ Sample IDs have been checked—Bottle numbers appended if required
- ☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
- ☐ Training has been circled
- ☐ Extract Storage recorded
- ☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
- ☐ All clean-ups have been noted on additional prep sheet
- ☐ Signed service request with Form V, if applicable, has been attached

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Procedure for extraction of Pesticides and PCB's in tissue by EPA Method 3541 (8081/8082)

1. Mix the sample thoroughly. Weigh appropriate amount into a beaker. Record the weight to the nearest 0.01 grams. Use ground turkey breast for the LCS and muffled sodium sulfate for the Method Blank.
2. Mix the samples with a sufficient amount of muffled sodium sulfate to completely dry the sample.
3. Transfer samples to Soxtherm thimbles that have been cycled with DCM.
4. Add surrogates and spikes as necessary.
5. Add 150mL of DCM to the extraction beaker.
6. Extract using the extraction method.
7. Take extract to 10mL intermediate volume in DCM.
8. Do GPC cleanup (3640). Refer to CAS SOP for GPC clean-up.
9. Evaporate on the S-evap, keeping temperature between 70-75°C. Solvent exchange into Hexane when extracts reach approximately 10mL.
10. Concentrate extracts and do a Florisil cleanup.
11. Take extracts to appropriate final volume.
12. Place exactly 1mL of extract into a yellow vial for the pesticide analysis.
13. Perform a sulfuric acid cleanup (3665) on the remaining PCB extract according to CAS SOP.
14. Place PCB extract into green vial for analysis.

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Additional Prep Information For EPA 3541

1653s by GCMS

Service Request _____ **Workgroup** _____

Sulfate Lot #: _____ **DCM (GC^2)Lot #:** _____

Date/Time/Initials Weighed:_____ **Balance ID:**_____ **Calibration Verified** ☐

Storage Location (if not extracted same day):_____

Glass Wool Lot#:_____

Soxtherm Start (Time/Date/Initial):_____

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Soxtherm Stop (Time/Date/Initial): _____

Turbovap/ACN Solvent Exchange (Temp/ID/Time/Date/Initial): _____

K_2CO_3 Lot #_____ **Acetic Anhydride Lot #** _____

Hexane Lot #_____ **ACN Lot #**_____

PROPRIETARY

Batch Start (Time/Date/Initial)_____

Batch Finish (Time/Date/Initial)_____

S-Evap (Temp/ID/Time/Date/Initial):_____

Turbo vap (Temp/ID/Time/Date/Initial):_____

AND

Date Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

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_____

Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled yes or no
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ Signed service request with Form V, if applicable, has been attached

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Columbia Analytical Services, INC.
Appendix from EXT-3541
For extracting 1653's in Solids by EPA Method 3541

Procedure:

1. Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Weigh approximately ***10 grams*** dry weight into extraction thimble. Record weight using all figures displayed on the scale.

4. Use DCM rinsed granular anhydrous Na_2SO_4 [a] for the MB and OPRS.

5. Add surrogates and matrix spikes. See chart below. **(Witnessed by a trained analyst)**

6. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.

7. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

8. Quantitatively transfer the extract to culture tubes.

9. Concentrate extract to 1 or 2 mL, solvent exchanging to ACN.

10. Add extract to 1 liter of DI water.

11. Allow samples to homogenize by spinning on stir plate for 15 minutes.

Derivitization steps 12-14 must proceed rapidly, one sample at a time.

12. Increase the speed of the stirring bar until the vortex is drawn to the bottom of the beaker.
13. Add 25mL of K_2CO_3 solution to spinning sample.
14. **IMMEDIATELY** add 25mL of Acetic Anhydride and spin for three to five minutes to complete the derivitization.

15. Transfer samples and add 200mL of Hexane to a 2L seperatory funnel, and shake vigorously for 2 minutes with periodic venting.

16. Allow phases to separate for a minimum of 10 minutes. Drain water back into beaker and collect the hexane in a 1000mL KD apparatus through a small layer of Na_2SO_4. It may be necessary to break up any emulsions in a centrifuge prior to adding to the KD.

17. Repeat steps 15-16 using 100mL of Hexane, two additional times.

18. Concentrate the extracts on an S-Evap with the temperature set between 95-100° C. Remove the KD when the solvent level is low enough to remove the collector. Extreme caution must be used to ensure that the sample does not concentrate too low or to dryness.
19. Concentrate the extracts to 0.5mL final volume in Hexane. Place in a labeled, amber 2mL autosampler vial.

Test	Initial Weight	Surrogates added	Spikes Added	Vial Color	Calculated Final Volume
1653 Solid/ Paperboards	10 grams dry	1653 Labeled Std: Acetone/1 mL + Methanol/1 mL	1653 Secondary Std: Acetone/500 µL + Methanol/500 µL	amber	0.5 mL

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Additional Prep Information For EPA 3541

OP Pesticides

Service Request: _____ **Workgroup:** _____

Sulfate Lot #:_____ DCM (GC^2)Lot #:_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

GPC Clean-up (3640): Start _____ (Time/Date/Initial)

Stop _____ (Time/Date/Initial)

S-Evap (Temp/ID/Time/Date/Initial): _____

Solvent Exchange to Hexane (Time/Date/Initial/Lot#): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Acetone Lot#:_____

Extract Storage: _____

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting OP Pesticides in Soil or Tissue by
EPA Method 3541

Procedure:

1.Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. ***Note:*** *Tissue glassware must be baked prior to use.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately *10 grams* dry weight into a 150ml beaker. Record weight using all figures displayed on the scale.

4. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS, and DLCS.

5. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.

6. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.

7. Add *100µL* OP surrogate and *100µL* OP matrix spikes. **(Witnessed by a trained analyst)**

8. Add enough DCM to cover samples completely.

9. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.

10. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

11. Quantitatively transfer the extract to culture tubes.

12. Take Sample to an intermediate volume of 10 mL.

13. Filter all 10 mL of sample using a 0.45µm filter.

14. Load sample on GPC using BNA program making sure all reservoirs are full and prior clean cycle has been completed.

15. Concentrate extracts on S-Evap. Temperature should be between 70-75° C.

16. Solvent Exchange to hexane on S-Evap.

17. Concentrate the extracts to *< 10 mL calculated final volume* on the N-Evap under a **gentle** stream of nitrogen with the temperature not exceeding 35°.

18. Take extracts to 5 mL for a calculated true final volume of 10ml in 1:1 Hexane/Acetone and place in labeled, amber 2mL autosampler vial. Extreme caution must be used to ensure that the sample does not concentrate too low or to dryness.
Note: When GPC cleanup is performed, only half of the original extract is retained. Therefore the extract must be concentrated to ½ the final volume to achieve the correct "calculated" final volume.

19. Complete all necessary paperwork.

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Additional Prep Information For EPA 3541

PAH ALK

Service Request _____ **Workgroup** _____

Sulfate Lot#:_____ DCM (GC^2)Lot#:_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

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N-Evap (Temp/ID/Time/Date/Initial): _____

Hexane Exchange for Silica Gel(Time/Date/Initial): _____

Hexane Lot#:_____

Silica Gel Clean-up (3630)(Time/Date/Initial): _____

PROPRIETARY

Silica Column Lot#:_____

1:1 Pentane/DCM Reagent Lot#:_____

Turbo Vap (Temp/ID/Time/Date/Initial): _____

Extract Storage: _____

AND

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Co-extracting PAHs and DROs and PAH Alks in Soil or Tissue by
EPA Method 3541

Procedure:

1. For low level work follow the low level glassware cleaning procedure.
2. Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. ***Note:*** *For UL and Tissues, baked glassware must be used.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.
3. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.
4. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately (see chart) *initial weight* into a 150ml beaker. Record weight using all figures displayed on the scale.
5. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS, and DLCS. For sediments and tissues weigh 5 grams of the appropriate SRM for analysis if requested on the service request.
6. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.
7. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.
8. Add surrogate and matrix spikes. See chart. **(Witnessed by a trained analyst)**
9. Add enough DCM to cover samples completely.
10. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.
11. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.
12. Quantitatively transfer the extract to culture tubes.
13. Take Sample to an *intermediate volume* (see chart). Split extracts into two equal aliquots with one aliquot relinquished to Semivoa GC for DRO clean-ups if co-extracted.
Note: *No clean-ups are necessary for puffs and filters. GCMS aliquot is taken to 2.5mL for a calculated final volume of 5 mL.*
14. Place 1mL of extract from GCMS aliquot into a blue vial for DPnB/Bio analysis if needed. Pull off 1mL of extract from GCMS aliquot and solvent exchange into hexane by adding ~1mL of hexane to extract and concentrating back down to ~1mL on N-evap. Repeat two more times.
15. Condition silica gel columns 3 times with DCM and 3 times with hexane.
16. Place a test tube under column and add extract to silica gel column.
17. Elute 5 times with 1:1 DCM/ Pentane.
18. Concentrate the extracts to ~1mL on turbo vap and bring to 1mL.
19. Place 1mL of extract into PAH vials.
20. Complete all necessary paperwork.

Test	Initial Weight	Surrogate Added	Spike Added	Intermediate Volume	Vial Color	Calculated Final Volume
PAH ALK Soils	10 grams dry	AP / 20µL	PAH / 200µL DPnB / 400 µL	10 mL	PAH / Green BIO / Blue	10 mL
PAH ALK tissues	10 grams	AP / 20µL	PAH / 100µL Corn oil/100 µL* DPnB 200uL	5 mL	PAH / Pink BIO / Blue	5 mL
SIM-PAH / PAH-ALK co-extract	20 grams dry	AP / 40µL SVF / 200 µL	PAH / 400 µL DPnB/800uL	20 mL	PAH / Green BIO / Blue	20 mL
SIM-PAH Puffs and Filters co-extract	1 puff or filter	AP / 20 µL SVF / 100 µL	PAH / 80 µL DPnB 200uL	10 mL	PAH/Green BIO/Blue	5 mL
SIM-PAH Filters and VOAs** Co-extract	1 filter	AP / 10 µL SVF / 50 µL	PAH / 40 µL DPnB 100uL	10 mL	PAH/Pink BIO/Blue	5 mL

*Add corn oil to MB/LCS/DLCS
**Filter extracted by 3541 then combined with VOA portion, each portion receiving the surrogates and spikes.

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Additional Prep Information For EPA 3541

OC Pesticides by GCMS

Service Request _____ **Workgroup** _____

Sulfate Lot #_____ DCM (GC^2)Lot #_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

GPC Clean-up (3640): Start _____ (Time/Date/Initial)

Stop _____ (Time/Date/Initial)

S-Evap (Temp/ID/Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial):_____

Hexane Exchange for Carbon(Time/Date/Initial): _____

Hexane Lot #_____

Carbon Clean-up (3630)(Time/Date/Initial): _____

Carbon Column Lot #_____ 4:1 Hexane / DCM Lot # _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Extract Storage: _____

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting OC Pesticides by GCMS in Soil or Tissue by
EPA Method 3541

Procedure:

1.Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. ***Note:*** *For UL and Tissues, baked glassware must be used.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately ***10 grams*** dry weight for soils, ***2grams*** dry weight for tissues, into a 150ml beaker. Record weight using all figures displayed on the scale.

4. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS, and DLCS.

5. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.

6. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.

7. Add ***100 µL*** OCPest surrogate and ***100 µL*** OCPest matrix spike. **(Witnessed by a trained analyst)**

8. Add enough DCM to cover samples completely.

9. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.

10. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

11. Quantitatively transfer the extract to culture tubes.

12. **For tissues:** Concentrate extracts to 10 mL and perform GPC clean-up

13. Concentrate extract to ~ 1 mL.

14. Solvent exchange into hexane by adding ~1mL of hexane to extract and concentrating back down to ~1mL on N-Evap. Repeat two more times.

15. Perform a carbon clean-up on the extract.

16. Concentrate extracts on N-Evap and bring back to ***1 mL final volume*** in hexane. Place in a 2mL amber autosampler vial.

17. Complete all necessary paperwork.

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Additional Prep Information For EPA 3541

Nonylphenols

Service Request _____ **Workgroup** _____

Sulfate Lot #:_____ DCM (GC^2) Lot #:_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Solvent Exchange to ACN (Time/Date/Initial): _____

ACN Lot #_____

Turbo Vap (Temp/ID/Time/Date/Initial): _____

Mg Sulfate lot #_____

Extract Storage: _____

Completed(Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting Nonylphenols in Solids by
EPA Method 3541

Procedure:

1.Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15mL, Ext. time=10m., Red B=1x15mL., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately 10 grams dry weight(soils) or 1gram for paperboards into a 150ml beaker. Record weight using all figures displayed on the scale.

4. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS and DLCS.

5. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.

6. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.

7. Add **100 µL** of Nonylphenol surrogate and **100 µL** of Nonylphenol matrix spike to samples. **(Witnessed by a trained analyst)**

8. Add enough DCM to cover samples completely.

9. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15mL, Ext. time=1h., Red B=6x15mL., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.

10. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

11. Quantitatively transfer the extract to culture tubes.

12. Take Sample to a final volume of 5 mLs.

13. Pull off 1 mL (for samples that are extremely "dirty" use a 200uL aliquot and proceed) of extract and add 4 mLs of ACN. Let extracts sit for at least 1 hour and filter.

14. Concentrate extracts on Turbo Vap and bring to 1 mL.

15. Add a pinch of magnesium sulfate and vortex extract for 5 seconds to dry the extract.

16. Use a 3 mL 0.45µm mesh filter to filter extract into a 2 mL amber autosampler vial.

17.Complete all necessary paperwork.

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Additional Prep Information For EPA 3541

PAH

Service Request _____ **Workgroup** _____

Sulfate Lot #_____ DCM (GC^2)Lot #_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Hexane Exchange for Silica Gel(Time/Date/Initial): _____

Hexane Lot #_____

Silica Gel Clean-up (3630)(Time/Date/Initial): _____

Silica Column Lot #_____ 1:1 Hexane/DCM Reagent Lot #_____

Turbo Vap (Temp/ID/Time/Date/Initial): _____

Extract Storage: _____

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting PAHs in Soil or Tissue by
EPA Method 3541

Procedure:

1. For low level work follow the low level glassware cleaning procedure.
2. Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. *Note: For UL and Tissues, baked glassware must be used.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.
3. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.
4. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately (see chart) *initial weight* into a 150ml beaker. Record weight using all figures displayed on the scale.
5. Use granular anhydrous Na_2SO_4[a] for the MB, LCS, and DLCS. For sediments and tissues weigh 5 grams of the appropriate SRM for analysis if requested on the service request.
6. Mix sample with DCM rinsed anhydrous Na_2SO_4[a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.
7. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.
8. Add surrogate and matrix spikes. See chart. **(Witnessed by a trained analyst)**
9. Add enough DCM to cover samples completely.
10. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.
11. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.
12. Quantitatively transfer the extract to culture tubes.
13. Take Sample to an intermediate volume.
14. Pull off 1mL of extract and solvent exchange into hexane by adding ~1mL of hexane to extract and concentrating back down to ~1mL on N-evap. Repeat two more times.
15. Condition silica gel columns 3 times with DCM and 3 times with hexane.
16. Place a test tube under column and add extract to silica gel column.
17. Elute 4 times with 1:1 DCM/ Hexane.
18. Concentrate the extracts to 1mL on turbo vap. Place 1 mL of extract into PAH vials.
19. Complete all necessary paperwork.

Test	Initial Weight	Surrogate Added	Spike Added	Vial Color	Calculated Final Volume
SIM-PAH/ SIMALK Soils/Paperboards	10 grams dry	AP / 20 µL	PAH / 200 µL	Green	10 mL
SIM-PAH UL Solids	20 grams dry	AP / 20 µL	PAH / 80 µL	Green	2 mL
SIM-PAH UL Tissue	10 grams	AP / 20 µL	PAH / 100 µL*	Pink	1 mL
SIM-PAH Tissue	10 grams	AP / 20 µL	PAH / 100 µL*	Pink	5 mL
SIM-PAH Wipe	1 wipe	AP / 10 µL	PAH / 20 µL	Green	1 mL

** Add 100 µL of corn oil to the LCS, DLCS, and MB*

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Additional Prep Information For EPA 3541

SIM-PAH-PCP

Service Request _____ **Workgroup** _____

Sulfate Lot #_____ DCM (GC^2)Lot #_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

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Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

PROPRIETARY

GPC Clean-up (3640): Start _____ (Time/Date/Initial)
Stop _____ (Time/Date/Initial)

S-Evap (Temp/ID/Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Extract Storage: _____

AND

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting SIM-PAH-PCPs in Soil or Tissue by
EPA Method 3541

Procedure:

1..Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately *10 grams dry* weight into a 150ml beaker. Record weight using all figures displayed on the scale.

4. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS, and DLCS. For sediments and tissues weigh 5 grams of the appropriate SRM for analysis if requested on the service request.

5. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.

6. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.

7. Add surrogate and matrix spikes. See chart. **(Witnessed by a trained analyst)**

8. Add enough DCM to cover samples completely.

9. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.

10. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

11. Quantitatively transfer the extract to culture tubes.

12. Take Sample to an intermediate volume of 10 mLs.

13. Filter all 10 mLs of sample using a 0.45µm filter.

14. Load sample on GPC using BNA program making sure all reservoirs are full and prior clean cycle has been completed.

15. Concentrate extracts on S-Evap. Temperature should be between 70-75° C.

16. Concentrate the extracts to 5mL on the N-Evap under a **gentle** stream of nitrogen with the temperature not exceeding 35° and place in labeled, green 2mL autosampler vial. Extreme caution must be used to ensure that the sample does not concentrate too low or to dryness.
Note: When GPC cleanup is performed, only half of the original extract is retained. Therefore the extract must be concentrated to ½ the final volume to achieve the correct "calculated" final volume.

17.Complete all necessary paperwork.

Test	Initial Weight	Surrogate Amount	Spike Amount	Vial Color	Calculated Final Volume
SIM-PAH-PCP Soil or Tissue	10 grams dry	AP / 20µL	PAH / 200 µL PCP / 400 µL	Green	10 mL

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Additional Prep Information For EPA 3541

PBDE

Service Request _____ **Workgroup** _____

Sulfate Lot #_____ DCM (GC^2)Lot #_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Hexane Exchange for Silica Gel (Time/Date/Initial): _____

Hexane Lot #_____

Silica Gel Clean-up (3630)(Time/Date/Initial): _____

Silica Column Lot #_____ 1:1 Hexane/DCM Reagent Lot #_____

N-Evap (Temp/ID/Time/Date/Initial): _____

Sulfuric Acid Clean-up (Time/Date/Initial): _____ Acid Lot #_____

Extract Storage: _____

Completed(Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting PBDEs in Soil or Tissue by
EPA Method 3541

Procedure:

1. For low level work follow the low level glassware cleaning procedure.
2. Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. ***Note:*** *For UL and Tissues, baked glassware must be used.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.
3. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.
4. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately (see chart) *initial weight* into a 150ml beaker. Record weight using all figures displayed on the scale.
5. Use granular anhydrous Na_2SO_4 [a] for the MB, LCS, and DLCS. For sediments and tissues weigh 5 grams of the appropriate SRM for analysis if requested on the service request.
6. Mix sample with DCM rinsed anhydrous Na_2SO_4 [a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.
7. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.
8. Add surrogate and matrix spikes. See chart. **(Witnessed by a trained analyst)**
9. Add enough DCM to cover samples completely.
10. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.
11. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.
12. Quantitatively transfer the extract to culture tubes.
13. Take Sample to the *calculated final volume*.
14. Pull off 2 mL of extract and solvent exchange into hexane by adding ~ 2 mL of hexane to extract and concentrating back down to ~2 mL on N-evap. Repeat two more times.
15. Condition silica gel cartridges 2 times with DCM and 2 times with hexane.
16. Place test tubes in manifold and load samples.
17. Elute 2 times with 1:1 DCM/ Hexane.
18. Concentrate the extracts to 2mL on N-Evap.
19. Perform sulfuric acid clean-up.
20. Complete all necessary paperwork.

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Test	Initial Weight	Surrogate Added	Spike Added	Vial Color	Calculated Final Volume
PBDE soil	10 grams dry	PBDE / 50µL	PBDE / 50 µL	Amber	2 mL
PBDE tissue	10 grams	PBDE / 50 µL	PBDE / 50 µL	Amber	2 mL
PBDE Paperboard	1 gram	PBDE / 100 µL	PBDE / 100 µL	Amber	10 mL

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Additional Prep Information For EPA 3541

8270 and 8270-LL

Service Request _____ **Workgroup** _____

Sulfate Lot #_____ DCM (GC^2)Lot #_____

Date/Time/Initials Weighed:_____ Balance ID:_____ Calibration Verified ☐

Storage Location (if not extracted same day):_____

Soxtherm Start (Time/Date/Initial): _____

Soxtherm Stop (Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

GPC Clean-up (3640): Start _____ (Time/Date/Initial)

Stop _____ (Time/Date/Initial)

S-Evap (Temp/ID/Time/Date/Initial): _____

N-Evap (Temp/ID/Time/Date/Initial): _____

Extract Storage: _____

Completed (Time/Date/Initial): _____

Comments/Observations:

_____

_____

_____

_____

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Bench Sheet Review Check List
☐ Hold Times Met (if no, Reason: _____)
☐ Prep date, dept, method, product code correct in stealth
☐ Spike Information correct
☐ Weights/Volumes and units correct on raw and final bench sheets
☐ Sample IDs have been checked—Bottle numbers appended if required
☐ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☐ Training has been circled
☐ Extract Storage recorded
☐ Additional Prep Sheet completely filled out (NA or line out Blanks)
☐ All clean-ups have been noted on additional prep sheet
☐ Signed service request with Form V, if applicable, has been attached

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COLUMBIA ANALYTICAL SERVICES, INC.
Appendix from EXT-3541
for Extracting 8270's and 8270-LL's in Soil or Tissue by
EPA Method 3541

Procedure:

1.Run the rinse cycle on Soxtherms prior to sample extraction. See EXT-3541 SOP and Operation Manual for programming instructions. ***Note:*** *Tissue glassware must be baked prior to use.*
Prog.=01, Temp. limit=200°, Ext. temp.=140°, Boil time=10m., Red. A=1x15ml., Ext. time=10m., Red B=1x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 56m.

2. All lab equipment that will have contact with the sample must be thoroughly rinsed with the extraction solvent.

3. Thoroughly mix sample. Remove large rocks, sticks, leaves and other organic matter unless this is the primary make-up of the sample. Weigh approximately (see chart) *initial weight* into a 150ml beaker. Record weight using all figures displayed on the scale.

4. Use granular anhydrous Na_2SO_4[a] for the MB, LCS, and DLCS. For sediments and tissues weigh 5 grams of the appropriate SRM for analysis if requested on the service request.

5. Mix sample with DCM rinsed anhydrous Na_2SO_4[a] until sample is sandy and free flowing. Be careful with amount of sulfate used so as not to overload thimble capacity. Up to two thimbles may be used. If two thimbles are needed, split extracts are then combined during reduction.

6. Transfer dried extract to assembled Soxtherm thimble. Be careful not to contaminate rinsed labware.

7. Add surrogate and matrix spikes. See chart. **(Witnessed by a trained analyst)**

8. Add enough DCM to cover samples completely.

9. Place sample on Soxtherm and run the associated program. See EXT-3541 SOP and Operation Manual for programming instructions.
Prog.=04, Temp. limit=200°, Ext. temp.=140°, Boil time=1h., Red. A=3x15ml., Ext. time=1h., Red B=6x15ml., sol. cool=30m., Red. int.=5m., Red pulse=5s., time 3h3m.

10. Be careful that the extract does not go dry. The goal is a volume of 10 to 20 ml. after reductions. Samples are removed and immediately covered in foil as soon as this level is reached to allow other sample to continue the reduction step. Additional reduction may be required.

11. Quantitatively transfer the extract to culture tubes.

12. Take samples to an intermediate volume of 10 mLs.

13. Filter all 10 mLs of sample using a 0.45µm filter.

14. Load samples on GPC using BNA program making sure all reservoirs are full and prior clean cycle has been completed.

15. Concentrate extracts on S-Evap. Temperature should be between 70-75° C.

16. Concentrate the extracts to < *calculated final volume (see below)* on the N-Evap under a **gentle** stream of nitrogen with the temperature not exceeding 35° and place in labeled, colored 2mL autosampler vial. Extreme caution must be used to ensure that the sample does not concentrate too low or to dryness.
Note: When GPC cleanup is performed, only half of the original extract is retained. Therefore the extract must be concentrated to ½ the final volume to achieve the correct "calculated" final volume.

17.Complete all necessary paperwork.

Test	Initial Weight	Surrogate Amount	Spike Amount	Vial Color	Calculated Final Volume
8270-LL	20 grams dry	AP/50µL	8270/50 µL Benzoic Acid/ 50 µL	Amber	2 mL
8270	30 grams dry	AP/ 1mL	8270/ 1mL	Clear	1 mL
8270 Paperboards	20 grams	AP/ 1mL	8270/ 1mL Benzidine/ 100 µ L Paperboard/ 20 µL	Clear	1 mL
8270 Wipe	1 wipe	AP/ 1mL	8270/ 1mL	Clear	1 mL
SVO-SIM Tissue	5 grams	AP/50µL	8270/50 µL	Amber	10 mL

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PROPRIETARY

STANDARD OPERATING PROCEDURE

PERCENT LIPIDS IN TISSUE

EXT-LIPID
Revision 2
September 20, 2010

CAS CONFIDENTIAL

Approved By: _____ Supervisor — 8/30/10 Date

_____ QA Manager — 8/30/10 Date

_____ Laboratory Manager — 8/30/10 Date

COLUMBIA ANALYTICAL SERVICES, INC.
1317 South 13th Avenue
Kelso, Washington 98626

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Annual review of this SOP has been performed and the SOP still reflects current practice.
Initials: _____ Date: _____
Initials: _____ Date: _____
Initials: _____ Date: _____

DOCUMENT CONTROL
NUMBER: _____
Initials: _____ Date: _____

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PERCENT LIPIDS IN TISSUE

PROPRIETARY

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine the lipid content in biological tissue. The procedures used are based on the procedure described in the Puget Sound Protocols, Bligh & Dyer, and the EPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories.

1.2. This procedure is typically applied to marine tissues. In some cases, the procedure can be used to determine lipids in other biological tissue.

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2. METHOD SUMMARY

2.1. A homogenized portion of the tissue sample is extracted with organic solvent. The extract is evaporated using moderate heat and the lipid weight is determined. Percent lipids is calculated from the weight measured.

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2.2. The extraction may either be performed independently of the extraction done for other organics analyses or a portion of the extract from another extraction may be used for the percent lipids determination

3. DEFINITION

Lipids - Naturally occurring compounds that are soluble in such organic solvents as dichloromethane, hydrocarbons, chloroform, benzene, and alcohols. This includes a diverse range of compounds, like fatty acids and their derivatives, carotenoids, terpenes, steroids, cholesterols, and bile acids

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4. INTERFERENCES

4.1. Since the procedure is used to provide an estimation of lipid content based on non-volatile extracted material, interferences from co-extracted components that are not considered lipids may occur.

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4.2. Due to the nature of the procedure, interferences attributed to laboratory procedures are not typically encountered.

5. SAFETY

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Personal protective equipment will include safety glasses (with side shields), gloves, and a lab coat. Follow normal precautions as per the CAS Safety Manual.

6. SAMPLE HANDLING AND PRESERVATION

Tissue samples should stored at -20 ± 4°C until analysis. When frozen, samples should be analyzed within 1 year of sampling. Project-specific protocols may apply to sample storage and holding time requirements.

7. APPARATUS

7.1. Evaporating pans: Aluminum weighing pans.

7.2. VOA vials, 40mL, precleaned.

7.3. Tissuemizer.

7.4. Drying oven, capable of maintaining a temperature of 70°C.

7.5. Hotplate, capable of maintaining a temperature of 70°C.

7.6. Analytical balance, capable of weighing to 0.1mg.

8. REAGENTS

8.1. Sodium sulfate (granular, anhydrous), Na_2SO_4. Purify by heating at 400°C for 4 hours in a shallow tray or crucible, or by pre-cleaning the sodium sulfate with dichloromethane.

8.2. Extraction solvents:

8.2.1. Dichloromethane

8.2.2. Chloroform/Methanol (1:1)

9. PREVENTIVE MAINTENANCE

9.1. Balance calibration checks are performed daily for each day analyses are performed. The results of these checks are recorded in the designated logbook for balance calibration verification located in the extractions lab.

9.2. Periodic balance servicing is performed by an outside qualified vendor.

10. RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate

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acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

11. PROCEDURE

PROPRIETARY

Note: If samples are suspected to be high in lipids (i.e. whole fish), the % lipids must be done before samples are run on GPC to prevent overloading of GPC column. The maximum amount of lipid that can be loaded on the GPC column is 2 g. If lipid is over 2g see the extraction supervisor for assistance.

11.1. PSEP Option:

11.1.1. Homogenize the tissue sample using the CAS *SOP Tissue Sample Preparation (MET-TISP)*. If using a portion of extract from an analytical extraction, use 2 ml of extract from the 10 ml intermediate volume before GPC cleanup and skip to section 11.1.6.

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11.1.2. Weigh 2 grams of tissue into a VOA vial. Dry the sample with sodium sulfate.

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11.1.3. Add 10mL dichloromethane.

11.1.4. Using a tissuemizer, homogenize the tissue/solvent mixture until sample is thoroughly mixed.

11.1.5. Vortex and centrifuge at 100xG for 10 minutes.

11.1.6. Heat sample pans in oven at 70°C for one hour. Remove from oven and weigh as soon as pans are no longer warm (less than 5 minutes). Weigh the pans to the nearest 0.0001 gram.

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11.1.7. Pipet 2mL of the extract into a DCM-rinsed glass syringe with a new filter. Filter the extract into a pan and evaporate to dryness. Using a hot plate with temperature <70°C. Place pans in oven at 70°C for one hour.

11.1.8. Remove from oven and weigh as soon as pans are no longer warm (less than 5 minutes). Weigh the pans to the nearest 0.0001 gram.

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11.1.9. Calculate percent (%) lipids and GPC loading.

11.2. Bligh & Dyer Option:

11.2.1. Prepare pans: Heat aluminum sample pans in oven at 70° C for a minimum of one hour. Cool pans in a desiccator for a minimum of 30 minutes. Weigh pans to the nearest 0.0001 gram.

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11.2.2. Homogenize tissue in accordance with CAS *SOP Tissue Sample Preparation (MET-TISP).*

11.2.3. Weigh the appropriate amount of tissue into a scintillation vial for samples ≤ 3 grams, into a 40 mL VOA vial for samples 3 - 6 grams, or into a 250 mL beaker for large sample 6 - 30 grams.

11.2.4. Add the appropriate amount of 1:1 Chloroform/Methanol (v/v):

≤ 2 grams, add 10 mL
> 2 - 5 grams, add 25 mL
5 - 10 grams, add 50 mL
10 - 30 grams, add 100 mL

11.2.5. Using a tissumizer, homogenize the sample/solvent mixture for approximately 1 minute or until sample is thoroughly dessimated. Rinse the tissuemizer with solvent. Collect the rinsate with the sample extract. Centrifuge the sample extract at 1000xG for 10 minutes. Transfer extract to a clean VOA vial, leaving the tissue behind. Rinse the tissue portion by adding 1-2 mL of solvent to the tissue. Vortex, centrifuge, and combine with the extract in the VOA vial. Examine the extract to verify that a single phase is present. High water content can result in phase separation. In these cases, add solvent in 1 mL increments until a single phase is achieved.

11.2.6. **Low Volume Extractions**: Back extract by adding 7 mL of sodium sulfate/DI water (25g sulfate/1000mL H2O) to the extract). Vortex extract and centrifuge at 1000xG for 10 minutes. Lipids will be retained in bottom chloroform layer. Pipette the top water layer off the bottom chloroform solvent layer and discard. If colloidal proteinaceous material is observed, add 0.5 mL of sodium sulfate/DI water, vortex, and centrifuge for another 10 minutes. Discard the top water layer.

11.2.7. **High Volume Extractions**: Transfer the extract with rinses into a 250 mL separatory funnel. Back extract 2 times with 100 mL sodium sulfate/DI water, discarding the top water layer each time (lipids will be retained in the bottom layer). Filter the bottom layer through muffled anhydrous sodium sulfate into a KD. Rinse the funnel with 10 - 20 mL of dichloromethane. Concentrate to approximately 5 mL on the S-evap, keeping the temperature ≤ 80°C. The extract may need to be centrifuged or filtered at this point.

11.2.8. Concentrate the extract to approximately 2mL using nitrogen.

11.2.9. Place pans on a hot plate at a setting of 3. Filter the extracts through 3mL syringes into the pans and evaporate to dryness. DO NOT LET EXTRACTS

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BOIL. Heat sample pans in oven at 70° C for a minimum of one hour. Cool pans in a desiccator for a minimum of 30 minutes. Weigh pans to the nearest 0.0001 gram and record the weight.

12. QA/QC REQUIREMENTS

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12.1. QC Samples Required

12.1.1. Analyze one sample in triplicate per 20 samples.

12.1.2. Analyze one blank, an empty aluminum pan, per twenty samples.

12.2. Acceptance Criteria

12.2.1. RPD for duplicates should be <20%.

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12.2.2. Method blank weight should be less than the absolute value of 0.5mg.

12.3. Calculations

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12.3.1. Calculate percent (%) lipids

PSEP Option:

$$\%\,Lipids = \frac{\left[\left(Wt_{dish+lipid(g)} - Wt_{dish(g)}\right) - Blank\right] \times 5}{Sample\ Wt.(g)} \times 100$$

Bligh & Dyer Option:

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$$\%\,Lipids = \frac{\left[\left(Wt_{dish+lipid(g)} - Wt_{dish(g)}\right) - Blank\right]}{Sample\ Wt.(g)} \times 100$$

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12.3.2. Calculate number of (g) loaded on GPC (5 ml):

$$\frac{\%\ Lipid}{200} \times Sample\ Wt.(g)$$

12.4. Reporting

12.4.1. Fill out the Excel report for % lipids found at R:\SVG\Forms\lipids.

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12.4.2. Samples are weighed to the nearest 0.1mg and report to the nearest 0.1%.

12.4.3. Report results using no more than 3 significant figures.

12.5. Data review

12.5.1. It is the analyst's responsibility to review analytical data to ensure that all quality control requirements have been met for each analytical run. Results for QC analyses are calculated and recorded as specified. All data will be initialed, dated and attached to required data quality worksheet.

12.5.2. The data packet for the sequence is submitted for review by supervisor or designee. The results are transferred to the appropriate report form located in the CAS network directory R:\SVG\WIP.

12.5.3. Refer to the SOP for *Laboratory Data Review Process* for general instructions for data review.

13. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

Corrective action measures applicable to specific analysis steps are discussed in the applicable section of this (and other applicable) SOP(s). Also, refer to the SOP for *Corrective Action* for correct procedures for identifying and documenting such data. Procedures for applying data qualifiers are described in the SOP for *Report Generation* or in project-specific requirements.

14. METHOD PERFORMANCE

This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

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15. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

16. WASTE MANAGEMENT

The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the laboratory Safety Manual, Sections 6 and 7.

17. TRAINING

17.1. Training outline

17.1.1. Review literature (see references section). Read and understand this SOP. Also review the applicable MSDS for all solvents used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3. Training is documented following the SOP *for Documentation of Training*.

17.1.4. NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

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18. REFERENCES

18.1. USEPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1 - Fish Sampling and Analysis, Third Edition, November, 2000.

18.2. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, January 1996 and subsequent chapter revisions.

18.3. Bligh & Dyer, Canadian J. Biochemistry and Physiology, Aug. 1959

18.4. NOAA (National Oceanic and Atmospheric Administration). 1993a. *Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992 Volume 11.Comprehensive Descriptions of Complementary Measurements.* NOAA Technical Memorandum NOS ORCA 71. Coastal Monitoring and Bioeffects Assessment Division, Office of Ocean Resources Conservation and Assessment, National Ocean Service, Silver Spring, MD. July.

18.5. NOAA (National Oceanic and Atmospheric Administration). 1993c. *Sampling and Analytical Methods of the National Status and Trends Program, National Benthic surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trance Organic Analytical Methods.* NOAA Technical Memorandum NOS ORCA 71. Coastal Monitoring and Bioeffects Assessment Division, Office of Ocean Resources Conservation and Assessment, National Ocean Service, Silver Spring, MD. July.

19. CHANGES SINCE THE LAST REVISION

19.1. Changed SOP No from SOC-LIPID to EXT-LIPID
19.2. Updated references to Corporate SOPs through-out the document.
19.3. Changed methylene chloride to dichloromethane.
19.4. Sec 12.2.1 Re-worded to clarify
19.5. Added new NOAA references (18)
19.6. Added standard training section 17 to the SOP.
19.7. Removed reference to MDL study (14)

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STANDARD OPERATING PROCEDURE

ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY

SOC-8081
Revision 16
August 26, 2011

CAS
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Approved By: _____ Supervisor 8/3/11 Date

_____ QA Manager 8/3/11 Date

_____ Laboratory Director 8/3/11 Date

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1. SCOPE AND APPLICATION

This procedure is used to determine the concentrations of Organochlorine Pesticides in liquid and solid matrices using EPA Method 8081B. Table 1 indicates compounds that are routinely determined by this procedure and lists the method reporting limits (MRLs) in water and soil/sediment. Additional analytes may also be determined as required by specific projects. The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. Method Detection Limits that have been achieved are given in Attachment A. MDLs may change as repeat studies are conducted. A low-level sediment option may be used, with MRLs given in Table 2.

2. SUMMARY OF METHOD

2.1. This procedure provides gas chromatographic conditions for the detection of low concentration (typically parts-per-billion level organochlorine pesticides) pesticides. Target analytes are extracted from the sample and isolated via extract cleanup if needed. Liquid samples are extracted using continuous liquid-liquid extraction (Method 3520, CAS SOP EXT-3520), or solid phase extraction (Method 3535, CAS SOP EXT-3535). TCLP leachates are extracted using separatory funnel (Method 3510, CAS SOP EXT-3510). In general, soil/sediment samples are extracted using Soxhlet (Method 3540, CAS SOP EXT-3540) or automated Soxhlet extraction (Method 3541, CAS SOP EXT-3541).

2.2. A portion of the extract is analyzed using a gas chromatograph (GC) equipped with dual column fused silica capillary columns and dual electron capture detectors (ECD). Identification is based on comparison of sample retention times to the retention times of known target compounds. Quantitative analysis is performed by using certified standards to produce a calibration curve response factor. Analyte concentration can then be calculated using theresponse factor of the calibration curve. Sample concentration is calculated using the extract concentration and the extracted sample weights, volumes and dilution factors.

2.3. The sensitivity of the procedure depends on the level of interferences rather than instrument limitations. If interferences prevent the detection of analytes, GPC cleanup, Florisil cleanup, sulfur cleanup, carbon cleanup, and other appropriate techniques may be used to reduce interferences.

2.4. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP *Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD)* may supersede the requirements defined in this SOP.

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3. DEFINITIONS

3.1. Analysis Sequence - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration followed by sample extracts interspersed with calibration standards. The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria are exceeded. See the SOP *ADM-BATCH.*

3.2. Independent Calibration Verification (ICV) - Verification of the ratio of instrument response to analyte amount, a calibration check, is done by analyzing for analyte standards in an appropriate solvent. ICV solutions are made from a stock solution which is different from the stock used to prepare calibration standards.

3.3. Internal Standards - Internal standards are organic compounds which are similar to the analytes of interest but which are not found in the samples. The chosen internal standards are used to help calibrate the instrument's response and to compensate for slight instrument variations from injection to injection.

3.4. Matrix Spike/Duplicate Matrix Spike Analysis - In the matrix spike analysis, predetermined quantities of stock solutions of certain analytes are added to a sample matrix prior to sample extraction and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. Samples are split into duplicates, spiked, and analyzed. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision.

3.5. Standard Curve - A standard curve is a curve which plots concentrations of a known analyte standard versus the instrument response to the analyte.

3.6. Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.

3.7. Method Blank - The method blank is an artificial sample designed to monitor introduction of artifacts into the process. The method blank is carried through the entire analytical procedure.

3.8. Continuing Calibration Verification Standard (CCV) - A standard injected into the instrument at specified intervals and is used to verify the initial calibration.

3.9. Instrument Blank (CCB) - The instrument blank (also called continuing calibration blank) is a volume of clean solvent analyzed on each GC column and instrument used for sample

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analysis. The purpose of the instrument blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples.

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4. INTERFERENCES

4.1. Solvents, reagents, glassware, gases, and sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by running method blanks.

4.2. Interferences from phthalate esters introduced during sample handling can pose a problem with pesticide determinations. Analysts should take precautions not to introduce phthalates during the analysis and sample preparation process. Much interference can be removed using GPC (SOP *SOC-3640A*) and/or Florisil cleanup (SOP *EXT-FLOR*). Florisil cleanup is typically used to reduce matrix interferences caused by polar compounds. The presence of elemental sulfur will result in peaks interfering with early eluting pesticides. Cleanup via method 3660 (SOP *SOC-3660*) may be used for the removal of sulfur if GPC cleanup is inadequate. Other co-extractables such as lipids, waxes, etc., are removed via GPC cleanup. A Cleanup procedure using carbon cartridges (SOP *EXT-CARCU*) that eliminate compounds which interfere with gas chromatographic analyses may also be utilized.

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4.3. xtracts using carbon cartridges. Carbon cleanup is a convenient way to eliminate compounds that interfere with gas chromatographic analysis of certain target analytes.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personnel protective equipment, such as, safety glasses, lab coat and the correct gloves.

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5.2. Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS *Environmental, Health and Safety Manual* and the appropriate MSDS prior to beginning this method.

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6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Containers used to collect samples should be purchased pre-cleaned containers. Alternatively, containers used to collect samples for the determination of semivolatile organic compounds may be soap and water washed followed by methanol (or isopropanol) rinsing. The sample containers should be of glass or Teflon and have screw-top covers with Teflon liners. In situations where Teflon is not available, solvent-rinsed aluminum foil may be used as a liner. Highly acidic or basic samples may react with the aluminum foil, causing eventual contamination of the sample. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic. Sampling should be performed according to SW-846 guidelines or project-specific procedures.

6.2. Water and soil samples must be iced or refrigerated at 4 ± 2°C from time of collection until extraction. Water samples must be extracted within 7 days of collection and soil/sediment samples must be extracted within 14 days of collection.

6.3. Sample extracts are stored at 4° in the dark and must be analyzed within 40 days.

7. STANDARDS, REAGENTS AND EQUIPMENT

7.1. Standards

7.1.1. The following commercially prepared stock standards and ICV stock standards are purchased from various vendors and must be certified by the manufacturer. The ICV stock standards are obtained from a different source from the initial calibration. The expiration date for unopened ampules is the manufacturer's assigned expiration date. If the manufacturer does not assign a date, use an expiration date of 1 year from receipt. Stock standards are stored at -10°C.

Standard	Concentration	Use
8081	1000 ug/mL	ICAL
8081 Surrogate[a]	200 ug/mL	ICAL
Isodrin	100 ug/mL	ICAL
Hexachlorobenzene	100 ug/mL	ICAL
8081 Misc. compounds*	250 ug/mL	ICAL
Chlordane	5000 ug/mL	ICAL
Toxaphene	1000 ug/mL	ICAL
8081	1000 ug/mL	ICV
Isodrin	100 ug/mL	ICV
Hexachlorobenzene	100 ug/mL	ICV
8081 Misc. compounds	100 ug/mL	ICV
Chlordane	1000 ug/mL	ICV
Toxaphene	1000 ug/mL	ICV
8081 Internal Standard[b]	5000ug/mL	Internal standard

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[a] Surrogates are Decachlorobiphenyl (DCB) and 2,4,5,6-Tetrachlorometaxylene (TCMX).
[b] Internal standard is 1-Bromo-2-nitrobenzene.

7.1.2. Intermediate standard solutions and ICV solutions are made in hexane by diluting stock standards to intermediate concentrations listed below. The ICV intermediates are prepared from the ICV stock standards obtained from a different source from the initial calibration stocks.

ICAL Intermediate	Concentration	Preparation
Combined 8081, isodrin, hexachlorobenzene, and surrogate.	10 ug/mL	1:100 dilution of 8081 stock, 1:10 dilution of isodrin & hexachlorobenzene stocks, 1:20 dilution of surr. stock.
8081 Misc. compounds*	10 ug/mL	1:25 dilution of stock
Chlordane	250 ug/mL	1:20 dilution of stock
Toxaphene	100 ug/mL	1:10 dilution of stock

Intermediate ICV Standard	Concentration	Preparation
Combined 8081, isodrin, and hexachlorobenzene	10 ug/mL	1:100 dilution of 8081 stock, 1:10 dilution of isodrin & hexachlorobenzene stocks.
8081 Misc. compounds*	10 ug/mL	1:10 dilution of stock
8081 Internal Stanard	5ug/mL	1:1000 dilution of stock

* Prepare only as needed for projects requiring non-routine additional compounds.

7.1.3. Working Standard Solutions

7.1.3.1. Calibration standards are prepared containing surrogates and analytes in hexane. Calibration standards are stored at 4° for up to six months. A series of standards are prepared from a common intermediate representing the MRL (or lower) to a value near the high end of the linear range. Calibration standards are prepared in hexane. See Table 4 for preparation and concentrations, including standards designated as CCVs.

7.1.3.2. The independent calibration verification (ICV) standards are prepared from stock solutions from a different source from the initial calibration as listed below. Expiration periods are the same as for equivalent stock and calibration standards.

ICV Standard	Concentration	Preparation
Combined 8081, isodrin, and hexachlorobenzene	40 ug/L	1:250 dilution of combined 8081 ICV intermediate.
8081 Misc. compounds	40 ug/L	1:250 dilution of 8081 misc. compounds intermediate.
Chlordane	800 ug/L	1:1250 dilution of Chlordane

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		ICV stock.
Toxaphene	1000 ug/L	1:1000 dilution of Toxaphene ICV stock.

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7.1.3.3. A surrogate spiking solution is prepared at 2ug/mL by making a 1:100 dilution of the surrogate stock standard in acetone. The surrogate solution is stored at 4° or up to six months.

7.1.3.4. An internal standard solution is prepared at 10ug/ml by diluting the internal stock standard in hexane. 5.0 uL of internal standard is added to each standard, blank and sample prior to analysis for a final concentration of 50ng/mL.

7.1.3.5. A matrix spike solution at 4ug/mL is prepared by diluting the stock solution in methanol. This solution is stored at 4° for 2 weeks. The matrix spike solution is added to all matrix spikes and lab control samples as outlined in section 12.

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Spiking Solution	Concentration	Preparation
8081, isodrin, and hexachlorobenzene.	4 ug/mL	1:250 dilution of 8081 stock, 1:25 dilution of isodrin & hexachlorobenzene stocks.
8081 Misc. compounds*	4 ug/mL	1:25 dilution of stock
Chlordane**	10 ug/mL	1:500 dilution of stock
Toxaphene**	10 ug/mL	1:100 dilution of stock

* Prepare only as needed for projects requiring non-routine additional compounds.
** Prepare only as needed for project requirements.

7.1.4. Solvents: Hexane, acetone, methylene chloride, isooctane, and methanol. Pesticide grade or equivalent

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8. APPARATUS AND EQUIPMENT

8.1. GC Instrumentation - Dual Column

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8.1.1. The dual column approach involves a single injection split between two columns mounted in a single gas chromatograph (Hewlett Packard 5890, 6890, 7890 or equivalent) equipped with cool-on-column, split/splitless, or temperature programmable injection system; with dual ECDs. See Table 3 for typical chromatographic conditions. Helium or hydrogen can be used as the carrier gas. Argon/methane mixture or Nitrogen is used as the detector make-up gas. Current instrumental systems are identified as follows:

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Instrument I.D.	Analytical System	Routine Matrix
GC23	Agilent 6890	Water/Soil/Tissue
GC28	Agilent 6890	Water
GC34	Agilent 7890A	Water/Soil/Tissue

8.1.2. Columns, J&W columns typically are used;

Column 1 : DB-XLB 30m x 0.32mm ID, 0.50 µm df or equivalent*
Column 2 : DB-35MS 30m x 0.32mm ID, 0.25 µm df or equivalent*

Note: Column diameter and film thickness may vary depending on instrument. Refer to the instrument maintenance logbook for the columns used for a specific instrument configuration.

8.1.3. Autosampler, capable of reproducible injections, Hewlett Packard/Agilent 7673 or equivalent.

8.1.4. Data System - A computer data system must be interfaced to the GC/ECD. The system must allow the continuous acquisition and storage on machine-readable media of all chromatographic data obtained throughout the duration of the chromatographic program. The computer must have software that includes automated calibration, identification, and quantitation routines. The software must also be capable of integrating the chromatographic peaks abundances. The most recent version of the manufacturer's software is preferred. HP Enviroquant.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument.

9.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3. Gas Chromatograph

9.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, seal, washer, o-ring, septum, column ferrule, and autosampler syringe as needed. Liners and seals should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners and seals may be cleaned and re-used.

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9.3.2. Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool. Clipping the column should be done from the guard column as the first option. If needed, replace the guard column. Only clip from the analytical column as a last option.

9.3.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in 8081B, is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Sample Preparation

11.1.1. Water samples (1L) are extracted at a pH of 5-9 with methylene chloride, using Method 3520 (SOP *EXT-3520)*, or solid phase extraction (SOP *EXT-3535*). TCLP leachates are extracted using separatory funnel (SOP *EXT-3510*). Refer to the applicable extraction SOP. For extraction by 3535, acidification of the sample prior to extraction may be allowable if project objectives and performance requirements of methods 3535 and 8081 are met.

Note: For projects originating from South Carolina and under the SC DHEC lab certification, use the 3535 extraction method only.

11.1.2. Soil/sediment samples are extracted using either EPA Method 3540 (SOP *EXT-3540*) or method 3541 (SOP *EXT-3541*). A low-level sediment option may be used where

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the sample weight or volume is adjusted to lower the level of detection in the sample. Refer to the applicable extraction SOP.

Note: For projects originating from South Carolina and under the SC DHEC lab certification, use the 3541 extraction method only.

11.1.3. Additional sample cleanup procedures may be used as appropriate for the samples. See Section 4.2 and refer to the applicable cleanup SOP.

11.2. Calibration

11.2.1. Refer to the SOP *Sample Batches* (*ADM-BATCH*) for guidance on analytical calibration and sample batches.

Note: Refer to the *SOP for Calibration of Instruments for Organics Chromatographic Analyses (SOC-CAL)*, where calibration procedures and policies are described. The calibration procedure(s) and options chosen must follow the SOP *SOC-CAL*.

11.2.2. Check for degradation of 4,4'-DDT and Endrin by injecting a standard containing only 4,4'-DDT at 100ppb and Endrin at 50 ppb.

$$\%\,Breakdown = \frac{Total\ DDT\ degratation\ peak\ area\ (DDE + DDD)}{Total\ DDT\ peak\ area\ (DDT + DDE + DDD)} x\ 100$$

$$\%\,Breakdown = \frac{\begin{matrix} Total\ endrin\ degratation\ peak\ area \\ endrin\ aldehyde\ +\ endrin\ Ketone \end{matrix}}{\begin{matrix} Total\ endrin\ peak\ area \\ endrin\ +\ endrin\ aldehyde\ +\ endrin\ Ketone \end{matrix}} x100$$

If degradation of either DDT or Endrin exceeds 15%, perform any necessary maintenance before proceeding with calibration. The breakdown of DDT and Endrin must be measured before samples are analyzed and at the beginning of each analytical sequence.

11.2.3. After determining that degradation is within acceptance, calibrate the system immediately prior to conducting any analyses. Analyze each calibration standard (containing internal standards) and tabulate the area against concentration for each compound. For multi-component analytes, only those specified in the project plan or work specification are used for calibration. Calculate response factors (RFs) for each compound relative to one of the internal standards as follows:

$$RF = (A_x C_{is})/(A_{is} C_x)$$

where:

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A_x = Area of the compound being measured.
A_{is} = Area of the specific internal standard.
C_{is} = Concentration of the specific internal standard (ng/µL).
C_x = Concentration of the compound being measured (ng/µL).

Note: For Chlordane, a minimum of 3 peaks must be chosen and for Toxaphene a minimum of 4 peaks must be chosen. The peaks must be characteristic of the compound of interest.

11.2.2.2 Calculate the mean response factor $(\overline{RF_x})$ for each analyte and surrogate from the calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$\%RSD = \frac{(SD)}{(\overline{RF_x})} 100.$$

11.2.2.3 The % RSD should be less than 20% for each compound.

11.2.2.4 If the % RSD for any compound is 20% or less, linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used to quantitate sample analytes.

11.2.2.5 If the %RSD exceeds 20%, then a linear curve or a quadratic calibration with a correlation coefficient of 0.990 or greater may be used.

11.2.4. Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. Evaluate the ICV as described in the SOC-CAL SOP. The acceptance criterion is ± 20% from the analytes assigned value.

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11.2.5. Continuing Calibration Verification

11.2.5.1. The working calibration curve or calibration response factors must be verified on each analytical sequence by the analysis of one or more mid-range calibration standards (CCV). A CCV must be injected at the start of each 12 hour shift or every 20 samples, whichever is first. The 12 hour window starts with the injection time of the first CCV. The use of internal standard calibration technique does not require that all sample results be bracketed with calibration verification standards.

Note: DoD projects require a CCV analysis every 10 field samples.

11.2.5.2. The acceptance criteria for all analytes in the CCV analysis are a response (RF or concentration) within ± 20% D of the expected value, as compared to the initial calibration. Refer to the SOP *SOC-CAL*.

11.2.5.3. The measured area of the internal standard must be no more than -50% to + 100% difference from the average area calculated during initial calibration.

11.2.5.4. The retention time of the internal standard must also be evaluated. A retention time shift of >30 sec necessitates system maintenance and reanalysis of CCV.

11.2.6. Retention Time Windows

11.2.6.1. Establish retention time windows with the GC system in acceptable operating conditions. Make three injections of all analytes throughout the course of a 72-hour period. Serial injections over less than a 72-hour period may result in retention time windows that are too tight. Using retention times from these analyses, calculate retention time windows. Refer to EPA Method 8000 for detailed instructions.

11.2.6.2. Plus or minus three times the standard deviation of the absolute retention times for each standard will be used to define the retention time window; however, the experience of the analyst should weigh heavily in the interpretation of chromatograms. In those cases where the standard deviation for a particular standard is zero, the laboratory may use a default window of ± 0.03 minutes. If the peak width is > 0.06 minutes, use a default window of 0.1 minutes.

11.2.6.3. Calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. Retain this data in the method file.

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11.3. Sample Analysis

11.3.1. Table 3 indicates the typical operating conditions for the GC. Setup the analysis sequence of sample and QC samples. Also, refer to the SOP for *Sample Batches* for guidance.

11.3.2. Calibrate the system as described in Section 11.2. Evaluate the CCVs as discussed in Section 11.2.4. If any standard falls outside of their daily retention time window, evaluate the chromatogram for possible causes such as carryover from a highly contaminated sample. If a problem related to GC system has been determined to be the cause of retention time shift, perform whatever maintenance is necessary before re-injecting a CCV or recalibrating and proceeding with sample analysis.

11.3.3. Spike 5 ul of the internal standard 1-Bromo-2-nitrobenzene at 10 ppm into each 1 ml of sample extract to give a final concentration of 50ng/ml. The measured area of the internal standard must be -50 to +100% as measured from the average of the most recent calibration. Any samples falling outside of this criterion require reanalysis.

11.3.4. The retention time of the internal standard must also be evaluated. A retention time shift of >30 sec requires reanalysis of all affected samples.

11.4. Identification of Analytes

11.4.1. Tentative identification begins with a response that is >3 times the baseline noise level(s/n). The retention time of the peak is compared against the retention time of a known compound in the daily standard chromatogram.

11.4.2. Tentative identification of an analyte occurs when a peak from a sample extract falls within the daily retention time window and the s/n ratio of the peak is >3. A tentatively identified compound is confirmed when the retention time for the compound on the confirmatory detector is within the retention time window on that system.

11.4.3. Confirmation of all tentative hits should be made. Confirmation is made by injecting the sample extract on two columns with dissimilar phases simultaneously. If the retention time matches on both columns, then the hit for the analyte is considered a confirmed hit. Refer to the SOP for *Confirmation of Organic Analytes*.

11.4.4. For Chlordane a minimum of 3 peaks must be chosen, and for Toxaphene a minimum of 4 peaks must be chosen for identification purposes. Refer to Section 13 for quantitation procedures for multi-response analytes.

11.5. Perform all necessary calculations as described in Sections 12 and 13.

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12. QUALITY CONTROL

12.1. Initial Precision and Recovery Validation

The precision of the extraction procedure and the GC procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four reagent water samples are spiked at a level near t he midpoint of the calibration range (typically the LCS level), then extracting and proceeding with Section 11. The (spiking solution may be prepared from pure standard materials, or purchased as certified solutions. If prepared by the laboratory, stock standards prepared independently from those used for calibration should be used. The concentration of the analytes to be spiked is 20x the MRL.

12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. Refer to the *SOP Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.* The MDL study must be verified annually.

12.2.2. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates (i.e. 1L of reagent water for water MDLs, 10 or 20g sand for soil MDLs) with MDL spiking solution at a level below the MRL. Follow the procedures starting in Section 11 to analyze the samples.

12.3. Limits of Quantification (LOQ)

12.3.1. The laboratory must establish a LOQ for each analyte as the lowest reliable laboratory reporting concentration or in most cases the lowest point in the calibration curve which is less than or equal to the desired regulatory action levels, based on the stated project requirements. Analysis of a standard prepared at the LOQ concentration levels or use of the LOQs as the lowest point calibration standard provides confirmation of the established sensitivity of the method. The LOQ recoveries must be within 50% of the true values to verify the data reporting limit. Refer to the CAS SOP Performing Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantification.

12.4. Ongoing QC Samples required are described in the CAS-Kelso *Quality Assurance Manual* and in the *SOP for Sample Batches*. In general, these include:

12.4.1. Method blank - A method blank is extracted and analyzed with every batch of 20 or fewer samples to demonstrate that there are no method interferences. The method blank must demonstrate that interferences from the analytical and preparation steps are

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minimized. No target analytes should be detected above the MRL in the method blank.

Note: DoD projects require that no analyte be detected > ½ the RL or 1/10 the regulatory limit, whichever is greater.

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12.4.2. A lab control sample (LCS) must be extracted and analyzed with every batch of 20 samples. The water LCS is prepared by adding 50 µL of the matrix spike solution (250uL for Toxaphene/Chlordane) to 1L of reagent water, resulting in concentrations of 0.2 ug/L for single-response analytes (2.5 ug/L for Toxaphene or Chlordane). The soil LCS is prepared by adding 100 µL of spike solution (400uL for Toxaphene/Chlordane) to 20g of sand, resulting in concentrations of 20 ug/kg for single-response analytes (200 ug/kg for Toxaphene or Chlordane). For project-specific low-level extractions, spiking amounts can be adjusted accordingly.

$$\%R = X/TV \times 100$$

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Where X = Concentration of the analyte recovered
TV = True value of amount spiked

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Current CAS QC acceptance criteria for lab control samples are listed in Attachment A. Project-specific or program-specific acceptance criteria may supersede CAS criteria. For example, for samples requiring South Carolina DHEC certification the acceptance criteria are 70-130 % recovery. If the lab control sample (LCS) fails acceptance limits for any of the compounds, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis. Refer to the *Quality Assurance Manual (QAM)* for guidance in evaluating recoveries that exceed LCS limits.

12.4.3. A matrix spike (MS) and duplicate matrix spike (DMS) must be extracted and analyzed with every batch of 20 samples. The MS/DMS is prepared by adding the same volume of the matrix spike solution to the sample as listed for the LCS, then proceeding with Section 11. Calculate percent recovery (%R) as:

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$$\%R = \frac{X - X1}{TV} \times 100$$

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Where X = Concentration of the analyte recovered
X1 = Concentration of unspiked analyte
TV = True value of amount spiked

Calculate Relative Percent Difference (RPD) as:

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$$RPD = \frac{|R1 - R2|}{(R1 + R2)/2} x\ 100$$

Where R1 = %recovery of the MS
R2 = %recovery of the DMS

Current CAS QC acceptance criteria for MS/DMS are listed in Attachment A. Project-specific acceptance criteria may supersede CAS criteria. If the MS/DMS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis.

12.4.4. Surrogate spike is added to every sample, blank and spike prior to extraction. Two surrogate standards (tetrachloro-m-xylene and decachlorobiphenyl) are added to each sample. For water, 100µL of the surrogate spike is added to 1L, resulting in 0.2ug/L. For soil, 200µL of the surrogate spike is added to 20g, resulting in 20ug/kg. Calculate surrogate percent recovery (%R) as:

$$\%R = S/V \times 100$$

Where S = The amount of surrogate recovered
V = The amount spiked/final volume

12.5. Current CAS QC acceptance criteria for surrogates are listed in Attachment A. Project-specific acceptance criteria may supersede CAS criteria. Both surrogate recoveries must be within the acceptance limits. If either (or both) surrogate is outside of acceptance limits for reasons other than matrix interferences, corrective action must be taken. Corrective actions include recalculation, reanalysis, or re-extraction and reanalysis. The acceptance criteria listed are current criteria, but are subject to change as control limits are updated.

12.6. Additional QA/QC measures include control charting of QC sample results and periodic analysis of certified reference materials.

13. DATA REDUCTION, REVIEW, AND REPORTING

13.1. Both detectors are used as primary and/or confirmatory systems when not interfered with by the sample matrix.

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13.2. Calculations

13.2.1. Quantitation of analytes in sample extracts is performed by comparing total area of residue peaks to total area or peaks from the appropriate reference materials.

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13.2.2. Quantitation of multi-response analytes:

13.2.2.1. The quantitation of Chlordane, Toxaphene, and other multi-response analytes is accomplished by comparison of the sample chromatogram to that of the authentic standard. All calibration acceptance criteria as described in section 11 must be met before reporting any results. Sample results should then be reported according to the organics confirmation SOP (*SOC-CONF*). Results may be reported from either of the columns as long as all calibration acceptance criteria are met.

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13.2.2.2. Once the analyte pattern has been identified, compare the responses of the major peaks in the calibration standard with the peaks observed in the sample extract. The amount of analyte is calculated using the individual calibration factor for each peak and the calibration model selected in section 11. The concentration is determined using the characteristic peaks and then the concentrations are averaged to determine the concentration. If there are interfering peaks that cause the average to be falsely overstated, then that interference peak is Q-deleted using the data system, provided 3 peaks remain for Chlordane and 4 peaks for Toxaphene. The average is then recalculated so that the average more truly represents the concentration in the sample.

The concentration of each analyte in the sample extract (Cex) is computed.. When $\overline{RF_x}$ is used, calculate the extract concentration as follows:

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$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})}$$

Where: C_{ex} = the concentration in the sample extract (ppm);
$Resp_x$ = the peak area of the analytes of interest;
$Resp_{ISTD}$ = the peak area of the associated internal standard;
Amt_{ISTD} = the amount, in ppm, of internal standard added
$\overline{RF_x}$ = the average response from the initial calibration.

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13.2.3. The concentration of analytes in the original sample is computed using the following equations:

Aqueous Samples: $$Concentration\ (\mu g / L) = \frac{(Cex)\ (Vf)\ (D)}{(Vs)}$$

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Where	Cex	=	Concentration in extract in µg/mL
	Vf	=	Final volume of extract in mL
	D	=	Dilution factor
	Vs	=	Volume of sample extracted, liters

Nonaqueous Samples: $$Concentration\ (mg / Kg) = \frac{(Cex)\ (Vf)\ (D)}{(W)}$$

Where	Cex	=	Concentration in extract in µg/mL
	Vf	=	Final volume of extract in mL
	D	=	Dilution factor
	W	=	Weight of sample extracted in grams.

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13.3. Data Review

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13.3.1. Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

13.4. Reporting

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13.4.1. Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be CAS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

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13.4.2. As an alternative, reports are generated using Excel© templates located in R:\SVG\forms. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The detected analytes surrogate and matrix spikes are then transferred, by hand or electronically, to the templates.

13.4.3. Sample concentrations are reported when all QC criteria for the analysis has been met or the results are qualified with an appropriate footnote. For Arizona projects the appropriate Arizona qualifier must be used.

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14. CORRECTIVE ACTION

14.1. Refer to the SOP for *Corrective Action* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.3. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.4. Documentation of a nonconformity must be done using a Nonconformity and Corrective Action Report (NCAR) when:

- Corrective action is not taken or not possible
- Corrective action fails to correct an out-of-control problem on a laboratory QC or calibration analysis.
- Reanalysis corrects the nonconformity but is not a procedurally compliant analysis.

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification* (ADM-MDL). Method Reporting Limits are established for this method based on MDL studies and as specified in the CAS *Quality Assurance Manual (QAM)*.

16. POLLUTION PREVENTION

It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

17. WASTE MANAGEMENT

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The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS EH&S Manual.

This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

18. TRAINING OUTLINE

18.1. The following items provide guidelines for training analysts. Refer to the SOP *Documentation of Training (ADM-TRANDOC)* for further requirements.

18.1.1. Review applicable references listed in section 19 and this SOP. Review the MSDS for all chemicals used in the analysis.

18.1.2. Observe the procedure as performed by an experienced analyst at least three times.

18.1.3. Assist in the procedure under the guidance of an experienced analyst for at least one month, preferably three months. During this training period, the analyst is expected to progress from a role of assisting to a role of performing the procedure with minimal oversight.

18.1.4. Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

18.2. Training is documented following the SOP for Documentation of Technical Personnel Training.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

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19. REFERENCES

19.1. EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, Update III, December 1996, Method 8081A, Revision 1.

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19.2. EPA SW-846, Determinative Chromatographic Separations, Update III, December 1996, Method 8000B, Revision 2.

19.3. EPA SW-846, Determinative Chromatographic Separations, On-Line, March 2003, Method 8000C, Revision 3.

19.4. *DoD Quality systems Manual for Environmental Laboratories* Version 4.2, 6/5/2003

19.5. 8000C Method criteria, Arizona DHS, 2/13/2007. Available online at http://www.azdhs.gov/lab/license/tech/8000cmethod.pdf

19.6. EPA SW-846, Method 8081B, *Organochlorine Pesticides by Gas Chromatography,* Revision 2, February, 2007.

20. CHANGES SINCE THE LAST REVISION

20.1. 7.1.3.4: Removed internal standard concentration at 5 µL and changed the amount added from 10.0 µL to 5 µL.
20.2. 8.1.1: Added GC34 to the list of current instruments.
20.3. 11.3.3: Changed the amount of internal standard from 10.0 µL to 5.0µL.
20.4. 11.3.3: Changed the amount of internal standard from 5 ppm to 10 ppm.
20.5. Section 19: Update references
20.6. Section4.2: Added CARCU to the paragraph.
20.7. Section 8.1: Added the option of using Hydrogen as a carrier gas.
20.8. 11.2.3: Updated section that replaces 1.0 µL with "an aliquot" of each calibration standard.

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TABLE 1 - CAS/KELSO DATA QUALITY OBJECTIVES

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8081	2,4'-DDD	53-19-0	Soil	1.4	5	2.8	5	ug/kg	53-115	12-147	40
8081	2,4'-DDE	3424-82-6	Soil	0.94	5	1.9	5	ug/kg	49-112	24-141	40
8081	2,4'-DDT	789-02-6	Soil	0.5	5	1.9	5	ug/kg	44-120	15-141	40
8081	4,4'-DDD	72-54-8	Soil	1	5	3.3	5	ug/kg	46-146	19-143	40
8081	4,4'-DDE	72-55-9	Soil	0.11	5	3.3	5	ug/kg	46-141	22-142	40
8081	4,4'-DDT	50-29-3	Soil	0.85	5	3.3	5	ug/kg	46-151	19-154	40
8081	Aldrin	309-00-2	Soil	0.34	5	1.2	5	ug/kg	37-134	22-135	40
8081	alpha-BHC	319-84-6	Soil	0.35	5	1.2	5	ug/kg	36-139	23-133	40
8081	alpha-Chlordane	5103-71-9	Soil	1.2	5	3.3	5	ug/kg	41-134	24-132	40
8081	beta-BHC	319-85-7	Soil	0.5	5	1.2	5	ug/kg	38-142	22-142	40
8081	Chlordane	57-74-9	Soil	22	100	44	100	ug/kg	42-136	30-136	40
8081	Chlorpyrifos	2921-88-2	Soil	0.66	5	1.4	5	ug/kg	23-137	23-137	40
8081	cis-Nonachlor	5103-73-1	Soil	0.57	5	1.4	5	ug/kg	51-119	18-139	40
8081	delta-BHC	319-86-8	Soil	0.37	5	1.2	5	ug/kg	48-145	25-148	40
8081	Dieldrin	60-57-1	Soil	0.48	5	1.2	5	ug/kg	46-136	26-133	40
8081	Endosulfan I	959-98-8	Soil	1.7	5	3.3	5	ug/kg	35-121	15-119	40
8081	Endosulfan II	33213-65-9	Soil	0.86	5	3.3	5	ug/kg	39-128	13-129	40
8081	Endosulfan Sulfate	1031-07-8	Soil	0.57	5	1.2	5	ug/kg	43-138	20-134	40
8081	Endrin	72-20-8	Soil	0.45	5	1.2	5	ug/kg	40-152	22-145	40
8081	Endrin Aldehyde	7421-93-4	Soil	1.4	5	3.3	5	ug/kg	32-132	10-129	40
8081	Endrin Ketone	53494-70-5	Soil	0.55	5	1.2	5	ug/kg	47-135	19-139	40
8081	gamma-BHC (Lindane)	58-89-9	Soil	0.45	5	1.2	5	ug/kg	40-142	26-135	40
8081	gamma-Chlordane	5566-34-7	Soil	0.6	5	1.2	5	ug/kg	41-135	24-133	40
8081	Heptachlor	76-44-8	Soil	0.83	5	3.3	5	ug/kg	39-135	21-136	40
8081	Heptachlor Epoxide	1024-57-3	Soil	0.39	5	1.2	5	ug/kg	45-118	25-129	40
8081	Hexachlorobenzene	118-74-1	Soil	0.47	5	1.2	5	ug/kg	21-100	11-118	40
8081	Hexachlorobutadiene	87-68-3	Soil	0.53	5	1.4	5	ug/kg	31-109	10-107	40
8081	Hexachloroethane	67-72-1	Soil	0.47	5	1.4	5	ug/kg	29-103	10-92	40
8081	Isodrin	465-73-6	Soil	0.3	5	1.2	5	ug/kg	32-126	32-126	40
8081	Methoxychlor	72-43-5	Soil	0.61	5	1.2	5	ug/kg	42-147	24-151	40
8081	Mirex	2385-85-5	Soil	0.68	5	1.4	5	ug/kg	38-123	10-131	40

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8081	Oxychlordane	27304-13-8	Soil	0.68	5	1.4	5	ug/kg	37-119	22-118	40
8081	Toxaphene	8001-35-2	Soil	37	250	74	250	ug/kg	44-137	20-155	40
8081	trans-Nonachlor	39765-80-5	Soil	0.53	5	1.4	5	ug/kg	39-123	24-120	40
8081	Decachlorobiphenyl (Surr.)	2051-24-3	Soil	NA	NA	NA	NA	%	22-130	NA	NA
8081	Tetrachloro-m-xylene (Surr.)	877-09-8	Soil	NA	NA	NA	NA	%	20-116	NA	NA
8081	2,4'-DDD	53-19-0	Water	0.00057	0.01	0.002	0.01	ug/L	51-112	51-112	30
8081	2,4'-DDE	3424-82-6	Water	0.00050	0.01	0.002	0.01	ug/L	29-126	29-126	30
8081	2,4'-DDT	789-02-6	Water	0.00059	0.01	0.002	0.01	ug/L	51-117	51-117	30
8081	4,4'-DDD	72-54-8	Water	0.0013	0.01	0.0045	0.01	ug/L	33-132	29-125	30
8081	4,4'-DDE	72-55-9	Water	0.00055	0.01	0.002	0.01	ug/L	41-116	24-129	30
8081	4,4'-DDT	50-29-3	Water	0.00039	0.01	0.001	0.01	ug/L	42-143	28-139	30
8081	Aldrin	309-00-2	Water	0.00063	0.01	0.002	0.01	ug/L	10-126	18-111	30
8081	alpha-BHC	319-84-6	Water	0.00061	0.01	0.002	0.01	ug/L	36-122	31-123	30
8081	alpha-Chlordane	5103-71-9	Water	0.00058	0.01	0.002	0.01	ug/L	45-115	34-120	30
8081	beta-BHC	319-85-7	Water	0.002	0.01	0.0045	0.01	ug/L	42-125	31-118	30
8081	Chlordane	57-74-9	Water	0.1	0.2	0.2	0.2	ug/L	45-148	45-148	30
8081	Chlorpyrifos	2921-88-2	Water	0.00083	0.01	0.002	0.01	ug/L	25-143	25-143	30
8081	cis-Nonachlor	5103-73-1	Water	0.00060	0.01	0.002	0.01	ug/L	42-125	42-125	30
8081	delta-BHC	319-86-8	Water	0.0017	0.01	0.0045	0.01	ug/L	48-123	40-129	30
8081	Dieldrin	60-57-1	Water	0.0022	0.01	0.0045	0.01	ug/L	50-115	32-121	30
8081	Endosulfan I	959-98-8	Water	0.00058	0.01	0.002	0.01	ug/L	35-115	17-118	30
8081	Endosulfan II	33213-65-9	Water	0.001	0.01	0.002	0.01	ug/L	40-127	19-122	30
8081	Endosulfan Sulfate	1031-07-8	Water	0.00068	0.01	0.002	0.01	ug/L	38-118	30-120	30
8081	Endrin	72-20-8	Water	0.00069	0.01	0.002	0.01	ug/L	48-126	34-133	30
8081	Endrin Aldehyde	7421-93-4	Water	0.0019	0.01	0.0045	0.01	ug/L	27-104	10-108	30
8081	Endrin Ketone	53494-70-5	Water	0.00082	0.01	0.002	0.01	ug/L	40-126	34-113	30
8081	gamma-BHC (Lindane)	58-89-9	Water	0.00084	0.01	0.002	0.01	ug/L	44-117	31-123	30
8081	gamma-Chlordane	5566-34-7	Water	0.002	0.01	0.0045	0.01	ug/L	47-113	35-119	30
8081	Heptachlor	76-44-8	Water	0.00036	0.01	0.001	0.01	ug/L	40-115	23-124	30
8081	Heptachlor Epoxide	1024-57-3	Water	0.00068	0.01	0.002	0.01	ug/L	49-109	28-122	30
8081	Hexachlorobenzene	118-74-1	Water	0.00053	0.01	0.002	0.01	ug/L	31-95	10-131	30
8081	Hexachlorobutadiene	87-68-3	Water	0.0019	0.01	0.0125	0.03	ug/L	10-95	10-95	30
8081	Hexachlorocyclopentadiene	77-47-4	Water	0.0011	0.01		0.01	ug/L	70-130	70-130	30
8081	Hexachloroethane	67-72-1	Water	0.0012	0.01	0.0125	0.03	ug/L	10-94	10-94	30
8081	Isodrin	465-73-6	Water	0.0007	0.01	0.002	0.01	ug/L	10-112	10-112	30

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8081	Methoxychlor	72-43-5	Water	0.001	0.01	0.002	0.01	ug/L	43-143	30-137	30
8081	Mirex	2385-85-5	Water	0.00081	0.01	0.002	0.01	ug/L	43-126	43-126	30
8081	Oxychlordane	27304-13-8	Water	0.0010	0.01	0.002	0.01	ug/L	40-126	40-16	30
8081	Toxaphene	8001-35-2	Water	0.2	0.5	0.4	0.5	ug/L	36-137	28-135	30
8081	trans-Nonachlor	39765-80-5	Water	0.00092	0.01	0.002	0.01	ug/L	47-123	47-123	30
8081	Decachlorobiphenyl (Surr.)	2051-24-3	Water	NA	NA	NA	NA	%	35-128	NA	NA
8081	Tetrachloro-m-xylene (Surr.)	877-09-8	Water	NA	NA	NA	NA	%	20-102	NA	NA
8081	2,4'-DDD	53-19-0	Tissue	0.38	1.0			ug/Kg	43-117	43-117	40
8081	2,4'-DDE	3424-82-6	Tissue	0.21	1.0			ug/Kg	44-115	44-115	40
8081	2,4'-DDT	789-02-6	Tissue	0.12	1.0			ug/Kg	42-118	42-118	40
8081	4,4'-DDD	72-54-8	Tissue	0.41	1.0			ug/Kg	33-138	35-126	40
8081	4,4'-DDE	72-55-9	Tissue	1.0	1.0			ug/Kg	36-139	33-134	40
8081	4,4'-DDT	50-29-3	Tissue	1.0	1.0			ug/Kg	49-136	26-133	40
8081	Aldrin	309-00-2	Tissue	0.19	1.0			ug/Kg	46-116	38-116	40
8081	alpha-BHC	319-84-6	Tissue	0.12	1.0			ug/Kg	42-124	31-118	40
8081	alpha-Chlordane	5103-71-9	Tissue	0.24	1.0			ug/Kg	40-121	39-113	40
8081	beta-BHC	319-85-7	Tissue	0.53	1.0			ug/Kg	39-122	22-123	40
8081	Chlordane	57-74-9	Tissue	3.1	10			ug/Kg	44-114	44-114	40
8081	Chlorpyrifos	2921-88-2	Tissue	0.26	1.0			ug/Kg	10-123	10-123	40
8081	cis-Nonachlor	5103-73-1	Tissue	0.22	1.0			ug/Kg	16-134	16-134	40
8081	delta-BHC	319-86-8	Tissue	0.18	1.0			ug/Kg	44-141	38-133	40
8081	Dieldrin	60-57-1	Tissue	0.23	1.0			ug/Kg	40-120	33-120	40
8081	Endosulfan I	959-98-8	Tissue	0.28	1.0			ug/Kg	23-116	22-113	40
8081	Endosulfan II	33213-65-9	Tissue	0.30	1.0			ug/Kg	35-111	28-120	40
8081	Endosulfan Sulfate	1031-07-8	Tissue	0.25	1.0			ug/Kg	36-127	23-128	40
8081	Endrin	72-20-8	Tissue	0.21	1.0			ug/Kg	44-130	43-124	40
8081	Endrin Aldehyde	7421-93-4	Tissue	0.40	1.0			ug/Kg	11-110	10-118	40
8081	Endrin Ketone	53494-70-5	Tissue	0.34	1.0			ug/Kg	29-133	27-128	40
8081	gamma-BHC (Lindane)	58-89-9	Tissue	0.21	1.0			ug/Kg	44-123	34-123	40
8081	gamma-Chlordane	5103-74-2	Tissue	0.20	1.0			ug/Kg	38-121	34-123	40
8081	Heptachlor	76-44-8	Tissue	0.13	1.0			ug/Kg	39-126	37-122	40
8081	Heptachlor Epoxide	1024-57-3	Tissue	0.28	1.0			ug/Kg	43-119	39-113	40
8081	Hexachlorobenzene	118-74-1	Tissue	0.15	1.0			ug/Kg	10-113	35-111	40
8081	Hexachlorobutadiene	87-68-3	Tissue	0.34	1.0			ug/Kg	10-130	10-130	40
8081	Hexachloroethane	67-72-1	Tissue	0.17	1.0			ug/Kg	10-113	10-113	40

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8081	Isodrin	465-73-6	Tissue	0.18	1.0	ug/Kg	13-133	13-133	40
8081	Methoxychlor	72-43-5	Tissue	0.61	1.0	ug/Kg	37-144	27-148	40
8081	Mirex	2385-85-5	Tissue	0.24	1.0	ug/Kg	15-127	15-127	40
8081	Oxychlordane	27304-13-8	Tissue	0.29	1.0	ug/Kg	15-128	15-128	40
8081	Toxaphene	8001-35-2	Tissue	9.3	50	ug/Kg	21-152	21-152	40
8081	trans-Nonachlor	39765-80-5	Tissue	0.24	1.0	ug/Kg	12-139	12-139	40
8081	Decachlorobiphenyl (Surr.)	2051-24-3	Tissue	NA	NA	%	22-121	-	-
8081	Tetrachloro-m-xylene (Surr.)	877-09-8	Tissue	NA	NA	%	29-117	-	-

CAS

a Method Detection Limits are subject to change as new MDL studies are completed.

a MDL is the smallest analyte concentration that can be demonstrated to be different from zero with 99% confidence

b The LOD is the smallest amount of a substance that must be present in a sample in order to be detected with 99% conficence.

Verification is acceptable if the response is > 3x instrument noise & 2nd column confirmed or pattern.

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TABLE 2 - CAS/KELSO DATA QUALITY OBJECTIVES

METHOD	ANALYTE	CAS No.	MATRIX	MDLa	MRL	LODb	LOQc	UNITS	Accuracy (LCS %Rec.)	Matrix Spike (%Rec.)	Precision (% RPD)
8081 LL	2,4'-DDD	53-19-0	Soil	0.13	1.0	0.325	1.0	ug/kg	53-115	12-147	40
8081 LL	2,4'-DDE	3424-82-6	Soil	0.16	1.0	0.325	1.0	ug/kg	49-112	24-141	40
8081 LL	2,4'-DDT	789-02-6	Soil	0.058	1.0	0.125	1.0	ug/kg	44-120	15-141	40
8081 LL	4,4'-DDD	72-54-8	Soil	0.11	1.0	0.25	1.0	ug/kg	46-146	19-143	40
8081 LL	4,4'-DDE	72-55-9	Soil	0.11	1.0	0.25	1.0	ug/kg	46-141	22-142	40
8081 LL	4,4'-DDT	50-29-3	Soil	0.17	1.0	0.4	1.0	ug/kg	46-151	19-154	40
8081 LL	Aldrin	309-00-2	Soil	0.16	1.0	0.4	1.0	ug/kg	37-134	22-135	40
8081 LL	alpha-BHC	319-84-6	Soil	0.11	1.0	0.25	1.0	ug/kg	36-139	23-133	40
8081 LL	alpha-Chlordane	5103-71-9	Soil	0.1	1.0	0.25	1.0	ug/kg	41-134	24-132	40
8081 LL	beta-BHC	319-85-7	Soil	0.18	1.0	0.4	1.0	ug/kg	38-142	22-142	40
8081 LL	Chlordane	57-74-9	Soil	1.9	10	4.9	10	ug/kg	42-136	30-136	40
8081 LL	Chlorpyrifos	2921-88-2	Soil	0.15	1.0	0.3	1.0	ug/kg	23-137	23-137	40
8081 LL	cis-Nonachlor	5103-73-1	Soil	0.12	1.0	0.3	1.0	ug/kg	51-119	18-139	40
8081 LL	delta-BHC	319-86-8	Soil	0.074	1.0	0.25	1.0	ug/kg	48-145	25-148	40
8081 LL	Dieldrin	60-57-1	Soil	0.14	1.0	0.4	1.0	ug/kg	46-136	26-133	40
8081 LL	Endosulfan I	959-98-8	Soil	0.063	1.0	0.25	1.0	ug/kg	35-121	15-119	40
8081 LL	Endosulfan II	33213-65-9	Soil	0.14	1.0	0.4	1.0	ug/kg	39-128	13-129	40
8081 LL	Endosulfan Sulfate	1031-07-8	Soil	0.11	1.0	0.25	1.0	ug/kg	43-138	20-134	40
8081 LL	Endrin	72-20-8	Soil	0.094	1.0	0.25	1.0	ug/kg	40-152	22-145	40
8081 LL	Endrin Aldehyde	7421-93-4	Soil	0.12	1.0	0.25	1.0	ug/kg	32-132	10-129	40
8081 LL	Endrin Ketone	53494-70-5	Soil	0.093	1.0	0.25	1.0	ug/kg	47-135	19-139	40
8081 LL	gamma-BHC (Lindane)	58-89-9	Soil	0.08	1.0	0.25	1.0	ug/kg	40-142	26-135	40
8081 LL	gamma-Chlordane	5566-34-7	Soil	0.09	1.0	0.25	1.0	ug/kg	41-135	24-133	40
8081 LL	Heptachlor	76-44-8	Soil	0.12	1.0	0.25	1.0	ug/kg	39-135	21-136	40
8081 LL	Heptachlor Epoxide	1024-57-3	Soil	0.084	1.0	0.25	1.0	ug/kg	45-118	25-129	40
8081 LL	Hexachlorobenzene	118-74-1	Soil	0.2	1.0	0.4	1.0	ug/kg	21-100	11-118	40
8081 LL	Hexachlorobutadiene	87-68-3	Soil	0.21	1.0	0.675	1.0	ug/kg	31-109	10-107	40
8081 LL	Hexachlorocyclopentadiene	77-47-4	Soil	1	1.0	-	-	ug/kg	70-130	70-130	40
8081 LL	Hexachloroethane	67-72-1	Soil	0.33	1.0	0.675	1.0	ug/kg	29-103	10-92	40
8081 LL	Isodrin	465-73-6	Soil	0.17	1.0	0.4	1.0	ug/kg	32-126	32-126	40
8081 LL	Methoxychlor	72-43-5	Soil	0.19	1.0	0.4	1.0	ug/kg	42-147	24-151	40

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8081 LL	Mirex	2385-85-5	Soil	0.099	1.0	0.3	1.0	ug/kg	38-123	10-131	40
8081 LL	Oxychlordane	27304-13-8	Soil	0.085	1.0	0.3	1.0	ug/kg	37-119	22-118	40
8081 LL	Toxaphene	8001-35-2	Soil	4.8	50	9.75	50	ug/kg	44-137	20-155	40
8081 LL	trans-Nonachlor	39765-80-5	Soil	0.087	1.0	0.3	1.0	ug/kg	39-123	24-120	40
8081 LL	Decachlorobiphenyl (Surr.)	2051-24-3	Soil	NA	NA	NA	NA	%	22-130	NA	NA
8081 LL	Tetrachloro-m-xylene (Surr.)	877-09-8	Soil	NA	NA	NA	NA	%	20-116	NA	NA
8081 LL	2,4'-DDD	53-19-0	Water	0.07	0.5	0.25	0.5	ng/L	51-112	51-112	30
8081 LL	2,4'-DDE	3424-82-6	Water	0.25	0.5	0.25	0.5	ng/L	29-126	29-126	30
8081 LL	2,4'-DDT	789-02-6	Water	0.13	0.5	0.25	0.5	ng/L	51-117	51-117	30
8081 LL	4,4'-DDD	72-54-8	Water	0.21	0.5	0.5	0.5	ng/L	33-132	29-125	30
8081 LL	4,4'-DDE	72-55-9	Water	0.19	0.5	0.5	0.5	ng/L	41-116	24-129	30
8081 LL	4,4'-DDT	50-29-3	Water	0.17	0.5	0.5	0.5	ng/L	42-143	28-139	30
8081 LL	Aldrin	309-00-2	Water	0.33	0.5	0.5	0.5	ng/L	10-126	18-111	30
8081 LL	alpha-BHC	319-84-6	Water	0.21	0.5	0.5	0.5	ng/L	36-122	31-123	30
8081 LL	alpha-Chlordane	5103-71-9	Water	0.27	0.5	0.5	0.5	ng/L	45-115	34-120	30
8081 LL	beta-BHC	319-85-7	Water	0.41	0.5	0.5	0.5	ng/L	42-125	31-118	30
8081 LL	Chlordane	57-74-9	Water	3	10	5	10	ng/L	45-148	45-148	30
8081 LL	Chlorpyrifos	2921-88-2	Water	0.23	1	0.4	1	ng/L	25-143	25-143	30
8081 LL	cis-Nonachlor	5103-73-1	Water	0.14	0.5	0.4	0.5	ng/L	42-125	42-125	30
8081 LL	delta-BHC	319-86-8	Water	0.14	0.5	0.4	0.5	ng/L	48-123	40-129	30
8081 LL	Dieldrin	60-57-1	Water	0.37	0.5	0.5	0.5	ng/L	50-115	32-121	30
8081 LL	Endosulfan I	959-98-8	Water	0.25	0.5	0.5	0.5	ng/L	35-115	17-118	30
8081 LL	Endosulfan II	33213-65-9	Water	0.35	0.5	0.5	0.5	ng/L	40-127	19-122	30
8081 LL	Endosulfan Sulfate	1031-07-8	Water	0.28	0.5	0.5	0.5	ng/L	38-118	30-120	30
8081 LL	Endrin	72-20-8	Water	0.49	0.5	0.5	0.5	ng/L	48-126	34-133	30
8081 LL	Endrin Aldehyde	7421-93-4	Water	0.21	0.5	0.4	0.5	ng/L	27-104	10-108	30
8081 LL	Endrin Ketone	53494-70-5	Water	0.32	0.5	0.5	0.5	ng/L	40-126	34-113	30
8081 LL	gamma-BHC (Lindane)	58-89-9	Water	0.47	0.5	0.5	0.5	ng/L	44-117	31-123	30
8081 LL	gamma-Chlordane	5566-34-7	Water	0.31	0.5	0.5	0.5	ng/L	47-113	35-119	30
8081 LL	Heptachlor	76-44-8	Water	0.18	0.5	0.4	0.5	ng/L	40-115	23-124	30
8081 LL	Heptachlor Epoxide	1024-57-3	Water	0.21	0.5	0.4	0.5	ng/L	49-109	28-122	30
8081 LL	Hexachlorobenzene	118-74-1	Water	0.27	0.5	0.5	0.5	ng/L	31-95	10-131	30
8081 LL	Hexachlorobutadiene	87-68-3	Water	0.095	0.5	0.25	0.5	ng/L	10-95	10-95	30
8081 LL	Hexachloroethane	67-72-1	Water	0.08	0.5	0.25	0.75	ng/L	10-94	10-94	30
8081 LL	Isodrin	465-73-6	Water	0.15	0.5	0.4	0.5	ng/L	10-112	10-112	30

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8081 LL	Methoxychlor	72-43-5	Water	0.44	0.5	1	1	ng/L	43-143	30-137	30
8081 LL	Mirex	2385-85-5	Water	0.19	0.5	0.4	1.2	ng/L	43-126	43-126	30
8081 LL	Oxychlordane	27304-13-8	Water	0.069	0.5	0.25	0.5	ng/L	40-126	40-16	30
8081 LL	Toxaphene	8001-35-2	Water	17	25	18	25	ng/L	36-137	28-135	30
8081 LL	trans-Nonachlor	39765-80-5	Water	0.11	0.5	0.4	0.5	ng/L	47-123	47-123	30
8081 LL	Decachlorobiphenyl (Surr.)	2051-24-3	Water	NA	NA	NA	NA	%	35-128	NA	NA
8081 LL	Tetrachloro-m-xylene (Surr.)	877-09-8	Water	NA	NA	NA	NA	%	20-102	NA	NA

CAS

a Method Detection Limits are subject to change as new MDL studies are completed.

a MDL is the smallest analyte concentration that can be demonstrated to be different from zero with 99% confidence

b The LOD is the smallest amount of a substance that must be present in a sample in order to be detected with 99% conficence.

Verification is acceptable if the response is > 3x instrument noise & 2nd column confirmed or pattern.

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TABLE 3

Gas Chromatograph Operating Conditions*

Gas Chromatograph:	Agilent 6890
Injection Port Temperature:	40°C, 40-250°C at 250°C/min., hold for 15 min., 250-325°C at 250°C/min., hold for 5 min.
Oven Temperature Program:	50°C hold for 0.5min., 50-150°C at 40°C/min.; Ramp 13°C/min. to 320°C, hold for 3.92 min.
Detector Temperature:	325°C
Injection Volume:	1 µL (5 µL for ultra low level analysis)
Column 1:	30-m, 0.32mm id, DB-XLB, 0.50µm film thickness or equivalent
Column 2:	30-m, 0.32mm id, DB-35MS, 0.25µm film thickness or equivalent.
Carrier Gas:	Helium
Auxillary Gas:	Argon/Methane
Data System:	HP Enviroquant

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*The above instrument temperatures may be modified when determining additional single response or multi-response pesticides.

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TABLE 4

CALIBRATION STANDARD PREPARATION

Initial Calibration Standards*

8081 Intermediate Std.	Initial Concentration	Final Volume	Solvent	Final Concentration	
10 uL	10 ug/mL	50 mL	Hexane	2 ug/L	
25 uL	↓	50 mL	↓	5 ug/L	
100 uL		50 mL		20 ug/L	
250 uL		50 mL		50 ug/L	CCV Standard
500 uL		50 mL		100 ug/L	
1.0 mL		50 mL		200 ug/L	

Chlordane Intermediate Std.	Initial Concentration	Final Volume	Solvent	Final Concentration	
5 uL	250 mg/L	50 mL	Hexane	25 ug/L	
10 uL	↓	↓	↓	50 ug/L	
20 uL				100 ug/L	
100 uL				500 ug/L	CCV Standard
200 uL				1000 ug/L	
400 uL				2000 ug/L	

Toxaphene Intermediate Std.	Initial Concentration	Final Volume	Solvent	Final Concentration	
50 uL	100 mg/L	50 mL	Hexane	100 ug/L	
125 uL	↓	50 mL	↓	250 ug/L	
250 uL		50 mL		500 ug/L	
500 uL		50 mL		1000 ug/L	CCV Standard
500 uL		25 mL		2000 ug/L	
1250 uL		25 mL		5000 ug/L	

* As needed for projects requiring non-routine additional compounds, similar dilutions are prepared to obtain calibration standards for these compounds.

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ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY (GC)

1 SCOPE AND APPLICATION

1.1 This method is used for the determination of organochlorine pesticides and related compounds in aqueous and solid matrices. The following compounds can be determined by this method:

Compound	CAS Registry No.
Aldrin	309-00-2
α-BHC	319-84-6
β-BHC	319-85-7
γ-BHC (Lindane)	58-89-9
δ-BHC	319-86-8
α-Chlordane	5103-71-9
γ-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
Methoxychlor	72-43-5
2,4’-DDE	3424-82-6
2,4’-DDD	53-19-0
2,4’-DDT	789-02-6
Hexachlorobenzene (HCB)	118-74-1
Pentachloronitrobenzene (PCNB)	82-68-8
Mirex	2385-85-5
trans-Nonachlor	39765-80-5
cis-Nonachlor	5103-73-1
Technical Chlordane (not otherwise specified)	57-74-9
Toxaphene	8001-35-2

1.2 Instrumentation: HP 5890 Gas Chromatograph (GC) equipped with an electron capture detector (ECD) and a LEAP Technologies CTC A200S autosampler and Agilent Chemstation Data Acquisition software

1.3 Compounds are all part of a class of compounds known as organochlorine pesticides. Historically included with this class is a class of compounds known as multi-responders (i.e. toxaphene, technical chlordane, and PCBs). PCB's can be analyzed from the same extract as the organochlorine pesticides and this method may be used to screen for PCB's and to report a semi-quantitative value. PCBs are analyzed by Method 8082.

1.4 When the method is used to analyze unknown samples, compound identification is achieved by retention times and supported by at least one additional qualitative technique. This method describes second column confirmation where two aliquots of each sample extract are injected on two GCs operating different capillary columns that result in different retention orders for target analytes. .

1.5 This method is restricted to use by, or under the supervision of, analysts experienced in the use of a gas chromatograph and skilled in the interpretation of chromatograms. Each analyst must demonstrate the ability to generate acceptable results with this method.

2 SUMMARY OF METHOD

2.1 The method provides for the extraction and GC conditions for the analysis of organochlorine pesticides in aqueous and solid matrices.

2.2 Soil samples are dried with sodium sulfate and extracted with a mixture of Iso-octane/Acetone. Water samples are extracted with dichloromethane, solvent evaporated, and made to volume with iso-octane/acetone.

2.3 The extract is transferred to injection vials and analyzed by GC-ECD.

2.4 The sensitivity and identification issues associated with this method depend on the level of matrix interferences in addition to instrumental limitations. If interferences are present, the resulting report limit may have to be elevated. Table 1 lists MDLs that can be obtained in sand and water in the absence of interferences.

2.5 Standard curves are generated for each analyte from a minimum five point standard curve using power regression as the regression analysis equation. Quantitation for each target analyte is done using reverse extrapolation.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Sources of interference in this method can be grouped into three broad categories: contaminated solvents, reagents, or sample processing hardware; contaminated GC carrier gas, parts, column surfaces, or detector surfaces; and the presence of non

target co-eluting interference compounds in the sample. Interferences co-extracted from the samples will vary considerably from sample to sample. While general cleanup techniques are referenced or provided as part of this method, unique samples may require additional cleanup approaches to achieve desired degrees of discrimination and quantitation.

4.2 Interferences by phthalates introduced during sample preparation can pose a major problem in organochlorine pesticide determinations. Common flexible plastics contain varying amounts of phthalates, which are easily extracted or leached from such materials during laboratory operations. Cross-contamination of clean glassware routinely occurs when plastics are handled during extraction steps, especially when solvent-wetted surfaces are handled. Avoiding contact with any plastic materials and checking all solvents and reagents for phthalate contamination can best minimize interferences from phthalate esters. Exhaustive cleanup of solvents, reagents and glassware may be required to eliminate background phthalate ester contamination.

4.3 Glassware must be scrupulously cleaned. Clean all glassware as soon as possible after use by detergent washing with hot water, three rinses with hot tap water, and three rinses with organic-free reagent water. Glassware/apparatus is then rinsed with dichloromethane or appropriate solvent just prior to use.

4.4 The presence of elemental sulfur will result in a broad peak that interferes with the detection of heptachlor epoxide through the DDT organochlorine pesticides on the RTX-35 and BHCs on the RTX-1701. Sulfur contamination should be expected with sediment samples. Liquid mercury cleanup is suggested for removal of sulfur. Since the recovery of Endrin aldehyde is drastically reduced, if possible this compound must be determined prior to sulfur cleanup, assuming it is a target analyte.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves must be worn while samples, standards, solvents, and reagents are being handled during this procedure. Lab coats are recommended.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 Gas Chromatograph (GC)

6.1.1 Gas Chromatograph: HP5890
Autosampler: LEAP Technologies A200S
Detector: HP Electron Capture
Injector: Split/splitless Injector
Data system: Agilent Chemstation

6.1.2 Dual column analysis: Columns are placed in two separate GCs set up for separation of as many of the analytes as possible.

6.1.2.1 Column 1: RTX-35, 30 m x 0.53 mm ID, 0.5 µm film thickness or equivalent

6.1.2.2 Column 2: RTX-1701, 30 m x 0.53 mm ID, 0.25 µm film thickness or equivalent

6.1.3 Injection hardware: Restek SILTEK 4 mm gooseneck liner and SILTEK cross seal

6.2 Balances:

6.2.1 Top loader capable of weighing to 0.01 g

6.2.2 Analytical capable of weighing to 0.0001 g

6.3 Vials:

6.3.1 2 mL amber gas chromatograph injection vials with Teflon® lined crimp seals

6.4 Syringes: Gas-tight, various sizes

6.5 Disposable glass transfer pipettes and 2 mL rubber bulbs

6.6 Compressed Gas

6.6.1 Helium, Grade 5

6.6.2 Nitrogen, Grade 5

6.6.3 Hydrogen, Grade 5

6.7 Refrigerator capable of maintaining 4 °C

6.8 Freezer capable of maintaining temperatures below -15 °C

6.9 Repeater digital – Eppendorf with appropriate size Combitips

7 REAGENTS

7.1 Solvents

7.1.1 Acetone, CH_3COCH_3 – pesticide quality or equivalent

7.1.2 Iso-octane (2,2,4-trimethyl pentane), $CH_3C(CH_3)_2CH_2CH(CH_3)CH_3$

7.1.3 80% Iso-octane/20% acetone: Combine 3200 mL of iso-octane with 800 mL of acetone in a 4 L solvent bottle. Label appropriately and assign a 6 month expiration date.

7.2 Solid Reagents – not applicable

7.3 Acids and Bases – not applicable

7.4 Stock Standards

7.4.1 Primary stock standards for pesticides mixtures are purchased from Absolute Standards as certified solutions at the following concentrations: 80, 160 and 800 µg/mL. See Table 4 for specific concentrations.

7.4.2 Mix 2 (10/20 µg/mL) standard purchased from Absolute Standards at certified concentrations (see Table 4 for concentrations of individual components).

7.4.3 Toxaphene (1000 µg/mL) is purchased from Absolute Standards or Restek at a certified concentration.

7.4.4 Technical Chlordane (1000 µg/mL) is purchased from Absolute Standards or Restek at a certified concentration.

7.5 Intermediate Standards

7.5.1 A secondary combined stock standard for the individual compounds (Mix A and Mix B separate mixtures) is prepared by diluting 1.25 mL (Use a 1 mL and 250 µL Gastight syringe) of each primary standard mix (Mix A and B) combined into a 100 mL volumetric flask and made to volume with 80% iso-octane/20% acetone. (See Table 5 for concentrations.) Transfer to 40 mL VOA vials that expire one year from preparation date.

7.6 Calibration Standards

7.6.1 Calibration standards are prepared at a minimum of five concentrations by dilution of the secondary stock standard (See Section 7.5.1) in 80% iso-octane/20% acetone. A calibration range was chosen to obtain satisfactory limits and a reasonable dynamic range. (See Table 6 Mix 1 for dilution and standard curve range.) Calibration standards expire one year from preparation date.

NOTE: See Figures 1 and 2 for typical chromatograms.

NOTE: Standards, once prepared and brought to volume, are transferred to 40 mL VOA vials and stored in a refrigerator when not in use.

7.6.2 Mix 2 Calibration Standards (See Table 6-2)

NOTE: See Figures 3 and 4 for typical chromatograms.

7.6.2.1 Level 7 (0.10/0.20 µg/mL). Using a 1 mL gas tight syringe, aliquot 1 mL of stock (See Section 7.4.2) and using a second volumetric pipette, aliquot 2 mL of surrogate at 6.0 µg/mL (See Section 7.7.1) into a 100 mL volumetric flask.

7.6.2.2 Refer to Table 6-2 for preparation of the remaining calibration standards.

7.6.2.3 Make all ICAL standards to 100 mL with 80% iso-octane / 20% acetone.

7.6.2.4 Transfer all standards to LIMS labeled 40 mL VOA vials, store refrigerated, and assign a one year expiration date.

7.6.3 Toxaphene ICAL

NOTE: See Figures 5 and 6 for typical chromatograms

7.6.3.1 Level 7 (8.0 µg/mL). Using a 1 mL gas tight syringe aliquot 800 mL of toxaphene (See Section 7.4.3) and using a 4 mL volumetric pipette, aliquot 4 mL of surrogate mix (6.0 µg/mL, See Section 7.7.1) into a 100 mL volumetric flask.

7.6.3.2 Refer to Table 6-3 for preparation of the remaining toxaphene standards

7.6.3.3 Make to volume with 80% iso-octane / 20% acetone, transfer to 40 mL VOA vials, and place a LIMS label on each vial.

7.6.3.4 Store refrigerated and assign an expiration date of 1 year from preparation date.

7.6.4 Technical Chlordane ICAL

NOTE: See Figures 7 and 8 for typical chromatograms.

7.6.4.1 Level 6 (1.0 µg/mL). Using a 100 µL syringe, aliquot 100 µL of 1000 µg/mL technical chlordane (See Section 7.4.4) and using a 250 µL syringe, aliquot 125 µL of 200 µg/mL surrogate TCMX/DCBP (See Section 7.7.1) into a 100 mL volumetric flask.

7.6.4.2 Refer to Table 6-3 for preparation of the remaining technical chlordane standards.

7.6.4.3 Make to volume with 80% iso-octane/20% acetone, transfer to 40 mL VOA vials, and place LIMS label on each vial.

7.6.4.4 Store refrigerated and assign an expiration date of one year from preparation date.

7.7 Surrogate Spiking Solution - DCBP and TCMX at 6.0 µg/mL

7.7.1.1 Surrogate mix containing DCBP and TCMX at 6.0 µg/mL is purchased in sealed 20 mL ampules from Absolute Standards, Part # 95677.

7.7.2 Different concentrations and spiking volumes are acceptable depending on project specific goals and different final volumes.

7.8 LCS Spiking Solution

7.8.1 Mix 1 Spiking Solution

7.8.1.1 The Mix 1 spiking solution is purchase from Absolute Standards in sealed 20 mL ampoules, Part # 95615. See Table 7 for analyte list and concentration.

7.8.2 Mix 2 Spiking Solution

7.8.2.1 Use Stock Standard Mix 2 (See Section 7.4.2).

7.8.2.2 Spiking is usually with 20 µL of the stock.

7.8.2.3 Alternative spiking Mix 2

7.8.3 Toxaphene Spiking Solution, (100 µg/mL): LCS/MS/MSD spiking standards are prepared by dilution of 1.0 mL of the purchased stock (See Section 7.4.3) into a 10 mL volumetric flask and made to volume with acetone. A 0.08 mL aliquot is usually added for LCSs or MS/MSDs. Transfer to a 3 dram amber vial or other appropriate container, store frozen, and assign an expiration date of one year from preparation date.

7.8.4 Technical chlordane (10.0 µg/mL): LCS/MS/MSD spiking standards are prepared by dilution of 1.0 mL of the purchased stock (See Section 7.4.4) into a 100 mL volumetric flask and made to volume with acetone. A 100 µL aliquot is usually added for LCSs or MS/MSDs. Transfer to 40 mL VOA vials, store frozen, and assign an expiration date of one year from preparation date.

7.9 MS/MSD Spiking Solution – Same solution as Section 7.8.1 through 7.8.4

7.10 Second Source Second source standards purchase from a different vendor than the ICAL are prepared for each of the four potential analyte groups Mix 1, Mix 2, toxaphene, and technical chlordane at the same concentration as the continuing calibration verification (CCV).

7.11 Internal Standard – Not applicable to this method

7.12 Breakdown Standards – 4, 4'-DDT and endrin

NOTE: See Figures 9 through 12 for typical chromatograms.

7.12.1 Purchase stocks in 1 mL ampules from Restek or Absolute Standards at 1000 µg/mL.

7.12.2 Intermediate stock – 20 µg/mL each DDT and endrin into separate volumetric flasks.

7.12.2.1 Aliquot 1 mL of endrin or DDT into separate 50 mL volumetric flasks and make to volume with 80% iso-octane/20% acetone. Transfer to 40 mL VOA vials, affix LIMS labels, store frozen, and assign a five year expiration date.

7.12.3 Breakdown injection standards – endrin/DDT at 0.2 µg/mL plus surrogate at 0.06 µg/mL

7.12.3.1 Aliquot 2.0 mL of endrin and DDT (20 µg/mL) into separate 200 mL volumetric flasks.

7.12.3.2 Aliquot 2 mL of TCMX and DCBP (6.0 µg/mL, See Section 7.7.1) into each volumetric flask.

7.12.3.3 Make each standard to volume with 80% iso-octane/20% acetone, transfer to 40 mL VOA vials, assign an expiration date of two years, affix LIMS labels, and store refrigerated. With the ICAL, an aliquot of each is transferred to injection vials and injected to check each GC system for degradation determinations.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Water samples should be collected in 1 L amber glass bottles with Teflon® lined caps and stored on ice or refrigerated at 4 °C immediately after collection. In the laboratory, store samples at 4 °C and out of direct sunlight at all times. Water samples must be extracted within 7 days of collection.

8.2 Soil samples should be collected in 4 ounce or larger amber glass jars with Teflon® lined caps. Samples are stored on ice or refrigerated at 4 °C immediately after collection. In the laboratory, store samples at 4 °C and out of direct sunlight at all times. Soil samples must be extracted within 14 days of collection.

8.3 Extracts are stored in the freezer and must be analyzed within 40 days of extraction.

8.4 All samples should be stored on ice or refrigerated at 4 °C immediately after collection. In the laboratory, store samples at 4 °C and out of direct sunlight at all times.

9 PROCEDURE

9.1 Preparation of Samples – Choose the appropriate preparation method below.

9.1.1 Water samples

9.1.1.1 PRE-001, Separatory Funnel Extraction

9.1.1.2 PRE-002, Self-Contained Water Extraction

9.1.2 Soil/sediment samples

9.1.2.1 PRE-003, Micro-Scale Soil Extraction

9.1.3 Wipe Samples

9.1.3.1 PRE-007, Wipe Sample Extraction

9.1.4 Waste

9.1.4.1 PRE-006, Waste Dilution

9.2 Clean-up of Samples – Choose the appropriate clean-up method below.

9.2.1 PRE-004, Sufuric Acid Clean-up

9.2.2 PRE-005, Mercury Clean-up

9.3 Instrument Conditions

9.3.1 Gas Chromatograph #1 RTX 35 Column (See Section 4.1.2.1)

Temperature Program	
Initial Temp:	140 °C
Initial Hold:	1.0 min
Initial Rate:	8 °C/min
Final Temp (1):	340 °C
Hold Time (1):	2.0 min
Injector Temp:	250 °C
Detector Temp:	300 °C
Carrier Gas:	Hydrogen or helium
Head Pressure:	~7 PSI
Make up Gas:	Nitrogen
Flow Rate:	~30 mL/min
Split Vent:	~28 mL/min
Septum Purge:	< 1.0 mL/min

Equilibration Time:	1.50 min
Oven Max:	350 °C
Split-less Valve:	Split-less box not checked
On time:	0.5 min
Off time:	3.00 min

NOTE: All the above parameters are set to obtain separation of all the compounds in the current mixed standard (except α-chlordane and endosulfan I) and to minimize breakdown of DDT and endrin.

9.3.2 Gas Chromatograph #2 RTX-1701 Column (See Section 4.1.2.2)

Temperature Program

Initial Temp:	140 °C
Initial Hold:	1.0 min
Initial Rate:	5 °C/min
Final Temp:	280 °C
Hold Time:	2 min
Injector Temp:	250 °C
Detector Temp:	300 °C
Carrier Gas:	Hydrogen or helium
Head Pressure:	~7 PSI
Make up Gas:	Nitrogen
Flow Rate:	~30 mL/min
Split Vent:	~28 mL/min
Septum Purge:	< 1.0 mL/min
Equilibration Time:	1.50 min
Oven Max:	285 °C
Split-less Valve:	Split-less box not checked
On time:	0.5 min
Off time:	3.00 min

NOTE: Final temp for RTX-1701 columns needs to be strictly adhered as even programming above 280 °C causes rapid column degradation.

NOTE: All the above parameters are set to obtain separation of all the compounds in the current mixed standard and to minimize breakdown of DDT and Endrin.

NOTE: All the above chromatographic parameters may be modified to obtain acceptable chromatography.

NOTE: The chromatograms in Figure 1 and Figure 2 portray the acceptable peak shape, peak resolution, compound response, and compound response ratios that

are required on both chromatography columns for the analysis of standards and samples to proceed.

9.4 Preventive Maintenance

9.4.1 Routine evaluation of the DDT and endrin breakdown is critical prior to starting any run. In all cases the system must have breakdowns of < 2% before starting a run.

9.4.2 Routine maintenance consists of clipping the column, replacing the Siltek® liner and seal, cleaning the hat, and installing a new septum.

9.4.3 Changing only the septum is okay as long as the DDT and endrin breakdown are acceptable (See Section 9.4.1.)

9.4.4 Carryover on the GC is usually caused by a worn out injection syringe. When replacing the syringe, use fine sandpaper to file off the sharp point and/or burr. Rinse with solvent from the top to remove any grit left in the syringe tip.

9.5 Calibration

9.5.1 For each compound of interest, prepare a calibration curve with a minimum of 5 concentrations from the 8 available (See Table 1 and 6-2). One of the standards should be at a concentration near, but above, the method detection limit. The other standards should correspond to the expected range of concentrations found in real samples or should define the working range of the detector.

NOTE: The lowest standard used for soils and waters is L-1 for any of the standard curves in Section 7.6.

9.5.2 Inject each calibration standard using the technique that will be used to introduce the actual samples into the gas chromatograph. Plot the peak height or area responses against the concentration of the calibration standard using power regression. The coefficient of determination (R^2) for each compound should be > 0.990 or a correlation coefficient of > 0.995.

NOTE: Peak heights are normally used for all calculations.

$$Regression\text{:}\ Y = AX^B\ or\ \ln Y = B \ln X + \ln A$$

Where: Y = Peak height
X = Concentration in µg/mL
A = Constant
B = Exponent

9.5.3 The working calibration curve is verified on each working day by the injection of one or more continuing calibration verification standards. If the response for any compound varies from theory by more than ± 20%, a new calibration curve must

be injected, and/or data is qualified.

$$Percent\ Difference = \frac{R2 - R1}{R1} \times 100$$

Where: R1 = Theoretical concentration
R2 = Concentration from CCV

9.6 Method 8081 has several multi-component mixtures as target analytes. For this reason, the choice of target analytes for calibration should be limited to those specified in the project plan. Toxaphene and/or technical chlordane may also be specified at certain sites.

Note: If target analytes include these multi-component analytes, inject a mid level standard with the ICAL. If not present, no further action needs to be taken. If present, either re-inject samples with a full calibration curve or report value as estimated based on a single point calibration.

9.7 Retention Time Windows

9.7.1 Retention times obtained from the ICAL are put into the calibration file and used throughout the set.

9.7.2 The ICAL retention times once established, may be adjusted as processing the data occurs using CCVs, LCSs and MS/MSDs for reference retention times. Normally windows are established for the surrogate TCMX/DCBP at approximately 0.10 minutes. The surrogates are set as reference peaks and as such the rest of the peaks' retention times will shift with the surrogate on an injection-by-injection basis.

9.7.3 Retention windows for the other target analytes are usually set between 0.04 and 0.06 minutes.

9.8 Sample Analysis

9.8.1 Set up the GC system using the conditions described in Section 9.3.

9.8.2 Samples are analyzed in a set referred to as a GC sequence. The sequence, generated in LIMS, usually begins with a standard curve (ICAL) followed by sample and quality control sample extracts interspersed with continuing calibration verification (CCV) standards. CCVs must be injected every 10 samples or less and at the end of the run. The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria are exceeded. Raw data is archived by sequence number.

NOTE: Run an initial calibration verification (ICV) immediately after the ICAL to verify the ICAL.

9.8.3 A portion of the standards, samples, and QC are all transferred using disposable pipets into properly labeled injection vials.

NOTE: Standard curves use 300 µL inserts in the injection vials to preserve ICAL standard solutions.

9.8.4 Injection – Inject 2 µL of the sample. The data system will record the resulting peak size for each compound in peak height.

9.8.5 If any of the responses exceeds the theoretical value of the highest standard, dilute the extract and re-inject. Dilute the sample so that all peaks are on scale but in the upper half of the standard curve range, if possible. Overlapping peaks are not always evident when peaks are off scale. Peak height measurements are used for all quantitation.

9.8.6 If peak detection is prevented by the presence of interferences, further cleanup may be required (e.g. mercury).

9.8.7 Tentative identification of a compound occurs when a peak from a sample extract falls within the retention time window. Tentative confirmation of that compound occurs when a peak from a sample extract falls within the retention time window for the second analytical column. Confirmation is absolute when the concentrations of the extract on both analytical columns agree within 40% of its highest value. If both columns show presence of a compound, and the difference is greater than 40%, always report the lower number.. If one column has a positive result and the other one doesn't, the result is not confirmed and the compound is determined to be not present.

9.8.8 Multi-component mixtures (i.e. Toxaphene) are reviewed on a sample-by-sample basis, making sure to always be looking to identify them if present. If the analyte (multi-component mixture) is required, inject at a minimum a mid-level standard with the run for each multi-component mixture to be reported.

NOTE: Report with an "E2" qualifier if a single point calibration was used.

9.9 Data Package Assembly and Review

9.9.1 Refer to GEN-016, Data Review Procedures for what should be contained in each sequence data package.

9.9.2 Refer to Gen-016, Data Review Procedures for the data package review procedure.

9.9.2.1 All of the above is required for both the quantitation and confirmation columns.

9.10 Calculations

9.10.1 The concentration of each compound in the sample extract injected is determined by reverse extrapolation from the peak height response in the sample using power regression analysis to obtain concentration of each analyte in µg/mL. The concentration in µg/L or µg/g of each of the target compounds in the sample is then calculated as follows:

$$Concentration\ (\mu g/L) = \frac{A_x \times D \times V_e}{V_s}$$

Where: A_x = Concentration of compound in the extract in µg/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL
V_s = Volume of sample extracted in Liters

$$Concentration\ (\mu g/g) = \frac{A_x \times D \times V_e}{W_s}$$

Where: A_x = Concentration of compound in the extract in µg/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL
W_s = Weight of sample extracted in g

10 QUALITY CONTROL

10.1 Refer to Method 8000 for general quality control procedures for chromatography methods.

10.2 An analytical batch consists of 20 or fewer samples. Batch quality control samples should be analyzed with each set with the following frequency:

Blanks - One per 20 or fewer samples, minimum one per day
LCSs - One per 20 or fewer samples, minimum one per day
MS/MSDs - One MS/MSD per 20 or fewer samples, minimum one set per day

Note: If an MS/MSD cannot be prepared because of limited sample volume, a second LCS must be prepared.

10.3 Method blanks consist of an aliquot of laboratory reagent water or silica sand that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.4 LCSs consist of an aliquot of laboratory reagent water or silica sand spiked with the target analytes, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. LCS control

limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. If the recovery of any of the target analytes is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.5 MS/MSD samples consist of duplicate aliquots of sample spiked with the target analytes, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. MS/MSD control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. MS/MSD control limits are advisory. If the recovery of any of the target analytes or the RPD is outside control limits, data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.6 Initial calibration (ICAL) is performed using the internal/external standard technique by injecting a minimum of 5 of the available calibration standards. The lowest calibration point must be at or below the reporting limit. An acceptable calibration curve has a coefficient of determination (r^2) of 0.990 or greater.

10.7 The working calibration curve must be verified on each working day by the injection of one or more CCV standards. If the response for any analyte varies from the theoretical concentration by more than 20 %, a new calibration curve must be prepared or data appropriately qualified in accordance with GEN-015, Qualification of Data.

10.8 Surrogates are added to every sample and QC sample. Surrogate control limits are generated on at least a yearly basis. If both surrogate recoveries are outside of control limits, the sample should be re-extracted and re-analyzed, if possible. If not, the data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.9 A second source calibration verification standard must be analyzed with every initial calibration. The accepted limits are 70-130% for all analytes. If an SCV fails, immediate corrective action is required before proceeding with sample analysis. Affected data should be qualified according to GEN-015, Qualification of Data.

10.10 DDT and endrin are easily degraded in the injection port. Breakdown occurs when the injection port liner becomes contaminated with high boiling residue from sample injections or when the injector contains metal fittings or filings. Check for degradation problems by injecting a standard containing only 4,4’-DDT and a standard containing only endrin. Presence of 4,4’-DDE; 4,4’-DDD; endrin ketone; or endrin aldehyde indicates breakdown. If degradation of either DDT or endrin exceeds 15%, take corrective action before proceeding with calibration/analysis of the GC run, or if necessary qualify affected data in accordance with GEN-015, Qualification of Data.

11 METHOD PERFORMANCE

11.1 Estimated method detection limits (MDLs) for eight replicates of laboratory reagent water and silica sand are listed in Table 1.

11.2 Typical demonstration of capability (DOC) data for laboratory reagent water and silica sand are summarized in Table 2.

12 CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

12.1 Contingencies for out-of-control data should be evaluated on a case-by-case basis. A Corrective Action Form (CAF) must be completed for those times that acceptable QC results cannot be achieved. The CAF must be completed by the analyst and filed with the Quality Manager. Analytical results shall be qualified as necessary.

13 WASTE MANAGEMENT / POLLUTION PREVENTION

13.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

14 REFERENCES

14.1 SW 846, Method 8081A, Update III Revision 0, December 1996.

14.2 SW 846, Method 3570, Micro-scale Extraction (MSE), Revision 0, November 2002.

TABLE 1-1

METHOD 8081 MDLS
ORGANOCHLORINE PESTICIDES

Compound	**Water (µg/L)[1]**	**Soil (µg/kg)[2]**
α-BHC	0.00083	0.21
γ-BHC (Lindane)	0.00071	0.20
β-BHC	0.00068	0.31
δ-BHC	0.0010	0.23
Heptachlor	0.00068	0.18
Aldrin	0.00092	0.23
Heptachlor epoxide	0.00092	0.26
γ-Chlordane	0.00062	0.26
α-Chlordane	0.00094	0.25
4,4'-DDE	0.0018	0.48
Endosulfan I	0.00045	0.25
Dieldrin	0.0017	0.47
Endrin	0.0023	0.46
4,4'-DDD	0.0029	0.65
Endosulfan II	0.0019	0.58
4,4'-DDT	0.0015	0.47
Endrin aldehyde	0.0019	0.61
Methoxychlor	0.010	2.3
Endosulfan sulfate	0.0015	0.48
Endrin ketone	0.0019	0.50

NOTES:
(1) MDL Data, GC-1297 03/07/06 RTX-1701 Column
(2) MDL Data, GC-1235 12/30/05 RTX-1701 Column

TABLE 1 -2

METHOD 8081 MDL'S
MULTI-COMPONENT COMPOUNDS

Compound	**Column**	**Water Concentration (µg/L)**	**Soil Concentration (µg/kg)**
Toxaphene	RTX-35	0.36 [1]	51 [1]
Toxaphene	RTX-1701	0.16 [1]	33 [1]
Technical Chlordane	RTX-200	NR	9.7 [2]
Technical Chlordane	RTX-XLB	NR	12 [2]

NOTES: (1) GC-1297, 03/08/06
(2) GC-1071, 02/11/05

NR = Te be determined

TABLE 2-1

INITIAL DEMONSTRATION OF CAPABILITY (IDC) FOR WATER SAMPLES

Compound	Spike Level (µg/L)	Mean Recovery	Percent Recovery	Percent RSD
α-BHC	0.016	0.0137	85.5	5.48
γ-BHC (Lindane)	0.016	0.0137	85.4	4.46
β-BHC	0.016	0.0139	86.9	4.11
δ-BHC	0.016	0.0142	88.6	3.77
Heptachlor	0.016	0.0119	74.5	4.72
Aldrin	0.016	0.0115	72.0	5.85
Heptachlor epoxide	0.016	0.0134	83.7	4.36
γ-Chlordane	0.016	0.0136	84.8	4.63
α-Chlordane	0.016	0.0136	84.8	4.6
4,4'-DDE	0.032	0.0299	93.3	4.62
Endosulfan I	0.016	0.0134	83.6	4.27
Dieldrin	0.032	0.0289	90.3	4.68
Endrin	0.032	0.0287	89.8	4.33
4,4'-DDD	0.032	0.0307	96.0	3.62
Endosulfan II	0.032	0.0298	93.0	4.49
4,4'-DDT	0.032	0.0296	92.4	3.20
Endrin aldehyde	0.032	0.0290	90.6	4.54
Methoxychlor	0.160	0.1583	98.9	4.03
Endosulfan sulfate	0.032	0.0303	94.7	3.69
Endrin ketone	0.032	0.0317	99.1	4.45

NOTES: (1) GC-2211, 10/31/08

TABLE 3

TYPICAL RETENTION TIME OF CHLORINATED PESTICIDES BY GC MIX 1

Compound	**RTX-35**	**RTX-1701**
TCMX (surrogate)	7.386	7.791
α-BHC	9.292	11.168
γ-BHC (Lindane)	10.365	12.561
β-BHC	10.596	15.538
Heptachlor	11.430	13.097
δ-BHC	11.558	16.051
Aldrin	12.314	13.888
Heptachlor epoxide	13.764	16.295
γ-Chlordane	14.267	17.404
α-Chlordane [1]	14.687	17.612
Endosulfan I [1]	14.687	17.051
4,4'-DDE	15.468	18.046
Dieldrin	16.331	18.834
Endrin	16.632	18.834
4,4'-DDD [1]	16.790	20.574
Endosulfan II [1]	16.790	20.478
4,4'-DDT	17.409	21.003
Endrin aldehyde	17.542	21.812
Endosulfan sulfate	17.944	22.825
Methoxychlor	19.357	23.080
Endrin ketone	19.681	23.837
DCBP (Surrogate)	22.687	26.528

NOTES: (1) Usually co-elute on RTX-35
(2) See Figures 1 and 2

TABLE 3 (CONTINUED)

TYPICAL RETENTION TIMES OF CHLORONATED PESTICIDES BY GC

MIX 2

Compound	**RTX-35**	**RTX-1701**
Hexachlorobenzene	8.881	9.457
Pentachloronitrobenzene	10.077	11.594
2,4'-DDE	14.583	16.970
trans – Nonachlor	14.422	17.732
2,4'-DDD	15.824	19.059
2,4'-DDT	16.614	19.395
cis –Nonachlor	16.497	20.604
Mirex	19.863	21.880

NOTE: (1) See Figures 3 and 4

TABLE 4STOCK STANDARD CONCENTRATIONS

Mix A	**µg/mL**
Tetrachloro-m-xylene (TCMX)	80
α-BHC	80
γ-BHC (Lindane)	80
Heptachlor	80
Endosulfan I	80
Dieldrin	160
Endrin	160
4,4'-DDD	160
4,4'-DDT	160
Methoxychlor	800
Decachlorobiphenyl (DCBP)	160

Mix B	**µg/mL**
Tetrachloro-m-xylene (TCMX)	80
β-BHC	80
δ-BHC	80
Aldrin	80
Heptachlor epoxide	80
α-Chlordane	80
γ-Chlordane	80
4,4'-DDE	160
Endosulfan II	160
Endosulfan sulfate	160
Endrin aldehyde	160
Endrin ketone	160
Decachlorobiphenyl (DCBP)	160

Mix 2	**µg/mL**
Hexachlorobenzene	10
Pentachloronitrobenzene (PCNB)	10
cis-Nonachlor	10
trans-Nonachlor	10
Mirex	20
2,4’-DDD	20
2,4’-DDE	20
2,4’-DDT	20

TABLE 5

INTERMEDIATE ICAL SOLUTION

Compound	Concentration (µg/mL)
TCMX (surrogate)	2.0
α-BHC	1.0
γ-BHC (Lindane)	1.0
β-BHC	1.0
Heptachlor	1.0
δ-BHC	1.0
Aldrin	1.0
Heptachlor epoxide	1.0
γ-Chlordane	1.0
α-Chlordane	1.0
Endosulfan I	1.0
4,4'-DDE	2.0
Dieldrin	2.0
Endrin	2.0
4,4'-DDD	2.0
Endosulfan II	2.0
4,4'-DDT	2.0
Endrin aldehyde	2.0
Endosulfan sulfate	2.0
Methoxychlor	10.0
Endrin ketone	2.0
DCBP (Surrogate)	4.0

NOTES: (1) Aliquot 1.25 mL of individual Mix A and Individual Mix B (See Section 7.2.1) into a 100 mL volumetric flask.

(2) Solvent: 80% iso-octane/20% acetone

TABLE 6-1

PREPARATION OF MIX 1 ICAL

CONCENTRATION (µg/mL)

Compound	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**	**L-8**
TCMX (surrogate)	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
α-BHC	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
γ-BHC (Lindane)	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
β-BHC	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
δ-BHC	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
Heptachlor	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
Aldrin	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
Heptachlor epoxide	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
γ-Chlordane	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
α-Chlordane	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
4,4'-DDE	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Endosulfan I	0.001	0.002	0.005	0.008	0.01	0.02	0.05	0.1
Dieldrin	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Endrin	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
4,4'-DDD	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Endosulfan II	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
4,4'-DDT	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Endrin aldehyde	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Methoxychlor	0.01	0.02	0.05	0.08	0.1	0.2	0.5	1.0
Endosulfan sulfate	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
Endrin ketone	0.002	0.004	0.01	0.016	0.02	0.04	0.1	0.2
DCBP (Surrogate)	0.004	0.008	0.02	0.032	0.05	0.08	0.2	0.4

	L-1	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**	**L-8**
mL Stock[1]	10	10	10	8	2	2	5	10
Stock Concentration	L-5	L-6	L-7	L-8	Table 5	Table 5	Table 5	Table 5
Final Volume (mL)	100	100	100	100	200	100	100	100

NOTE: (1) Solvent: 80% iso-octane/20% acetone

TABLE 6-2

PREPARATION OF MIX 2 ICAL

CONCENTRATION (µg/mL)

Compound	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
Hexachlorobenzene (HCB)	0.001	0.002	0.005	0.01	0.02	0.05	0.10
Pentachloronitrobenzene (PCNB)	0.001	0.002	0.005	0.01	0.02	0.05	0.10
cis – Nonachlor	0.001	0.002	0.005	0.01	0.02	0.05	0.10
trans – Nonachlor	0.001	0.002	0.005	0.01	0.02	0.05	0.10
MIREX	0.002	0.004	0.01	0.02	0.04	0.10	0.20
2,4’ – DDE	0.002	0.004	0.01	0.02	0.04	0.10	0.20
2,4’ – DDD	0.002	0.004	0.01	0.02	0.04	0.10	0.20
2,4’ – DDT	0.002	0.004	0.01	0.02	0.04	0.10	0.20
TCMX	0.0012	0.003	0.006	0.012	0.03	0.06	0.12
DCBP	0.0012	0.003	0.006	0.012	0.03	0.06	0.12

	L-1	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
Aliquot (mL)	5	10	10	10	0.4	0.5	1.0
Stock ID	L-5	L-5	L-6	L-7	Step 5.5.1	Step 5.5.1	Step 5.5.1
Final Volume	100	100	100	100	200	100	100
Surrogate Aliquote (mL)					1.0	1.0	2.0
Surrogate stock ID					Step 5.7.4	Step 5.7.4	Step 5.7.4

NOTE: (1) Solvent: 80% iso-octane/20% acetone

TABLE 6-3

PREPARATION OF TOXAPHENE ICAL

CONCENTRATION (µg/mL)

Compound	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
Volume stock (mL)	10	10	10	200	200	400	800
Stock Standard ID	L-4	L-5	L-6	Step 5.4.3	Step 5.4.3	Step 5.4.3	Step 5.4.3
Surrogate Stock ID	-	-	-	Step 5.7.4	Step 5.7.4	Step 5.7.4	Step 5.7.4
Volume Surrogate (µL)	-	-	-	1.0	1.0	2.0	4.0
Final Volume	100	100	100	200	100	100	100
Conc Toxaphene	0.10	0.20	0.40	1.0	2.0	4.0	8.0
Conc Surrogate	0.003	0.006	0.012	0.03	0.06	0.12	0.24

NOTE: (1) Solvent: 80% iso-octane/20% acetone

TABLE 6 - 4

PREPARATION OF TECHNICAL CHORDANE ICAL

Compound	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**
Volume stock (mL)	10	10	10	40	40	100
Stock Standard ID	L-4	L-5	L-6	Step 5.4.4	Step 5.4.4	Step 5.4.4
Surrogate Stock ID	-	-	-	Step 5.7.2	Step 5.7.2	Step 5.7.2
Volume Surrogate (µL)	-	-	-	50	50	0.125
Final Volume	100	100	100	200	100	100
Conc Technical Chlordane	0.02	0.04	0.1	0.2	0.4	1.0
Conc Surrogate	0.005	0.01	0.025	0.05	0.10	0.25

NOTE: (1) Solvent 80% iso-octane/20% acetone

TABLE 7

CONCENTRATIONS OF LCS/MS/MSD SPIKE SOLUTION

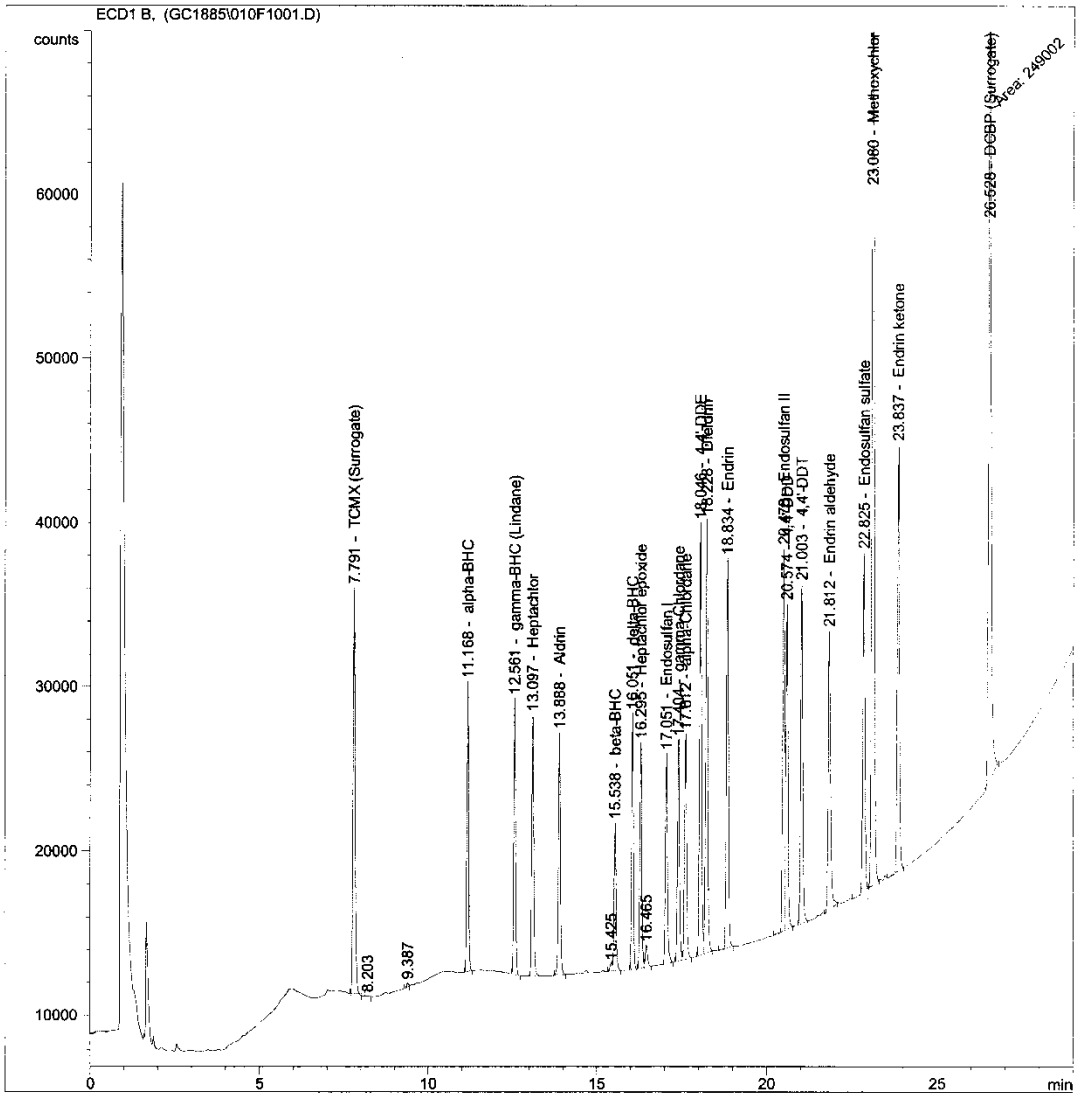
Compound	**Concentration (µg/mL)**
α-BHC	0.8
γ-BHC (Lindane)	0.8
β-BHC	0.8
δ-BHC	0.8
Heptachlor	0.8
Aldrin	0.8
Heptachlor epoxide	0.8
γ-Chlordane	0.8
α-Chlordane	0.8
4,4'-DDE	1.6
Endosulfan I	0.8
Dieldrin	1.6
Endrin	1.6
4,4'-DDD	1.6
Endosulfan II	1.6
4,4'-DDT	1.6
Endrin aldehyde	1.6
Methoxychlor	8.0
Endosulfan sulfate	1.6
Endrin ketone	1.6

Solvent: MTBE

FIGURE 1

CHROMATOGRAM OF MIX 1-5, RTX – 1701

```
Data File E:\HPCHEM\2\DATA\GC1885\010F1001.D                    Sample Name: L1-5  L143 P110
    ==================================================================
    Injection Date  : 12/11/2007 3:41:11 PM          Seq. Line :  10
    Sample Name     : L1-5  L143 P110                 Location : Vial 10
    Acq. Operator   : FUZ                                  Inj :   1
                                                     Inj Volume : Manually
    Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
    Last changed    : 12/10/2007 2:51:55 PM by FUZ
    Analysis Method : E:\HPCHEM\2\METHODS\GC1885A.M
    Last changed    : 1/28/2008 12:06:19 PM by jjk
                      (modified after loading)
    Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 835482) 30 M X 0.
    53 mmID 0.25 micron film.
    Splitless using siltex gooseneck liner, 2ul injection.
    ==================================================================
```

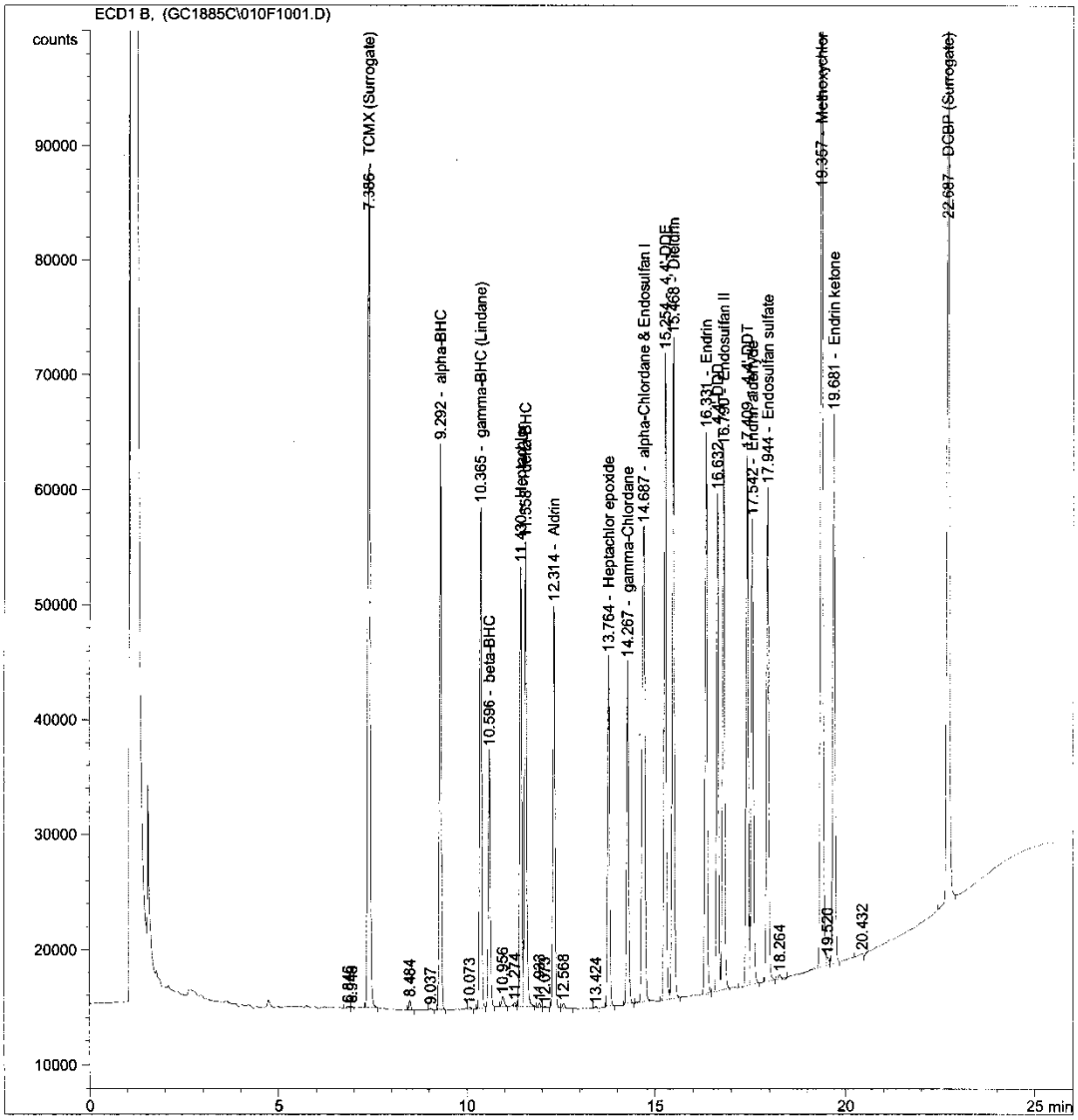


2921A24180 1/28/2008 12:07:35 PM jjk Page 1 of 2

FIGURE 2

CHROMATOGRAM OF MIX 1-5, RTX – 35

```
Data File E:\HPCHEM\1\DATA\GC1885C\010F1001.D                    Sample Name: L1-5  L143 P110
    ==================================================================
    Injection Date  : 12/11/2007 2:44:54 PM          Seq. Line :  10
    Sample Name     : L1-5  L143 P110                 Location : Vial 10
    Acq. Operator   : FUZ                                  Inj :   1
                                                    Inj Volume : Manually
    Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
    Last changed    : 12/10/2007 2:47:29 PM by FUZ
    Analysis Method : E:\HPCHEM\1\METHODS\GC1885CA.M
    Last changed    : 1/28/2008 12:25:58 PM by jjk
                      (modified after loading)
    Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 824251) 30M X 0.53mm ID 0.50
    micron film. Split/splitless injection.
    ==================================================================
```



3336A54352 ECD 1/28/2008 12:28:56 PM jjk Page 1 of 2

FIGURE 3

CHROMATOGRAM OF MIX 2-5, RTX – 1701

```
Data File E:\HPCHEM\2\DATA\GC1885\015F1501.D                    Sample Name: CCV 8081 MIX 2-5
    L173P64

    ==================================================================
    Injection Date  : 12/11/2007 6:40:39 PM          Seq. Line :  15
    Sample Name     : CCV 8081 MIX 2-5                Location : Vial 15
    Acq. Operator   : FUZ                                  Inj :   1
                                                     Inj Volume : Manually
    Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
    Last changed    : 12/10/2007 2:51:55 PM by FUZ
    Analysis Method : E:\HPCHEM\2\METHODS\GC1885-2.M
    Last changed    : 1/28/2008 12:39:11 PM by jjk
    Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 661245) 30 M X 0.
    53 mmID 0.25 micron film.
    Splitless using siltex gooseneck liner, 2ul injection.
    ==================================================================
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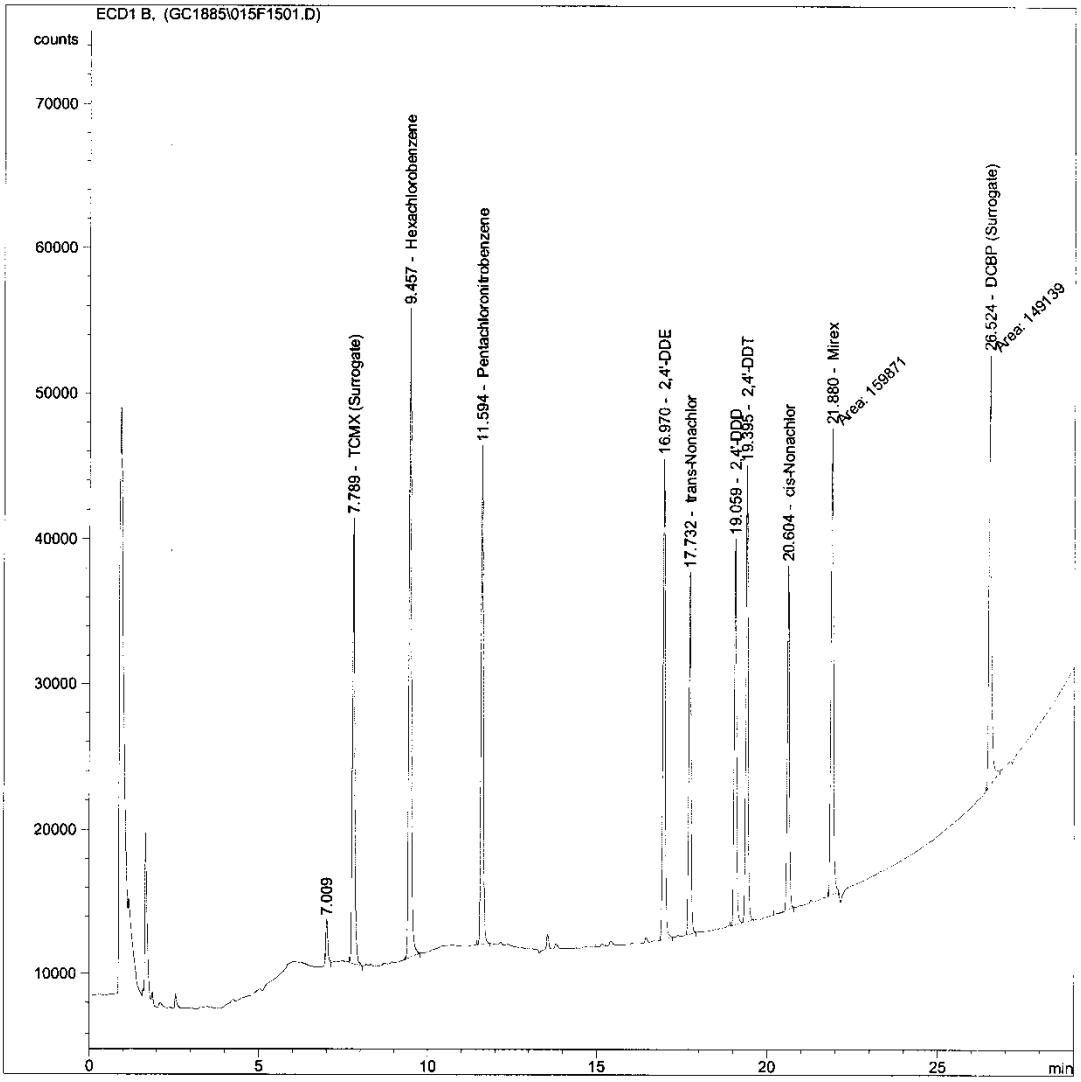

2921A24180 1/28/2008 12:39:49 PM jjk Page 1 of 2

FIGURE 4

CHROMATOGRAM OF MIX 2-5, RTX – 35

Data File E:\HPCHEM\1\DATA\GC1885C\015F1501.D Sample Name: CCV 8081 MIX 2-5
L173P64

```
==================================================================
Injection Date  : 12/11/2007 5:15:33 PM          Seq. Line :  15
Sample Name     : CCV 8081 MIX 2-5                Location : Vial 15
Acq. Operator   : FUZ                                  Inj :   1
                                                 Inj Volume : Manually
Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
Last changed    : 12/10/2007 2:47:29 PM by FUZ
Analysis Method : E:\HPCHEM\1\METHODS\GC1885C2.M
Last changed    : 1/28/2008 12:35:34 PM by jjk
                  (modified after loading)
Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 720907) 30M X 0.53mm ID 0.50
micron film. Split/splitless injection.
==================================================================
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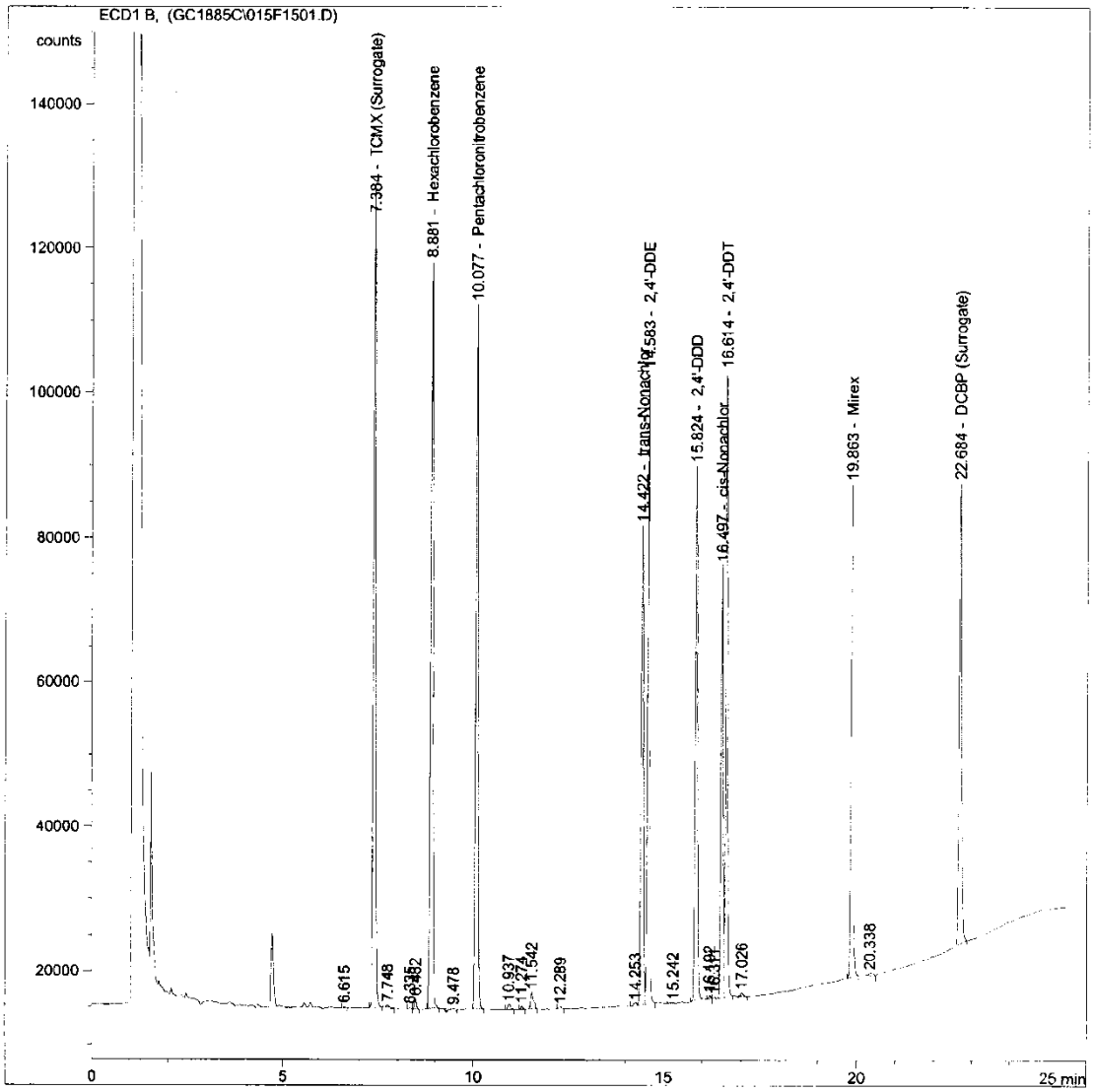


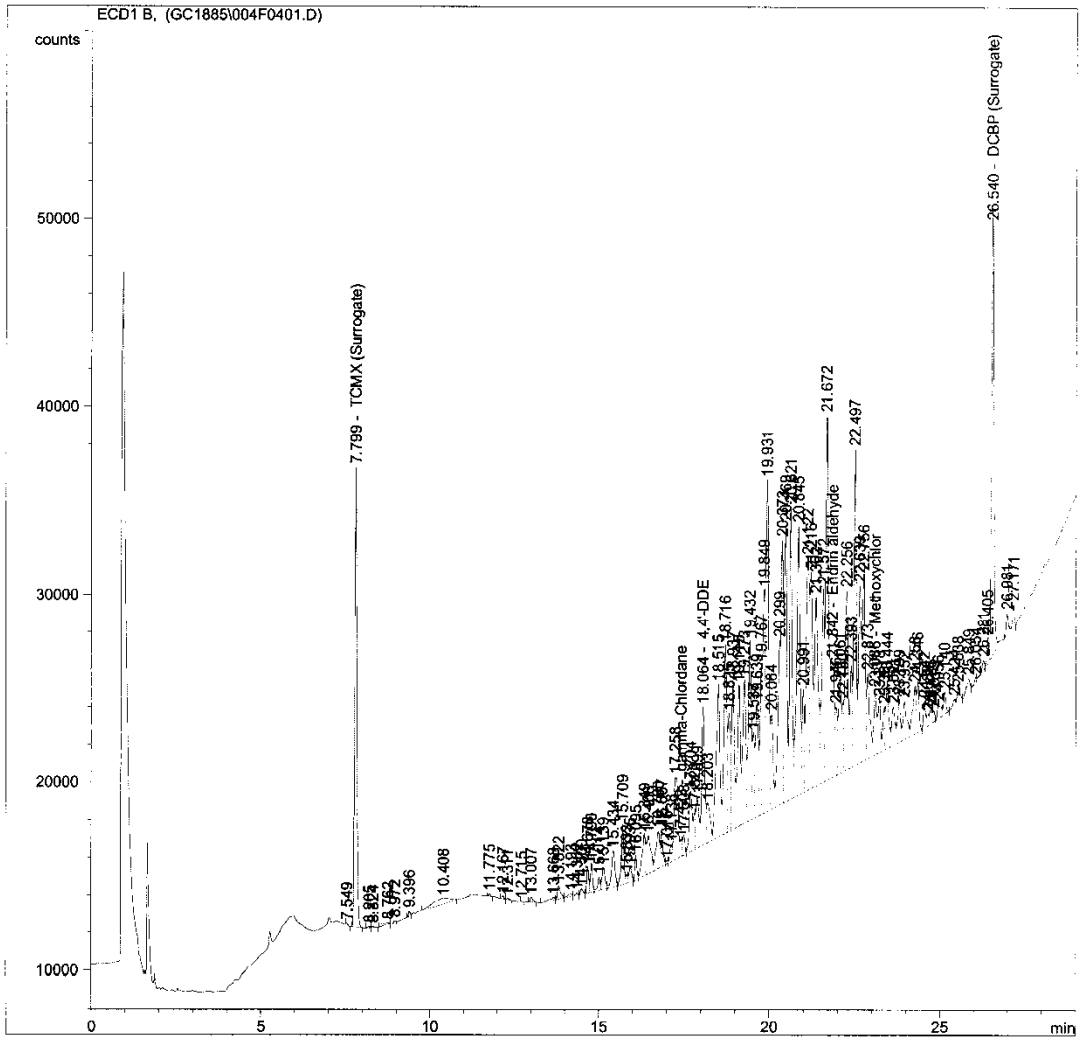
3336A54352 ECD 1/28/2008 12:36:47 PM jjk Page 1 of 2

FIGURE 5

CHROMATOGRAM OF TOXOPHENE 0.8 µg/mL, RTX – 1701

Data File E:\HPCHEM\2\DATA\GC1885\004F0401.D Sample Name: TOXAPHENE 0.8
L143P100

```
==================================================================
Injection Date  : 12/11/2007 12:06:26 PM        Seq. Line :   4
Sample Name     : TOXAPHENE 0.8                  Location : Vial 4
Acq. Operator   : FUZ                                Inj :   1
                                               Inj Volume : Manually
Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
Last changed    : 12/10/2007 2:51:55 PM by FUZ
Analysis Method : E:\HPCHEM\2\METHODS\GC1885A.M
Last changed    : 1/28/2008 12:00:25 PM by jjk
                  (modified after loading)
Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 835482) 30 M X 0.
53 mmID 0.25 micron film.
Splitless using siltex gooseneck liner, 2ul injection.
==================================================================
```



2921A24180 1/28/2008 12:01:55 PM jjk Page 1 of 2

FIGURE 6.1

CHROMATOGRAM OF TOXOPHENE 0.8 µg/mL, RTX – 35

Data File E:\HPCHEM\1\DATA\GC1885C\004F0401.D
L143P100

Sample Name: TOXAPHENE 0.8

```
==================================================================
Injection Date  : 12/11/2007 11:45:20 AM        Seq. Line :   4
Sample Name     : TOXAPHENE 0.8                  Location : Vial 4
Acq. Operator   : FUZ                                 Inj :   1
                                               Inj Volume : Manually
Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
Last changed    : 12/10/2007 2:47:29 PM by FUZ
Analysis Method : E:\HPCHEM\1\METHODS\GC1885CA.M
Last changed    : 1/28/2008 12:23:16 PM by jjk
                  (modified after loading)
Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 824251) 30M X 0.53mm ID 0.50
micron film. Split/splitless injection.
==================================================================
```

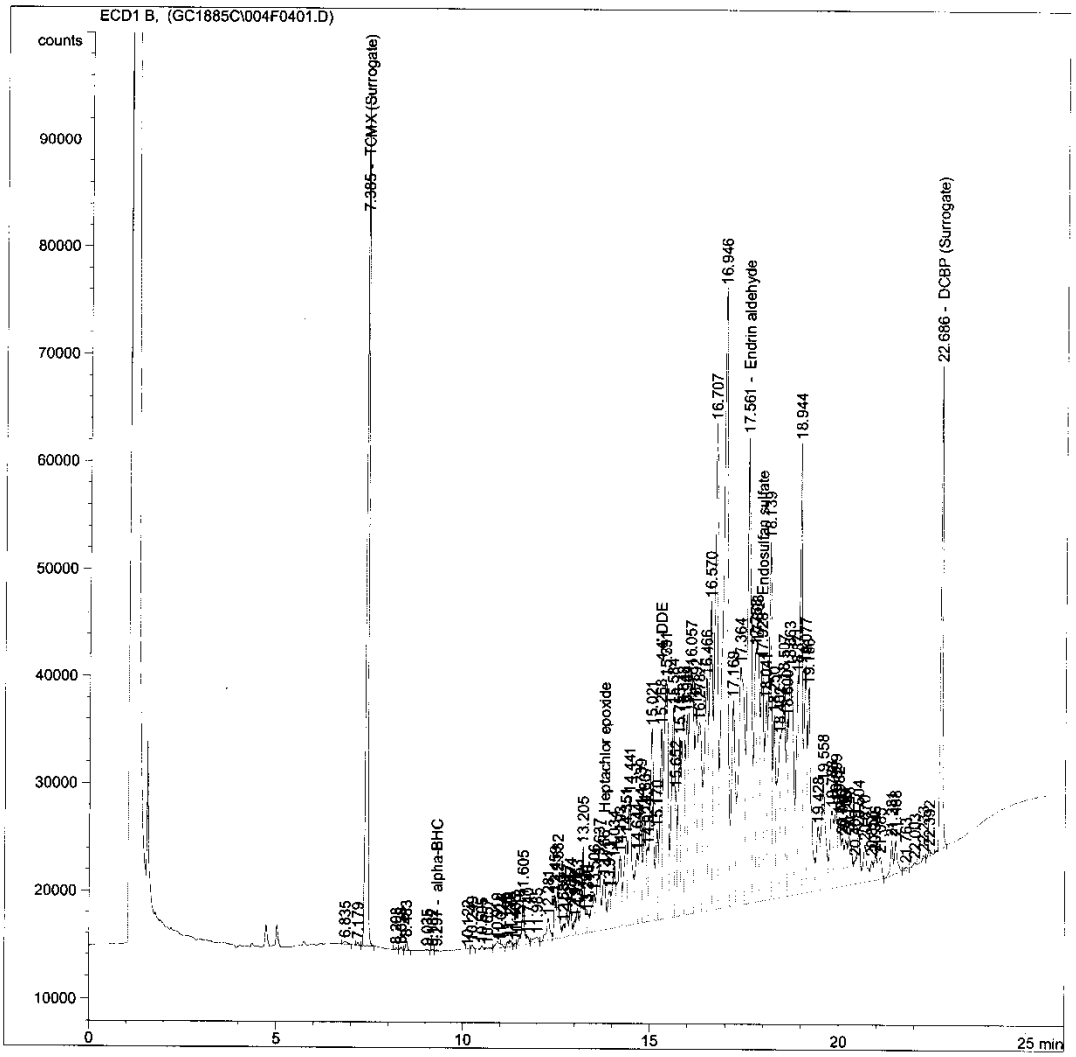


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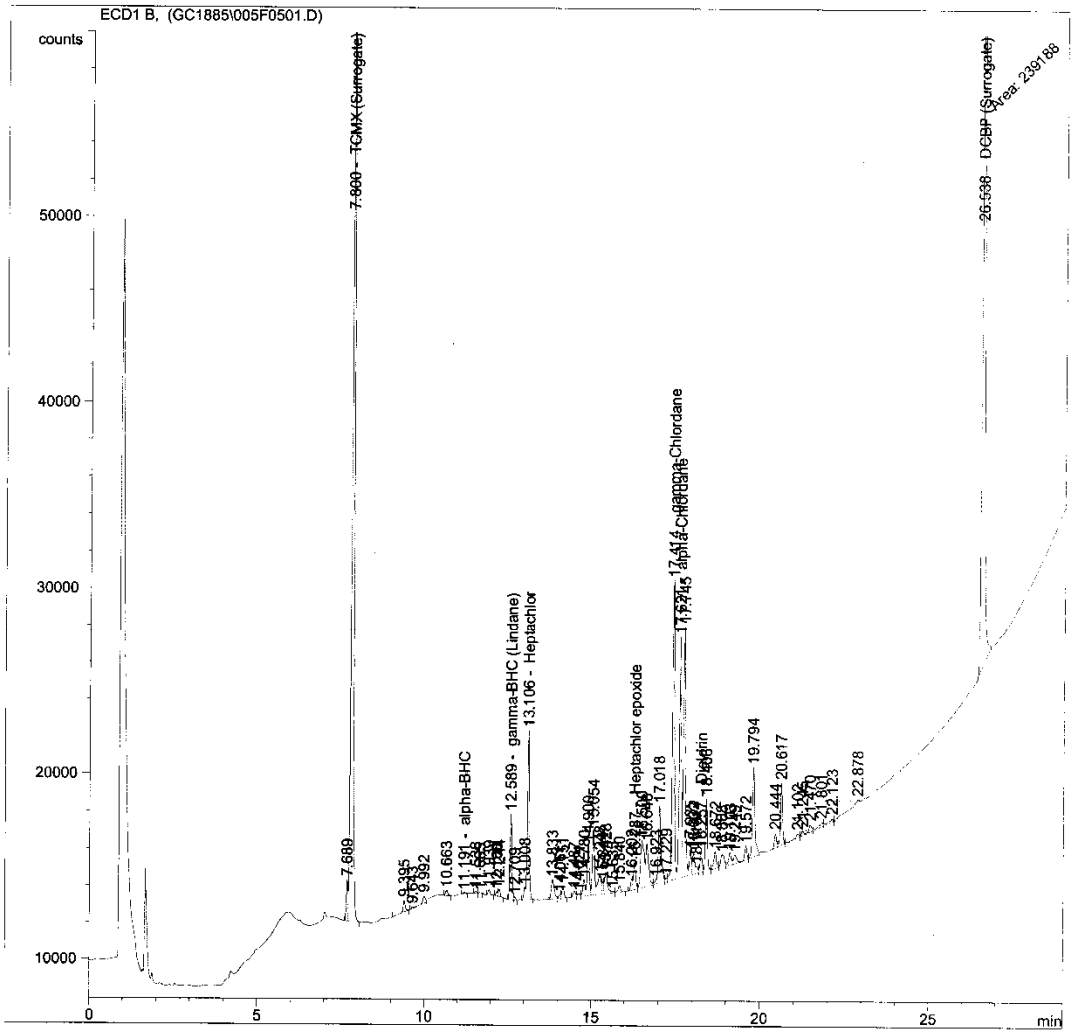
FIGURE 7

CHROMATOGRAM OF TECHNICAL CHLORDANE 0.8 µg/mL, RTX – 1701

Data File E:\HPCHEM\2\DATA\GC1885\005F0501.D
L143P99

Sample Name: TECH CL

```
==================================================================
Injection Date  : 12/11/2007 12:42:23 PM        Seq. Line :   5
Sample Name     : TECH CL                        Location : Vial 5
Acq. Operator   : FUZ                                Inj :   1
                                                Inj Volume : Manually
Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
Last changed    : 12/10/2007 2:51:55 PM by FUZ
Analysis Method : E:\HPCHEM\2\METHODS\GC1885A.M
Last changed    : 1/28/2008 12:00:25 PM by jjk
                  (modified after loading)
Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 835482) 30 M X 0.
53 mmID 0.25 micron film.
Splitless using siltex gooseneck liner, 2ul injection.
==================================================================
```



2921A24180 1/28/2008 12:03:50 PM jjk

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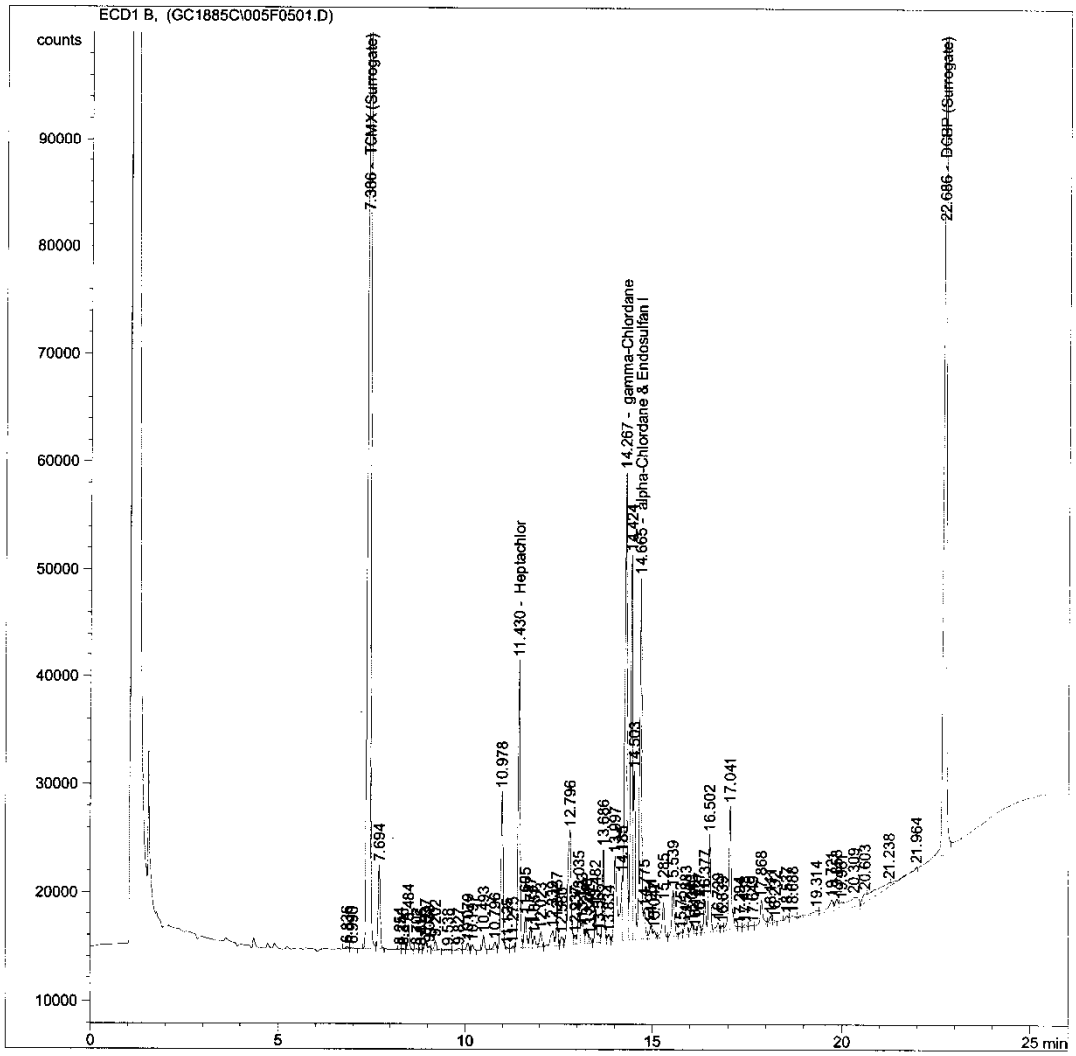
FIGURE 8

CHROMATOGRAM OF TECHNICAL CHLORDANE 0.8 µG/ML, RTX – 35

Data File E:\HPCHEM\1\DATA\GC1885C\005F0501.D
L143P99

Sample Name: TECH CL 0.08

```
==================================================================
Injection Date  : 12/11/2007 12:15:20 PM        Seq. Line :   5
Sample Name     : TECH CL 0.08                   Location : Vial 5
Acq. Operator   : FUZ                                Inj :   1
                                               Inj Volume : Manually
Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
Last changed    : 12/10/2007 2:47:29 PM by FUZ
Analysis Method : E:\HPCHEM\1\METHODS\GC1885CA.M
Last changed    : 1/28/2008 12:25:58 PM by jjk
                  (modified after loading)
Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 824251) 30M X 0.53mm ID 0.50
micron film. Split/splitless injection.
==================================================================
```



3336A54352 ECD 1/28/2008 12:27:07 PM jjk

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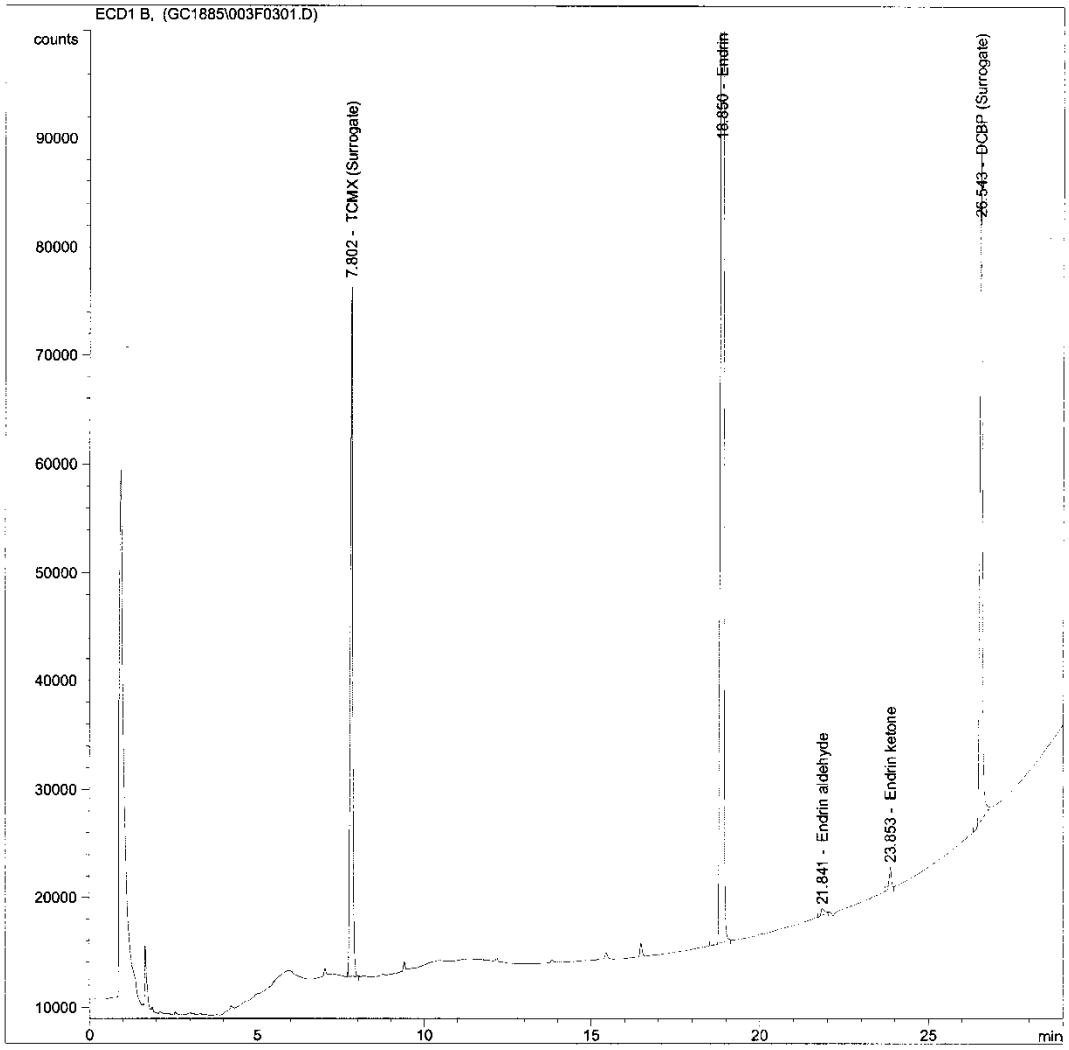
FIGURE 9

CHROMATOGRAM ENDRIN BREAKDOWN, RTX – 1701

```
Data File E:\HPCHEM\2\DATA\GC1885\003F0301.D                    Sample Name: ENDRIN BREAK
    L143P94

    ==================================================================
    Injection Date  : 12/11/2007 11:30:26 AM        Seq. Line :   3
    Sample Name     : ENDRIN BREAK                   Location : Vial 3
    Acq. Operator   : FUZ                                 Inj :   1
                                                    Inj Volume : Manually
    Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
    Last changed    : 12/10/2007 2:51:55 PM by FUZ
    Analysis Method : E:\HPCHEM\2\METHODS\GC1885A.M
    Last changed    : 1/28/2008 11:56:55 AM by jjk
                      (modified after loading)
    Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 835482) 30 M X 0.
    53 mmID 0.25 micron film.
    Splitless using siltex gooseneck liner, 2ul injection.
    ==================================================================
```



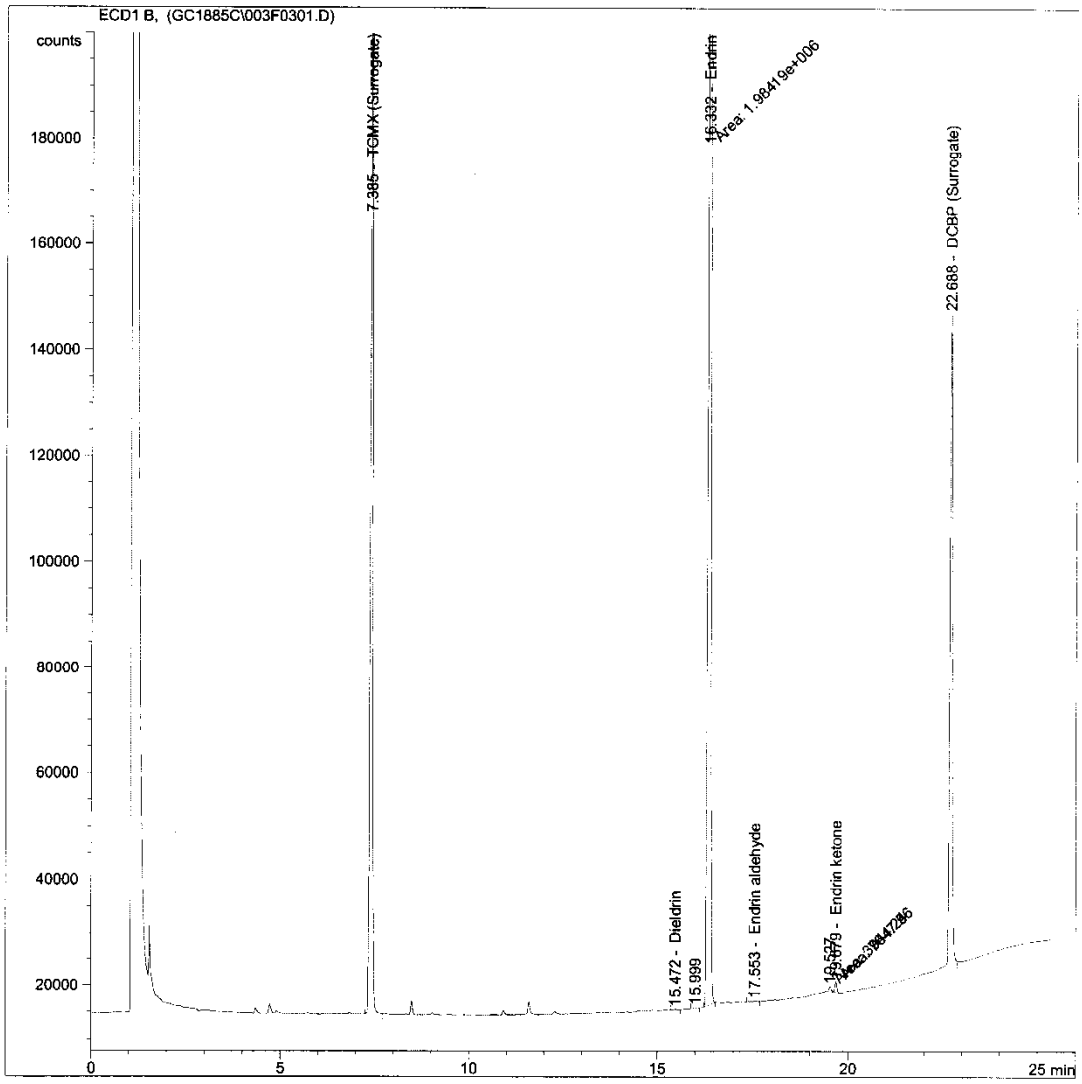

```
2921A24180 1/28/2008 11:59:12 AM jjk                                    Page 1 of 2
```

FIGURE 10

CHROMATOGRAM ENDRIN BREAKDOWN, RTX – 35

Data File E:\HPCHEM\1\DATA\GC1885C\003F0301.D Sample Name: ENDRIN BREAK
L143P94

```
==================================================================
Injection Date  : 12/11/2007 11:15:22 AM        Seq. Line :   3
Sample Name     : ENDRIN BREAK                   Location : Vial 3
Acq. Operator   : FUZ                                Inj :   1
                                               Inj Volume : Manually
Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
Last changed    : 12/10/2007 2:47:29 PM by FUZ
Analysis Method : E:\HPCHEM\1\METHODS\GC1885CA.M
Last changed    : 1/28/2008 12:19:57 PM by jjk
                  (modified after loading)
Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 824251) 30M X 0.53mm ID 0.50
micron film. Split/splitless injection.
==================================================================
```



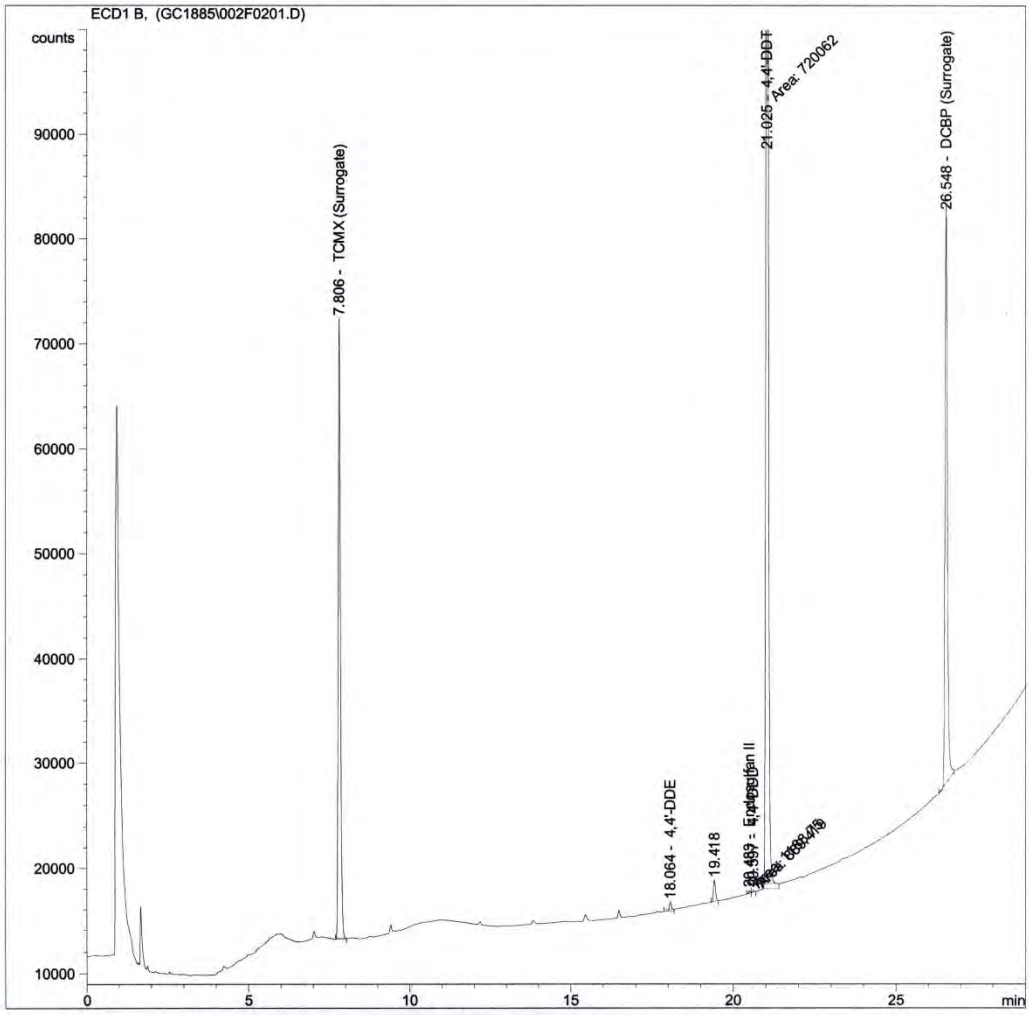
3336A54352 ECD 1/28/2008 12:22:47 PM jjk Page 1 of 2

FIGURE 11

CHROMATOGRAM OF DDT BREAKDOWN, RTX – 1701

```
Data File E:\HPCHEM\2\DATA\GC1885\002F0201.D                          Sample Name: DDT BREAK
    L143P96

    ==================================================================
    Injection Date  : 12/11/2007 10:54:28 AM          Seq. Line :   2
    Sample Name     : DDT BREAK                        Location : Vial 2
    Acq. Operator   : FUZ                                   Inj :   1
                                                     Inj Volume : Manually
    Acq. Method     : E:\HPCHEM\2\METHODS\GC1885.M
    Last changed    : 12/10/2007 2:51:55 PM by FUZ
    Analysis Method : E:\HPCHEM\2\METHODS\GC1885A.M
    Last changed    : 1/28/2008 11:56:55 AM by jjk
                      (modified after loading)
    Chlorinated pecticides and pcb's method (8081 & 8082). Column RTX-1701(S/N 835482) 30 M X 0.
    53 mmID 0.25 micron film.
    Splitless using siltex gooseneck liner, 2ul injection.
    ==================================================================
```

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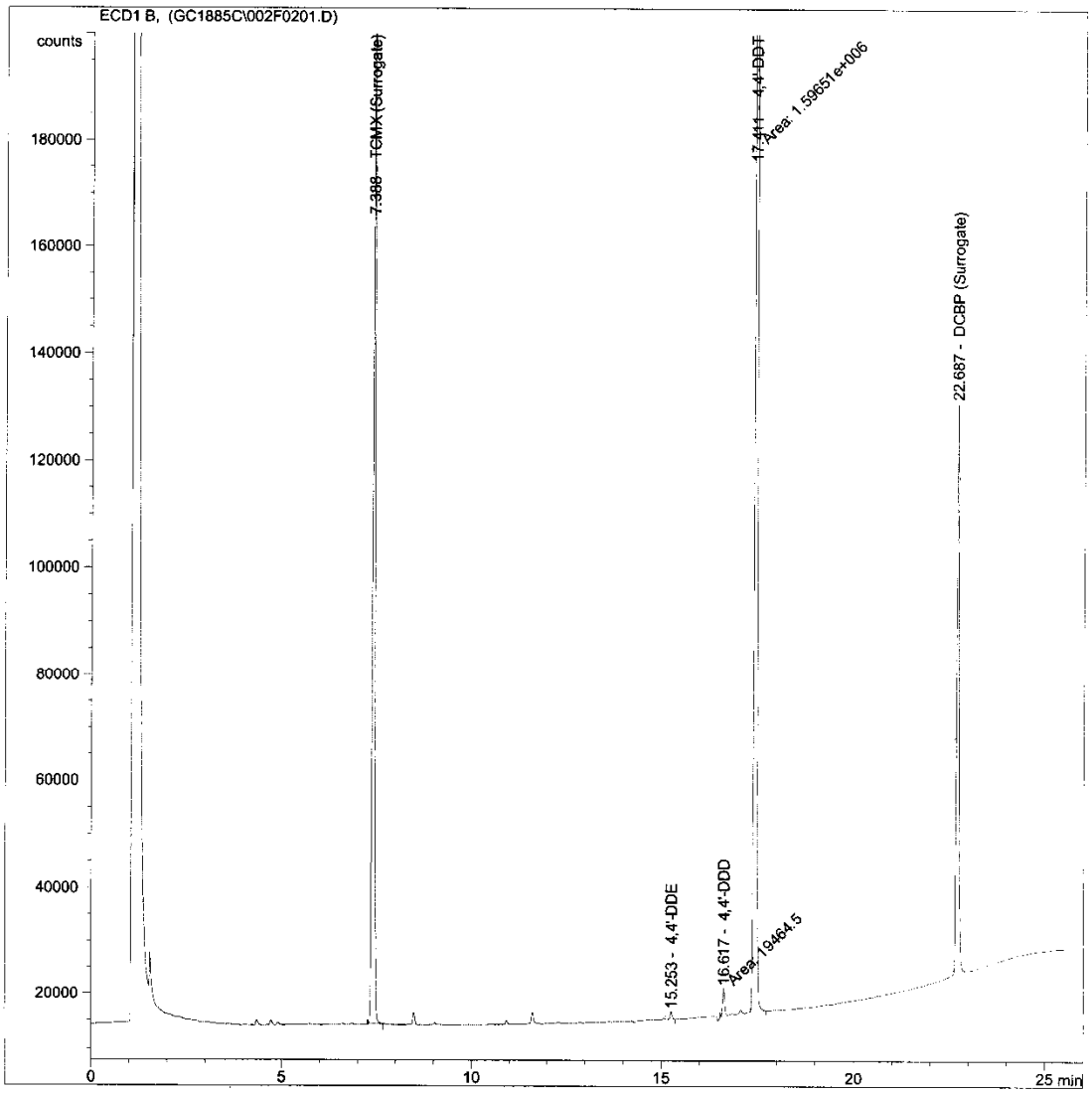
2921A24180 1/28/2008 11:56:59 AM jjk                                   Page 1 of 2
```

FIGURE 12

CHROMATOGRAM OF DDT BREAKDOWN, RTX – 35

Data File E:\HPCHEM\1\DATA\GC1885C\002F0201.D Sample Name: DDT BREAK
L143P96

```
==================================================================
Injection Date  : 12/11/2007 10:45:21 AM        Seq. Line :   2
Sample Name     : DDT BREAK                      Location : Vial 2
Acq. Operator   : FUZ                                 Inj :   1
                                                Inj Volume : Manually
Acq. Method     : E:\HPCHEM\1\METHODS\GC1885C.M
Last changed    : 12/10/2007 2:47:29 PM by FUZ
Analysis Method : E:\HPCHEM\1\METHODS\GC1885CA.M
Last changed    : 1/28/2008 12:19:57 PM by jjk
                  (modified after loading)
Chlorinated pesticide and TOX method 8081/8082. RTX-35 (S/N 824251) 30M X 0.53mm ID 0.50
micron film. Split/splitless injection.
==================================================================
```



3336A54352 ECD 1/28/2008 12:21:12 PM jjk Page 1 of 2

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede prior revisions as of the effective date of this SOP.

Reviewed By:

Richard W Johnson

02/18/11

Richard Johnson, Senior Chemist — Date

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02/18/11

Michael Linskens, Quality Manager — Date

Approved By:

02/18/11

Nick Nigro, President — Date

VOLATILE ORGANIC COMPOUNDS BY PURGE AND TRAP/GAS CHROMATOGRAPHY/MASS SPECTROMETRY

BASED ON EPA METHOD 8260B

1 SCOPE AND APPLICATION

1.1 This method is a capillary column gas chromatography/mass spectrometry (GC/MS) method used to determine part per billion concentrations of volatile organic compounds (VOC). The volatiles are introduced into the GC/MS system by the purge and trap technique. This method is based on Method 5030B and 8260B, and is used to determine volatile organic compounds in a variety of matrices. This method is applicable to soil, water, and waste samples.

Compound	CAS No.	Compound	CAS No.
1,1,1,2-Tetrachloroethane	630-20-6	Carbon Tetrachloride	56-23-5
1,1,1-Trichloroethane (1,1,1-TCA)	71-55-6	Chlorobenzene	08-90-7
1,1,2,2-Tetrachloroethane	79-34-5	Chlorodibromomethane	124-48-1
1,1,2-Trichloroethane (1,1,2-TCA)	79-00-5	Chloroethane	75-00-3
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	Chloroform	67-66-3
1,1-Dichloroethane (1,1-DCA)	75-34-3	Chloromethane	74-87-3
1,1-Dichloroethene (1,1-DCE)	75-35-4	cis-1,2-Dichloroethene (cis-1,2-DCE)	156-59-2
1,1-Dichloropropene	563-58-6	cis-1,3-Dichloropropene	10061-01-5
1,2,3-Trichlorobenzene	87-61-6	Dibromomethane	74-95-3
1,2,3-Trichloropropane	96-18-4	Dichlorodifluoromethane	75-71-8
1,2,4-Trichlorobenzene	120-82-1	Di-isopropylether	108-20-3
1,2,4-Trimethylbenzene	95-63-6	Ethylbenzene	100-41-4
1,2-Dibromo-3-chloro-propane	96-12-8	Hexachlorobutadiene	87-68-3
1,2-Dibromoethane	106-93-4	Isopropylbenzene	98-82-8
1,2-Dichlorobenzene	95-50-1	Methylene chloride	75-09-2
1,2-Dichloroethane (1,2-DCA)	107-06-2	Methyl-tert-butylether (MTBE)	1634-04-4
1,2-Dichloropropane	78-87-5	m-Xylene	108-38-3
1,3,5-Trimethylbenzene	108-67-8	Naphthalene	91-20-3
1,3-Dichlorobenzene	541-73-1	n-Butylbenzene	104-51-8
1,3-Dichloropropane	142-28-9	n-Hexane	110-54-3
1,4-Dichlorobenzene	106-46-7	n-Propylbenzene	103-65-1
2,2-Dichloropropane	594-20-7	o-Xylene	95-47-6
2-Butanone (MEK)	78-93-3	p-Isopropyltoluene	99-87-6
2-Chlorotoluene	95-49-8	p-Xylene	106-42-3
2-Hexanone	591-78-6	sec-Butylbenzene	135-98-8
2-Pentanone,4-methyl (MIBK)	108-10-1	Styrene	100-42-5
4-Chlorotoluene	106-43-4	tert-Butylbenzene	98-06-6
Acetone	67-64-1	Tetrachloroethene (PCE)	127-18-4

Benzene	71-43-2	Tetrahydrofuran	109-99-9
Bromobenzene	108-86-1	Toluene	08-88-3
Bromochloromethane	74-97-5	trans-1,2-Dichloroethene	156-60-5
Bromodichloromethane	75-27-4	trans-1,3-Dichloropropene	10061-02-6
Bromoform	75-25-2	Trichloroethene (TCE)	79-01-6
Bromomethane	74-83-9	Trichlorofluoromethane	75-69-4
Carbon Disulfide	75-15-0	Vinyl chloride	75-01-4

1.1 This method is used to identify and quantitate volatile organic compounds that have boiling points below 200 °C.

1.2 The GC/MSD provides for selective detection of the VOCs by extracting specific ions for quantitation and qualification from the total ion chromatogram. Compound identification is performed by comparing the unknown compounds retention time and spectra against reference mass spectrum and retention time acquired from authentic standards.

1.3 The Chemist should be a chromatography expert capable of operating and maintaining the purge and trap GC/MS system and experienced in the analysis of VOCs. Training includes generating a valid initial calibration and an acceptable initial demonstration of capability study in addition to understanding the use of mass spectra for identification and quantitation.

2 SUMMARY OF METHOD

2.1 Water samples are analyzed directly without any sample preparation by GC/MS purge and trap. Soil samples require extraction with methanol. An aliquot is then added to reagent water and analyzed by purge and trap GC/MS.

2.2 The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method. This method purges the VOCs from the water matrix into a stream of inert helium gas. The VOCs are trapped from the gas stream onto an organic polymer at room temperature. When the polymer is rapidly heated, the VOCs desorb back into the gas stream and enter the GC. The analytes are introduced directly to a narrow-bore capillary column from the purge and trap using a direct split-injector interface at the gas chromatograph (GC). The column is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) directly interfaced to the GC. A total ion chromatogram of a mid-range calibration standard is provided in Figure 2.

2.3 Identification of target analytes is accomplished by comparing their mass spectra with the mass spectra of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using an average response factor regression type analysis.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Major contaminant sources are volatile materials and solvents that enter the atmosphere or diffuse into the de-ionized water which will be concentrated on the trap during the purge and trap operation. Special care must be used with solvents to avoid methylene chloride and acetone contamination. The VOC laboratory is isolated from the remainder of the laboratory across the parking lot in the annex. No solvents other than methanol must enter this laboratory. Methanol is stored apart from other solvents in the VOA annex.

4.2 Chloromethane can form as a by-product with hydrochloric acid preservation of water samples. Chloromethane can also be generated on a used trap contaminated with salts in the purge and trap system. Corrective action should be taken whenever the chloromethane level exceeds 2.0 µg/L. Corrective action could include, but not be limited to, replacing the trap or using an alternative chemical preservative for waters.

4.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample container into the sample during shipment and storage. A trip blank prepared from organic-free water or methanol and carried through the sampling, handling, and storage protocols serves as a check on such contamination. Trip blanks are issued to clients with each bottle order.

4.4 Contamination of the purge and trap system will occur when a sample is analyzed containing VOCs that exceed 100 µg/L. Erroneous positive results will occur when a sample containing low concentrations of volatile organic compounds is analyzed immediately after a sample containing very high concentrations of volatile organic compounds. After analysis of a sample containing high concentrations of volatile organic compounds, a calibration blank should be analyzed to check for cross contamination. This carry-over is minimized by application of single use glassware but not eliminated.

4.4.1 The purge and trap should be programmed to run through a “clean” cycle prior to the analysis of actual samples. This clean cycle is a two step process. In the first step, no purge tube is attached and for 1.5 minutes excess water is blown out of the purge lines. In the second step, a purge tube is attached and for 5 minutes clean helium gas is purged through the system. Finally, the sample is loaded into the purge tube through the 3-way valve without breaking the tube’s inert seal (See 9.6.1, Table 8).

4.4.2 Screening of unfamiliar samples prior to purge-and-trap GC/MS analysis is recommended to prevent contamination of the system. Screening of soil samples is accomplished by analyzing an aliquot of the soil methanol extract first by

Direct Injection GC/MS (see LAM-010). Alternative methods of screening soil extracts include GC with either electron capture detection (ECD) or flame ionization detection (FID). Screening of water samples is best accomplished with the purge and trap GC/MS system by performing a minimum 100 fold dilution on the sample. Alternatively, water samples may be screened by GC/ECD for common chlorinated VOCs – 1,1-DCE, 1,1-DCA, cis-1,2-DCE, PCE, TCE, and 1,1,1-TCA.

4.5 High levels of petroleum hydrocarbons, such as those found in diesel fuel, will generate interferences for 1,1,1,2-tetrachloroethane, 2-chlorotoluene, 4-chlorotoluene and 1,2,3-trichloropropane. Noisy quantitation ion profiles and poor qualifier ion matches associated with these compounds due to the petroleum interference will be evident during data analysis and will interfere with the accurate analysis of these compounds.

4.6 The internal standard, pentafluorobenzene, co-elutes and interferes with the qualifier ion for 1,1,1-TCA at m/z 61. Poor "Q Value" matches will result for 1,1,1-TCA from this interference at concentrations below 5 µg/L. Pentafluorobenzene elutes within the extraction windows for carbon tetrachloride at m/z 117 and 1,1-dichloropropene at m/z 75. These compounds may be detected by the contribution from pentafluorobenzene; however the retention time will not be accurate. Similarly, the surrogate, bromofluorobenzene, elutes within the extraction window of 1,2,3-trichloropropane at m/z 75.

4.7 Methanol from soil extracts and added to water samples interferes with bromomethane and chloroethane. The methanol has a quenching effect upon the operation of the MSD for the period that it co-elutes from the column with these compounds. The response of bromomethane and chloroethane is erratic and suppressed due to the methanol.

4.8 The response of the ketones (acetone, MEK, MIBK, 2-hexanone) and tetrahydrofuran is controlled by their purging efficiency. Their purging efficiency is affected by the ambient temperature of the sample in the purge tube. Every attempt should be made to maintain a stable temperature in the laboratory.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves must be worn while samples, standards, solvents, and reagents are being handled during this procedure. Lab coats are recommended.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 Gas Chromatograph / Mass Spectrometer System

Gas Chromatograph:	HP 5890 with Split/Splitless Injector
Detector:	HP 5971 Mass Selective Detector
Purge and Trap:	2 Tekmar LSC 2000s and ALS 2016s with Duet interface
Trap:	Supelco Trap K
Column:	RTX-624, 30 m x 0.32 mm I.D., 1.8 µ film or equivalent
Data System:	Agilent MSD Productivity Chemstation with Enviroquant

6.1.1 GC/MS supplies list

Seals:	Dual Vespel Ring Inlet Seal, Restek Cat.#21239
Septa:	LB-2 Septa, 11mm, Supelco #164742
Ferrules:	1/16” x 0.5 mm Vespel/Graphite, Restek Cat# 20231/20249
Liners:	Gooseneck Splitless Liner 4 mm x 6.5 mm x 78.5 mm, Restek Cat.#20799

6.2 Computer Hardware: HP Compaq DC7600

6.3 Computer Software: Microsoft Windows 2000 with Agilent MS Productivity G1701BA with Enviroquant Data Analysis

6.4 Shaker table

6.5 Ultrasonic bath

6.6 Centrifuge capable of holding 40 mL VOA vials

6.7 Balances

6.7.1 Top loader capable of weighting to 0.01 gram

6.7.2 Analytical capable of weighting to 0.0001 gram

6.8 Sample syringe: 10 mL Gastight with a Teflon® Luer-lock tip

6.9 Micro-syringes: Gastight, 10, 25, 100, 250, 500, and 1,000 µL

6.10 Vials:

6.10.1 40 mL VOA vials

6.10.2 40 mL VOA vials preserved with 0.5 mL of 1:1 HCL

6.10.3 40 mL VOA vials containing 10 mL of purge and trap grade methanol, labeled and pre-weighed. Used for sampling of soils using Lock and Load system. See GEN-003, Chain-of-Custody, Log In, Tracking Procedures, and Sample Tracking for more details.

6.10.4 GC vials: 2 mL amber autosampler vials Catalog. #40811A-120 and PTFE/silicon aluminum seals, Part #5150-11, LSDC

6.10.5 "Lock and Load" sampling supplies

6.10.6 Plastic syringes for collection of a nominal 10 gram soil sample, Environmental Sampling Supply Part # LL5035SRNG

6.10.7 Plastic re-usable handle, Environmental Sampling Supply Part # LL5035HNDL

6.11 Specimen container (5 oz.) with lid for collection of soils intended for percent solids analysis, VWR Part # 15704-020 and 15704-019.

6.12 Disposable single use glass purge tubes, 19 x 150 mm glass culture tubes, VWR Part # 45060-19150

6.13 Glass disposable transfer pipettes – 5 ¾"

6.14 Metal hub needles: 18 gauge, 1.27 mm O.D., 0.84 mm I.D. Hamilton part # 90018 or equivalent for attachment to the 10 mL Luer lock syringe when adding makeup methanol to samples

6.15 Optifix solvent dispenser capable of 10 mL volume (EM Science or equivalent)

6.16 Stainless steel spatulas

6.17 Drying oven capable of maintaining 105 °C

6.18 Refrigerator capable of maintaining 4 °C

6.19 Freezer capable of maintaining temperatures below -15 °C

6.20 Plastic 250 to 500 mL squirt bottles

7 REAGENTS

7.1 Solvents

7.1.1 VOC-free water purchased commercially.

NOTE: Store away from contact with other solvents except methanol.

7.1.2 Methanol: purge & trap grade, stored away from contact with other solvents.

7.2 Solids – not applicable to this method

7.3 Acids/bases – not applicable to this method

7.4 Stock Standards

7.4.1 Stock initial calibration standard solutions - Stock solutions are purchased from vendors as certified concentrations in methanol. The vendor is Absolute Standards. The 54 liquids (Part # 32001), 6 gases (Part #30058), are purchased at 2000 µg/mL. The ketones (Part# 82492) and tetrahydrofuran (Part# 34191) are purchased at 20,000 ug/mL. Additional compounds to complete the target list, MTBE, carbon disulfide, di-isopropyl ether, hexane, and 1,1,2-trichloro-1,2,2-trifluoroethane are purchased individually at 1000 µg/mL. Their respective part numbers are 70209, 70060, 70987, 70962, , and 70474. Table 4 provides a listing of components in each stock solution. Stocks are used only once when the ampoule is opened and then diluted to prepare the working solution.

7.5 Intermediate Standard Solution:

7.5.1 (20/100/200 µg/mL)

7.5.1.1 The working intermediate standard solution (20/100/200 µg/mL) is prepared by diluting the stock standard solutions (See 7.4.1) in a 50 mL volumetric flask with methanol.

7.5.1.2 The working standard is prepared at 20 µg/mL for all targets except the ketones (200 µg/mL) and tetrahydrofuran (100 µg/mL).

7.5.1.3 Fill a 50 mL volumetric flask ¾ full of purge and trap grade methanol known to be free of volatiles. Make sure the volumetric has enough methanol so that a syringe needle tip can be submerged in the methanol.

7.5.1.4 Aliquots of the stock are added below the level of methanol in the flask from the syringe needle.

NOTE: Table 5 summarizes the preparation of this standard.

7.5.1.4.1 Using a 500 µL Gastight syringe, aliquot 500 µL of the 2000 µg/mL liquid (32001) and gas stock (30058) to the 50 mL volumetric.

7.5.1.4.2 Using a 1000 µL Gastight syringe, aliquot 1000 µL of the individual standards (70209, 70060, 70987, 70962, and 70474) to the 50 mL

volumetric.

7.5.1.4.3 Using a 500 µL Gastight syringe, aliquot 500 µL of ketones (82492) and 250 µl of tetrahydrofuran (34191) to the 50 mL volumetric.

7.5.1.5 Once all components are added to the 50 mL volumetric, make to volume with purge and trap grade methanol.

7.5.1.6 The standard is subdivided into 2 mL GC vials. Make sure to fill each vial full and cap. Store frozen and assign a one month expiration date.

7.6 Calibration Standards: Prepare calibration standards directly in the 10 mL Luer-lock syringe at eight levels immediately prior to loading them onto the purge and trap autosampler (See Step 9.7.3).

7.7 Surrogate

7.7.1 See 7.11, internal standard/surrogate solution

7.8 Laboratory Control Sample (LCS) Stock Solution

7.8.1 The LCS spike mix is also the intermediate standard mix detailed in Section 7.5.

7.9 MS/MSD Spike Mix

7.9.1 The MS/MSD spike mix is also the intermediate standard mix detailed in Section 7.5.

7.10 LOD Spike Mix: The LOD spike mix is also the intermediate standard mix detailed in Section 7.5. Add 0.2µL of the intermediate standard to 10 mLs of reagent water when preparing the water LOD sample. Add 10µL of the intermediate standard to 10mL of methanol when preparing the soil LOD sample.

7.11 Second Source

7.11.1 Stock second source standard solutions: The second source stock standards are acquired from a different commercial vendor than that used for the initial calibration standard. This second source is Restek Corporation. A mega mix (Part #30633) contains the vast majority of the compounds at 2,000 µg/mL. The gases (Part #30042), and oxygenates (MTBE, di-isopropyl ether, Part #30465) are also acquired at 2000 µg/mL. The ketones (Part #30006) are acquired at 5,000 µg/mL. Table 4 provides a listing of components in each stock solution. A hexane stock is not available from Restek and therefore is not included in the second source standard.

7.11.2 Intermediate second source standard (20/200 µg/mL)

7.11.2.1 Similar to the intermediate calibration standard, the second source standard

is prepared at 20 µg/mL for all targets, except the ketones (200 µg/mL).

7.11.2.2 Fill a 25 mL volumetric flask ¾ full of purge and trap grade methanol known to be free of volatiles. Make sure the volumetric has enough methanol so that a syringe needle tip can be submerged.

7.11.2.2.1 Using a 500 µL Gastight syringe aliquot 250 µL of Mega Mix (36033) to the 25 mL volumetric.

7.11.2.2.2 Using a 1000 µL Gastight syringe aliquot 1,000 µL of the ketone mix (30006) to the 25 mL volumetric.

7.11.2.2.3 Using a 500 µL Gastight syringe aliquot 250 µL of the six gases (30042) and 250 µL of the oxygenates (30465) into the 25 mL volumetric.

NOTE: Once vials are opened and aliquots taken, vials are discarded.

7.11.2.3 Make to volume with methanol, transfer to 2 mL GC vials and cap tightly.

7.11.2.4 Store frozen at all times and assign a one month expiration date.

7.12 Internal Standard/Surrogate

7.12.1 Stock internal standard and surrogate solutions: Stock solutions are acquired commercially as certified solutions in methanol from Restek. The internal standards (Part #30074) and surrogates (Part #30073) are purchased at 2,500 µg/mL. Table 4 provides a listing of the components in each stock solution.

7.12.2 Working internal standard/surrogate solution

7.12.2.1 The working internal standard/surrogate solution is prepared at 25 µg/mL by diluting the stock standard solutions (See 7.12.1) in a 50 mL volumetric flask. With a 2500 µg/mL stock internal or surrogate standard, 500 µL would be added to the flask. Table 5 summarizes preparation of this standard.

7.12.2.2 Fill a 50 mL volumetric ¾ full of purge and trap grade methanol known to be free of volatiles. Make sure the volumetric has enough methanol so that the syringe needle tip can be submerged below the level of the methanol.

7.12.2.3 Using a 500 µL Gastight syringe aliquot 500 µL of internal standard Mix (#30074) and add to the 50 mL volumetric.

7.12.2.4 Using a 500 µL Gastight syringe aliquot 500 µL of Surrogate Mix (#30073) and add to the 50 mL volumetric.

NOTE: Discard unused ampoules once aliquot has been taken.

7.12.2.5 Make to volume with purge and trap methanol.

7.12.2.6 Once prepared, the working internal standard/surrogate solution is then portioned into 2 mL GC vials for daily use. Each vial is filled to its neck and capped.

7.12.2.7 Assign an expiration date of three months, enter information into LIMS system and store frozen

7.13 BFB tuning standard (25 µg/mL)

7.13.1 The BFB Tuning Standard is also the Working Internal Standard/Surrogate solution (7.12.2).

7.13.2 Add 2µL of this standard to 10mL of deionized water resulting in 50 ng of BFB delivered to the GC/MS system.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Water Samples

8.1.1 Glass 40-mL VOA vials, containing 0.5 mL of 1:1 HCl with Teflon® lined septa are provided by ECCS for water samples. Hydrochloric acid preserved VOA vials are purchased from a variety of vendors. Once VOA vials are received at ECCS laboratories they are stored in a refrigerator at 4 °C. Water samples preserved with 1:1 HCl have a hold time of 14 days. Water samples not preserved with 1:1 HCl have a hold time of 7 days.

NOTE: HCl is used to eliminate/retard degradation of compounds by bacteria.

NOTE: A temperature blank may be used if temperature reporting is critical.

8.2 Soil Samples

8.2.1 Methanol preserved

8.2.1.1 ECCS supplies a pre-weighed 40 mL VOA vial containing 10 mL of methanol for soil collection. In addition, ECCS supplies a Lock and Load T handle (See 6.11) and disposable sample container for collection of a pre-measured approximately 10 g of soil. The client is responsible to put the nominal 10 g of soil from the Lock and Load syringe into the VOA vial containing purge and trap methanol.. Soil samples received are stored in a refrigerator at 4 °C.

8.2.1.2 An alternative approach used with a mobile laboratory is for the client to collect the soil sample with a Lock and Load disposable syringe and quickly submit the core still contained in the capped syringe to the laboratory. The laboratory immediately extrudes the core into a tared 40 mL VOA vial

containing 10mL of purge and trap methanol and measures the weight of the soil. Methanol preserved soil samples have a hold time of 14 days from time of collection.

8.2.2 Soil samples not preserved in methanol are out of control and require a note in the comments of the VOA extraction log (See Figure 5) and in the case narrative. These soil samples are extracted as soon as practical.

9 PROCEDURE

9.1 Sample Preparation

9.1.1 Water Samples: Water samples are analyzed directly.

9.1.1.1 Withdraw 10 mL or an appropriate aliquot (based upon the screening analysis) of the water sample from the VOA vial into the 10 mL Luer lock syringe.

9.1.1.2 Tilt the VOA vial while withdrawing the sample to prevent inclusion of air bubbles.

9.1.1.3 Using a 250 µL syringe, add 200 µL of methanol through the Luer tip of the 10 mL syringe containing the unknown sample, Then add 10 µL of the surrogate/IS solution (See 7.12.2) with a 25 µL syringe.

9.1.1.4 Immediately transfer the sample from the 10 mL syringe into the Tekmar ALS 2016 purge tube assigned to that sample.

9.1.2 Preparation of water blanks

9.1.2.1 Fill a 10 mL Luer lock syringe with 10 mL of clean water.

9.1.2.2 Add 200 µL of methanol. Add 10 µL of surrogate/IS solution (See 7.11.2) to the 10 mL of water.

9.1.2.3 Lock the syringe to the appropriate position on the Purge and Trap autosampler and transfer the blank into the purge tube.

9.1.2.4 Method blank frequency is 1 per purge and trap side/20 samples or less.

9.1.3 Preparation of LCS Samples: LCS samples for waters are identical to CCV standards, so LCS samples are not required for waters.

9.1.3.1 CCV/LCS are prepared the same.

9.1.3.2 Fill a 10 mL Luer lock syringe with 10 mL of clean water.

9.1.3.3 Add 198 µL of methanol.

9.1.3.4 Add 10 µL of surrogate/IS solution (See 7.11.2) to the 10 mL of water.

9.1.3.5 Add 2.5 µL of the 20/200/100 µg/mL intermediate standard (See 7.5.1) to the 10 mL in the syringe.

9.1.3.6 Lock the syringe to the appropriate position on the purge and trap autosampler and transfer the CCV/LCS into the purge tube.

9.1.3.7 CCV/LCS frequency is 1 per purge and trap side/10 unknowns or tubes.

9.1.4 Matrix spike water samples: Load a duplicate volume of sample into the 10 mL Luer lock syringe as described in Section 9.1.5. Add 198 µL of methanol followed by 10 µL of the surrogate/IS solution (See 7.12.2). To fortify the sample, add 2.5 µL of the 20/200/100 µg/mL intermediate standard (See 7.5) resulting in an addition of 5.0 µg/L. The ketones and tetrahydrofuran are spiked at 50 and 25 µg/L, respectively. Lock the syringe to the appropriate position on the purge and trap auto-sampler and transfer the sample into the purge tube. Repeat the process for the matrix spike duplicate sample.

9.1.5 Soil Samples: Client supplied soil samples in non-ECCS containers, preserved with methanol – use weight of soil and volume of methanol supplied with the sample.

9.1.5.1 Client supplied soil samples, no methanol

9.1.5.1.1 Accurately weigh about 10 g of soil into a 40 mL VOA vial, record weight and add 10 mL of methanol.

9.1.5.2 Client supplied soil in Lock and Load syringe

9.1.5.2.1 This commonly occurs with use of the mobile laboratory

9.1.5.2.2 A 40 mL VOA vial is tared on a top loading balance and the soil core is extruded into the vial with the weight recorded to XX.XX g.

9.1.5.2.3 Immediately add 10 mL of methanol to the vial immersing the soil.

9.1.5.3 VOA vials supplied by ECCS with the Lock and Load supplies.

9.1.5.3.1 Each VOA vial contains 10 mL of methanol and the entire container was pre-weighed prior to shipment to the client. The total container weight to 0.XX g (Vial, label, and methanol) is recorded on the label with indelible marker.

9.1.5.3.2 Upon receipt at ECCS the vial is reweighted to 0.XX g. The weight is recorded on the COC and the information is entered into the laboratory

information management system (LIMS) either by sample entry or by the chemist prior to analysis.

9.1.5.3.3 The soil weight obtained is the wet weight to be used for sample analysis.

9.1.5.4 A paper record of the determination of soil weight is kept in the VOA Extraction Log (See Figure 5).

9.1.6 Extraction by shaker table/sonication:

9.1.6.1 With clay and dense type soils it may be necessary to break up the soil clods into smaller pieces by mechanical means. A stainless steel spatula is used to manually break up the clods while immersed in methanol and in the VOA vial.

9.1.6.2 Position the ultrasonic bath on the shaker table platform so the long side of the bath is oriented in the same direction as the horizontal movement of the shaker table.

9.1.6.3 Place two foam VOA vial shipping blocks on each end the VOA vial containing the methanol preserved soil samples. Place the blocks and VOA vials into the sonicator lengthwise so the VOA vials are positioned on their sides. Place enough water in the bath to cover the top vials but keep the water level below 2 inches from the top of the sonicator. The water in the bath needs to be clean, free of dust and debris, in order to effectively transfer energy in the bath. It may be necessary to place weight on top of the vials and blocks to keep them submerged. Plastic ice blocks can be used for this purpose.

9.1.6.4 Adjust the variable speed of the shaker table to provide 120 cycles per minute of horizontal shaking without spilling water over the sides of the sonicator.

9.1.6.5 Sonicate and shake the samples for 20 minutes.

NOTE: The sonicator bath needs to be kept cool either by using ice or changing the water.

9.1.6.6 Allow the samples to equilibrate for approximately 20 minutes after sonication prior to opening the vial. Aliquoting extracts and archiving: .Allow the soil to settle from the upper layer of clear methanol extract - usually ½ hour. Alternatively, the vial may be centrifuged at a low speed (<1500 rpm) to separate the clay soils from the extract. If the vial is centrifuged, still allow ½ hour before opening the vial.

9.1.6.7 VOA vials containing soil extracts may be stored in a refrigerator or a portion may be transferred to a crimp top vial for storage in a freezer.

9.2 Clean-up Methods - not applicable for this method

9.3 Instrument Conditions

9.3.1 GC/MSD pump down: Allow the GC/MS system to stabilize under high vacuum when starting from a vented state. Before analysis, allow at least 4 hours for the MS to stabilize after pump-down.

9.3.2 Purge and trap & GC/MS operating conditions

9.3.2.1 Purge and trap:

Purge Flow:	Helium, 35 mL/min.
Purge Time:	11 minutes
Dry Purge:	2 minutes
Desorb:	1 minute at 250 °C
Bake Time:	8 minutes at 260 °C

9.3.2.2 GC conditions:

Column:	DB-624, 30 m x 0.32 mm, 1.8 µm film
Injector Temp:	200 °C
Transfer Line Temp:	280 °C
Column Head Pressure:	2 PSI
Column Flow:	1.7 mL/min
Split Flow:	120 mL/min
Split Ratio:	82:1

Oven Temperature Program

Initial Temperature:	45 °C
Initial Hold:	4 minutes
Initial Ramp:	23 °C/ minute
Final Temperature:	240 °C
Final Hold:	2.5 minutes

9.3.2.3 MS conditions

Tune:	maximum sensitivity autotune
EM Voltage:	2000 (200 above autotune)
Scan Range:	45-260 amu
Scan Time:	2 scans/sec

9.3.3 Screening Methods

9.3.3.1 Water samples or soil extracts should be initially screened by one of the two following methods for potentially high levels of VOCs that might otherwise contaminate the purge and trap system.

9.3.3.2 Screening by purge and trap

9.3.3.2.1 A 100 fold dilution is a good starting point when using the purge and trap to screen water samples or soil extracts.

9.3.3.2.2 Pull up 9.9 mL of clean water into the 10 mL Gastight syringe.

9.3.3.2.3 Using a 100 µL Gastight syringe, aliquot 100 µL of the unknown water sample or 2 µL of the soil extract and add to the 10 mL syringe.

9.3.3.2.4 Add 200 µL of methanol and 10 µL of the surrogate/IS solution (7.12.2) and transfer the sample to the Tekmar 2016 purge and trap autosampler.

9.3.3.3 Direct inject GC/MS screening: See LAM-010 .

9.4 Preventative Maintenance/Troubleshooting

9.4.1 Cleaning the purge and trap system: To minimize the possibility of carryover from occurring between analyses the purge and trap should be cleaned and programmed to run through a "clean cycle" prior to the analysis of actual samples, especially whenever high concentrations of VOCs, above 50 µg/L, have been previously run on the system. Cleaning the purge and trap involves swabbing the outside of the Luer lock threads and purge needle on the purge and trap with a clean "Kimwipe" moistened with reagent water. Reagent water is then used to rinse the 3-way valve and purge needle. The purge and trap "clean cycle" is a two step process. In the first step, no purge tube is attached and for 1.5 minutes excess water is blown out of the purge lines. This step uses Method 2 on the purge and trap. In the second step, a new purge tube is attached and for 5 minutes clean helium gas is purged through the system. This step uses Method 3 on the purge and trap. The tube is never removed after the second step and the sample is loaded to the tube through the 3-way valve. The very short, dummy GCMS acquisition is performed during these two steps so the duet box will switch and alternate between the two purge and trap systems. Table 8 summarizes the purge and trap and GCMS conditions used for this "clean cycle."

9.4.2 The maximum sensitivity autotune report (See Figure 1) for the MSD serves as a useful diagnostic tool. It can be used to indicate when maintenance on the MSD is required.

9.4.2.1 Detection of leaks in the GC/MS system: The presence of a base peak at m/z 28 (N2) that is higher than m/z 69 (base peak of PFTBA) in the tune report indicates the presence of a gross leak in the GC/MS vacuum system. A common source of the leak is a loose transfer line nut sealing the GC capillary column to the MSD transfer line. Tightening this nut often eliminates a leak.

9.4.2.2 Water in the GC/MS system: The presence of a base peak at m/z 18 (H20)

that is higher than m/z 69 in the tune report indicates excessive water remains in the MSD manifold. The MSD vacuum system does not efficiently remove water and this condition indicates that a longer equilibration time is needed prior to initial calibration.

9.4.2.3 Electron multiplier voltage: An electron multiplier voltage higher than 2700 in the tune report indicates that the multiplier needs replacement and/or the MSD source needs cleaning.

9.4.2.4 Peak shape/resolution of PFTBA calibration peaks: The appearance of the PFTBA peaks (m/z 69, 219, 502) used to calibrate the MSD should be symmetric without any shoulders. Isotope masses of these same peaks (m/z 70, 220, 503) should be present and indicated in the auto tune report. Non-symmetric peak shape or the non-detection of isotope masses usually indicates that the MSD source needs to be cleaned.

9.4.3 The response factors of system performance check compounds (SPCCs) calculated during the initial calibration also serve as useful diagnostic tool. SPCCs are used to check that purge and trap and GC conditions are appropriate and that compound degradation is acceptable. Chloromethane will be low if the purge flow is too fast while bromoform will be low if the flow is too slow. 1,1-DCA and especially 1,1,2,2-tetrachloroethane will be low due to degradation from active sites on contaminated transfer lines or valves in the purge and trap system. Clipping the front end of the GC column can be the first action taken to eliminate active sites. Flushing the lines and valves of the purge and trap system with 1:1 HNO_3: water, de-ionized water, and methanol may further remove the active sites. Finally, it is often necessary to totally replace contaminated lines or valves in the purge and trap system when active sites are encountered.

9.5 Retention Time Windows: The retention time window for extracted ion chromatograms in peak identification is 0.6 minutes wide. The GC/MS software then identifies the peak in this window with the relative retention time closest to the actual relative retention time determined from the authentic standard. The window must be this wide in order for the software's integration algorithm to have sufficient time to accurately calculate baselines as part of peak integration. The absolute retention time of target compounds should not vary by more than ± 0.05 minutes when compared to the authentic standard. However, retention times are used, only in part, to qualitatively identify compounds as in conventional GC analysis. Rather, the GC/MS method also utilizes the mass spectra of peaks for qualitative identification of target compounds.

9.6 Instrumental Analysis

9.6.1 Using the results of a few test analyses, adjust the electron multiplier voltage for the MSD tune file accordingly to achieve approximately 750,000 thousand area counts for the internal standard, 1,4-difluorobenzene, Analyze a low standard at 0.5 µg/L to verify adequate sensitivity once the EM voltage has been adjusted.

9.6.2 The GC/MS system is software-tuned by successfully completing a maximum sensitivity autotune. Perflurotributylamine (PFTBA) is the tuning compound used by the MSD during the maximum sensitivity autotune. A hardcopy report is generated from the tune (See Figure 1). See Section 7.6.2 for interpretation of the tune report. Further manual adjustments to the MSD optics settings may be also be necessary in order to successfully pass the following BFB tuning evaluation.

9.6.2.1 BFB tuning evaluation: Introduce 50 ng of the BFB tuning standard (See 7.13) into the Purge and trap GC/MSD system..

9.6.2.2 The mass spectra acquired from the BFB tuning standard must pass the acceptance criteria provided in Table 9

9.6.2.3 The BFB mass spectra used for tune evaluation may be a single scan or an average using any combination of the three individual MSD scans for BFB including the peak apex and the two scans to the right and/or left of the peak apex. Using a background subtracted BFB mass spectra is preferred using an appropriate background region adjacent to the BFB peak.

9.6.3 Calibration Standards: A separate series of calibration standards must be analyzed on each of the two Tekmar 2016 auto-samplers used with the Tekmar Duet purge and trap configuration. Similarly, separate quantitation methods are used to calculate VOC concentrations for samples analyzed on each of the two auto-samplers.

9.6.3.1 Prepare calibration standards as outlined in Section 9.6.4 to be used for both soil and water samples. The total volume of methanol added to calibration standards is 210 µL. When analyzing waters only, a separate calibration may be performed using less methanol in order to increase accuracy of bromomethane and chloroethane. Prepare a second source verification standard from the intermediate second source standard (See 7.10.2) at 5 µg/L and analyze with each initial calibration on Side A and Side B of the purge and trap.

9.6.4 Accurate use of micro-syringes: Care must be exercised when making a measurement with a micro-syringe that air bubbles are not included and that the syringe barrel does not partially drop during handling thus ejecting a portion of the aliquot. Air bubbles can be eliminated from the syringe by lifting and pumping the syringe plunger quickly a few times prior to measuring the aliquot. Draw the aliquot up slowly for the final measurement. Do not invert the vial containing a standard while filling the syringe as excess standard will run down the outside needle of the syringe resulting in a high bias. When handling an aliquot contained in a syringe, hold the syringe in a manner that a finger is slightly pushing against the extended plunger of the syringe to prevent its movement.

9.6.5 Standard curve preparation

9.6.5.1 The total volume of methanol for initial calibration standards is 210µL. To

prepare the level 1 ICAL (0.5 µg/L) add 200 µL of makeup methanol through the Luer tip into the 10 mL of water in the 10 mL syringe. Using a 10 µL syringe add 10 µL of Surrogate/IS (See 7.12.2) through the Luer tip in to the 10 mL of water. Using a 1 µL syringe add 0.25 µL of spike mix (See 7.5.1) through the Luer tip into the 10 mL of water.

9.6.5.2 Immediately transfer the standard into the Tekmar ALS 2016 tube assigned to that ICAL level.

9.6.5.3 ICAL Levels L-2 through L-8 follow the ICAL grid as listed in Table 6.

9.6.5.4 Analyze each of the calibration standards listed in Section 9.6.4, collect the data and tabulate the area response of the characteristic ions against the concentration for each target compound using internal standard method. Characteristic ions are listed in Table 3. The internal standard selected for the calculation of these ratios should be the internal standard that has a retention time closest to the compound being measured. The internal standard used for each target compound is provided in Table 7. Calculate amount ratios and response ratios for each target compound and at each calibration level relative to the appropriate internal standard.

The amount ratio and response ratios are calculated as follows:

$$Amount\ Ratio = \frac{C(s)}{C(is)}\ Response\ Ratio = \frac{A(s)}{A(is)}$$

Where:

A(s) = Peak area of the target compound or surrogate
A(is) = Peak area of the internal standard
C(s) = Concentration of the target compound or surrogate in µg/L
C(is) = Concentration of the internal standard in µg/L

9.6.5.5 Calculation of response factors (RF) and percent relative standard deviation (% RSD): Calculation of response factors are used to evaluate the initial calibration against specific criteria listed in method 8260 and is also used to quantitate sample concentrations. Individual response factors are calculated by the following formula for each calibration level:

$$Response\ Factor\ (RF) = \frac{Response\ Ratio}{Amount\ Ratio}$$

The % RSD is calculated by the following formula:

$$\%\ RSD = \left(\frac{RF_{STDEV}}{RF_{AVE}}\right) \times 100$$

Where:

RF_{STDDEV} = Standard deviation of individual response factors
RF_{AVE} = Average of individual response factors

NOTE: Chemstation has software to calculate and generate a response factor report for every ICAL generated. See Figure 4 for example.

9.6.5.6 Calibration check compounds (CCCs): The % RSD of the response factors must be < 30% for individual CCCs in order for the initial calibration to be valid. The CCCs are:

vinyl chloride	1,1-dichloroethene
chloroform,	1,2-dichloropropane
toluene	ethylbenzene

9.6.5.7 The % RSD for other target compounds must also be less than 30%, except for 1,2-dibromo-3-chloropropane and naphthalene which must be less than 40%. In addition, bromomethane, chloroethane, acetone, 2-butanone, tetrahydrofuran, methyl isobutyl ketone, and 2-hexanone are exempt from a % RSD requirement. These compounds must meet a linear calibration criteria of correlation coefficient (r^2) of > 0.990.

9.6.5.7.1 If the correlation coefficient or % RSD does not meet the acceptance criteria for any compound then the integrity of the system is failing and corrective action is needed to eliminate a system leak and/or active sites (See 9.6). Visual inspection of a calibration curve can be a useful diagnostic tool. The inspection may indicate analytical problems, including errors in standard preparation, the presence of active sites, or poor chromatographic behavior. Polar compounds, like acetone, purge poorly and will always exhibit an erratic response.

9.6.5.8 System performance check compounds (SPCCs) are monitored for a minimum average response factor (RF_{AVE}) from the initial calibration data. Figure 4 provides a data system report listing a summary of response factors. The SPCCs and the minimum average response factor are:

chloromethane	0.10	1,1-dichloroethane	0.10
chlorobenzene	0.30	bromoform	0.10
1,1,2,2-tetrachloroethane	0.30		

9.6.5.9 The average response factor is determined by the data system from the mean of individual response factors by the formula:

9.6.5.10 $$RF_{AVE} = \frac{\Sigma\left(\frac{Response\ Ratio}{Amount\ Ratio}\right)}{N}$$

9.6.5.11 Where: N = Number of standards used in ICAL.

9.6.5.12 The average RF calculated from the calibration data must be greater than the

minimum average response factors in order for the initial calibration to be valid.

9.6.5.13 SPCCs are used to check that purge and trap and GC conditions are appropriate and that compound degradation is acceptable. Chloromethane will be low if the purge flow is too fast while bromoform will be low if the flow is too slow. 1,1-Dichloroethane and especially 1,1,2,2-tetrachloroethane will be low due to degradation from active sites on contaminated transfer lines or valves in the purge and trap system.

NOTE: Typically, the first compound to fail is the 1,1,2,2-TCA. If failure occurs, the system may need to be cleaned, non use of purge & trap location, and/or the 1,1,2,2-TCA data must be qualified. If problems persist the unit should be removed from service and maintenance performed as noted in other sections of this method.

9.6.5.14 Use of linear calibration curves: Linear calibration curves are used for select target compounds because they typically have high % RSDs. These compounds include:

bromomethane	chloroethane	acetone
2-butanone	tetrahydrofuran	methyl isobutyl ketone
2-hexanone		

9.6.5.14.1 Bromomethane and chloroethane exhibit erratic response due to methanol quenching of the MSD. The ketones and tetrahydrofuran exhibit erratic purging efficiencies. Plot the response ratio against the amount ratio for each of these target compounds. The curve fit is linear regression with the weight of the inverse of the concentration. The linear regression equation is:

$$Y = m \times x + b$$

Where:
Y = response ratio
m = slope
x = amount ratio
b = intercept
1/x = weighting factor

9.6.5.14.2 The correlation coefficient for these target compounds must be > 0.990.

9.6.6 Updating qualifier ion abundances: The relative responses of qualifier ions for target compounds are updated through the data system with each initial calibration. The 5 µg/L initial calibration standard is used for this purpose. Mass spectra of peaks found in samples are compared to these qualifier ion responses

and the purity of the match is included in the report as a Q value. A Q value above 90 typically indicates the qualitative identification of a target compound in samples. The same qualifier ion ratios are included as a unique window in the Qedit data analysis menu and can further assist the mass spectrometrist during data review.

9.6.7 Second Source Verification: Analyze the second source standard with each initial calibration performed. The second source standard is prepared at 5 ug/l for all target compounds except the ketones at 50 ug/l. Prepare the second source standard by adding 198 µL of makeup methanol to the 10 mL syringe followed by 10 µL of the combined internal standard/surrogate solution (7.12.2). Add 2.5 µL of the intermediate second source (7.11.2) to the 10 mL syringe and load the standard on the 2016 purge and trap autosampler.

9.6.8 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV):

9.6.8.1 The working calibration curve must be verified on each analysis day and every 10 injections and at the end of the run. The concentration of the CCV is 5 µg/L, except for the ketones (50 µg/L) and tetrahydrofuran (25 µg/L). The percent difference between the response factor for the CCCs in the CCV standard and the average response factor determined from the initial calibration data must not vary by more than 20% in order for the calibration to remain valid. If the response factor of any CCC varies by more than 20%, then a new calibration curve must be prepared and affected samples reanalyzed or the data must be appropriately qualified.

$$Percent\ Difference = \left| \frac{(RF_{AVE} - RF_{CCV})}{RF_{AVE}} \times 100 \right|$$

Where:
RF_{AVE} = average response factor from the initial calibration
RF_{CCV} = response factor for the CCV

9.6.8.2 The percent difference must not vary by more than 30% for other target compounds. Initiate corrective action only if a non CCC compound exceeds the 30% limit for any two sequential CCVs. Bromomethane, chloroethane, acetone, 2-butanaone, MEK, tetrahydrofuran, 2-hexanaone and naphthalene are allowed a 40% percent difference.

9.6.8.3 In addition, the SPCCS in the CCV must meet their minimum response factor specified in Section 9.7.5.3 in order for the initial calibration to remain valid.

9.6.8.4 Figure 4 provides a data system report of the % difference between continuing calibration response factors and the initial calibration average response factors.

9.6.9 Water Sample Analysis: Withdraw 10 mL or an appropriate aliquot (based upon the screening analysis) of the water sample from the VOA vial into the 10 mL Luer lock syringe.

9.6.9.1 Tilt the VOA vial while withdrawing the sample to prevent inclusion of air bubbles.

9.6.9.2 Using a 250 µL syringe, add 200 µL of methanol through the Luer tip of the 10 mL syringe containing the unknown sample, Then add 10 µL of the surrogate/IS solution (See 7.12.2) with a 25 µL syringe.

9.6.9.3 Immediately transfer the sample from the 10 mL syringe into the Tekmar ALS 2016 purge tube assigned to that sample.

9.6.9.4 Preparation of water blanks

9.6.9.4.1 Fill a 10 mL Luer lock syringe with 10 mL of clean water.

9.6.9.4.2 Add 200 µL of methanol. Add 10 µL of surrogate/IS solution (See 7.12.2) to the 10 mL of water.

9.6.9.4.3 Lock the syringe to the appropriate position on the Purge and Trap autosampler and transfer the blank into the purge tube.

9.6.9.4.4 Method blank frequency is 1 per purge and trap side/20 samples or less.

9.6.9.5 Preparation of LCS Samples: LCS samples for waters are identical to CCV standards, so LCS samples are not required for waters.

9.6.9.6 Water CCV Preparation

9.6.9.6.1 Fill a 10 mL Luer lock syringe with 10 mL of clean water.

9.6.9.6.2 Add 198 µL of methanol.

9.6.9.6.3 Add 10 µL of surrogate/IS solution (See 7.12.2) to the 10 mL of water.

9.6.9.6.4 Add 2.5 µL of the 20/200/100 µg/mL intermediate standard (See 7.5.1) to the 10 mL in the syringe.

9.6.9.6.5 Lock the syringe to the appropriate position on the purge and trap autosampler and transfer the CCV/LCS into the purge tube.

9.6.9.6.6 CCV frequency is 1 per purge and trap side/10 unknowns or tubes.

9.6.9.7 Matrix spike water samples: Load a duplicate volume of sample into the 10 mL Luer lock syringe as described in Section 9.1.5. Add 198 µL of methanol followed by 10 µL of the surrogate/IS solution (See 7.12.2). To

fortify the sample, add 2.5 µL of the 20/200/100 µg/mL intermediate standard (See 7.5.1) resulting in an addition of 5.0 µg/L. The ketones and tetrahydrofuran are spiked at 50 and 25 µg/L, respectively. Lock the syringe to the appropriate position on the purge and trap auto-sampler and transfer the sample into the purge tube. Repeat the process for the matrix spike duplicate sample.

9.6.10 Soil Aliquot and Analysis

9.6.10.1 Withdraw 10 mL of reagent water into the 10 mL Luer lock syringe.

9.6.10.2 Add 10 µL of the surrogate/IS solution (See 7.12.2) directly into the reagent water in the 10 mL syringe.

9.6.10.3 Using a 250 µL Gastight syringe, remove 200 µL of the soil extract from the 40 mL soil sample VOA vial and add directly into the 10 mL syringe.

9.6.10.4 In all cases, the total volume of methanol in the 10 mL of reagent water prior to loading into the purge and trap is 210 µL.

9.6.10.5 If high levels of VOCs are encountered during a screening process than add the appropriate volume of soil extract followed by addition of methanol so the total volume of methanol equals 210 µL.

9.6.10.6 Immediately transfer the 10 mL of reagent water containing the soil extract in the 10 mL Luer lock syringe into the purge and trap.

9.6.10.7 Blank for soils: Prepare a blank for soils in a 40 mL VOA vial with 10 mL of methanol.

9.6.10.7.1 Extract and sonicate the blank with the soil samples starting with Step 9.1.6. Analysis requires one blank/20 unknowns or less per day.

9.6.10.7.2 The LCS is carried through the procedure as though it were a sample.

9.6.10.8 LCS for Soils

9.6.10.8.1 Prepare a LCS for soils in a 40 mL VOA vial with 10 mL of methanol.

9.6.10.8.2 Add 125 µL of the intermediate initial calibration standard to the 10mL of methanol in the 40 mL VOA vial.

9.6.10.8.3 Extract and sonicate the blank with the soil samples starting with Step 9.1.6. Analysis requires one blank/20 unknowns or less per day.

9.6.10.8.4 The LCS is carried through the procedure as though it were a sample.

9.6.10.9 Matrix spike (MS), matrix spike duplicate (MSD) soil samples:

9.6.10.9.1 Select a soil sample extract for MS/MSD analysis.

9.6.10.9.2 Withdraw 10mL of reagent water into the 10 mL syringe.

9.6.10.9.3 Load a duplicate (200 µL) volume of soil extract from the 40 mL VOA vial into the 10 mL Luer lock syringe.

9.6.10.9.4 Add 10 µL of the surrogate/IS solution (See 7.12.2) directly into the 10 mL syringe through the Luer lock end.

9.6.10.9.5 To fortify the sample by adding 2.5 µL of the 20/200/100 µg/mL intermediate standard (See 7.5.1) directly into the 10 mL syringe through the Luer lock end.

NOTE: Resulting fortified concentrations are 5/25/50 µg/L.

9.6.10.9.6 Repeat steps 9.6.10.9.2 through 9.6.10.9.5 to prepare the matrix spike duplicate sample.

9.6.10.10 Continuing calibration verification (CCV) is required after every 10 unknown samples and at the end of every run.

9.6.10.10.1 CCVs for soils are prepared the same as water CCVs (See 9.6.9.6)

9.6.11 Qualitative analysis

9.6.11.1 The qualitative identification of each compound determined by this method is based on retention time, and on comparison of the sample mass spectrum with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated using the conditions of this method. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met.

9.6.11.2 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

9.6.11.3 The absolute retention time of the sample component is within ± 0.05 minutes of the absolute retention time of the standard component.

9.6.11.4 The relative intensities of the characteristic ions agree with 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding

abundance in a sample spectrum can range between 20 % and 80 %.)

9.6.11.5 Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

9.6.11.6 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte background spectra is important.

9.6.11.7 Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes co-elute (i.e., only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the co-eluting compound.

9.6.12 Calculations

9.6.12.1 Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance from the extracted ion current profile of the primary characteristic ion. The concentration in the sample analysis is determined using the average response factor as described in Section 9.6.5.1. Linear regression analysis is used for the select compounds described in Section 9.765.8.

9.6.12.2 Water Sample Calculations: Concentrations of VOCs in water are determined directly from the average response factor and multiplied by any dilution factor:

$$\mu g/L\ water\ sample = \mu g/L\ measured \times DF$$

Where: DF = Dilution factor, based on 10 mL of sample in the purge tube (e.g. If 10 mL of sample is used, the DF =1; likewise, if 2 mL of sample was used with 8 mL water, the DF = 5.)

9.6.12.3 Soil sample calculations: Concentrations of VOCs in soil are determined on a dry-weight basis by the following formula:

$$\mu g/kg\ \ soil\ sample = (\mu g/L\ measured \times 0.01L) \times \left(\frac{V_m/V_p}{W_s}\right) \div FS$$

Where:
V_m = Volume of methanol used to extract samples in mL, normally 10

mL
V_p = Volume of methanol extract purged in mL, normally 0.200 mL
W_s = Wet weight of soil extracted in kg, nominally 0.010 kg
FS = Fraction of dry solids of in the soil sample, approximately 0.85

9.6.12.3.1 Soil sample correction factor by LIMS: The correction factor for calculating soils from uploaded GC/MS data is established in the bench sheet by setting the initial sample volume at 10 mL and the final sample volume to 500 mL. This multiplier of 50 converts µg/L results from the uploaded GC/MS data to µg/kg results for methanol extracted soils Exact soil weights are entered into the LIMs batch when calculating soil results. The fraction of dry solids in samples is determined in a separate, % solids batch and this fraction is used by the LIMS when calculating soil results.

9.6.12.4 Where applicable, the concentration of any non-target analytes identified in the sample should be estimated by the same formula, except the areas A(x) and A(is) should be from the total ion chromatograms, and the response ratio for the compound should be assumed to be 1. The resulting concentration should be reported indicating: (1) that the value is an estimate, and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

10 QUALITY CONTROL

10.1 Refer to Method 8000 for general quality control procedures for chromatography methods.

10.2 The MSD must successfully complete both a maximum sensitivity autotune and a BFB tune evaluation (See 9.6.1 and Table 9).

10.3 Initial calibration must consist of at least 5 points from the available 7 calibration standards. The % RSD of response factors must be less than 30% for individual CCCs (See 9.6.5.2). The % RSD of the remaining target compound must be less than 30% except as noted in Section 9.6.5.3.

10.4 An analytical batch consists of 20 or fewer samples. Batch quality control samples should be analyzed with each set with the following frequency:

Blanks - One per 20 or fewer samples, minimum one per day
LCSs - One per 20 or fewer samples, minimum one per day
MS/MSDs - One MS/MSD per 20 or fewer samples, minimum one set per day

10.5 Method blanks consist of an aliquot of laboratory reagent water or methanol that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-

extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.6 LCSs are prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. An LCS is not required for water analysis as it is the same as a CCV. Soil LCS control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. If the recovery of any of the target analytes is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.7 MS/MSD samples consist of duplicate aliquots of sample spiked with the target analytes., MS/MSD control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. MS/MSD control limits are advisory. If the recovery or RPD of any of the target analytes is outside control limits, data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.8 The working calibration curve must be verified on each working day by the injection of one or more CCV standards. The percent difference between the response factors for the CCCs in the CCV standard must be within 20% of the average response factor calculated from the initial calibration (See 9.6.8.). The percent difference of the remaining target compounds in the CCV must not vary by more than 30% for each of any two sequential CCVs. The response factor determined for SPCCs in the CCV must also exceed their minimum response factor (See 9.6.5.4). If any CCC or SPCC in a CCV fails, a new calibration curve must be prepared or data appropriately qualified in accordance with GEN-015, Qualification of Data.

10.9 Surrogates are added to every sample and QC sample. Surrogate control limits are generated on at least a yearly basis. If a surrogate recovery is outside of control limits, the sample should be re-extracted and re-analyzed, if possible. If not, the data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.10 A second source calibration verification standard must be analyzed with every initial calibration. The accepted limits are 70-130% for all analytes. If an SCV fails, immediate corrective action is required before proceeding with sample analysis. Affected data should be qualified according to GEN-015, Qualification of Data.

10.11 Internal standards are added to every injection vial. The response of the internal standards must not vary by < 50% or > 200% from the initial response of the mid-point standard in the initial calibration.

11 PERFORMANCE DATA

11.1 Limit of detection s (LODs) have been determined for waters and soils from the analysis of seven replicates fortified at 0.50 µg/L and 25 µg/kg, respectively. The LODs are presented in Table 1.

11.2 Demonstration of capability (DOC) was performed for water samples by analyzing 4 replicates spiked at 5 µg/L. The DOC summary for waters is listed in Table 2. DOC was also performed for soils at 250 µg/kg. The DOC summary for soils is provided in Table 2.

12 CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

12.1 Contingencies for out-of-control data should be evaluated on a case-by-case basis. A Corrective Action Form (CAF) must be completed for those times that acceptable QC results cannot be achieved. The CAF must be completed by the analyst and filed with the Quality Manager. Analytical results shall be qualified as necessary.

13 WASTE MANAGEMENT / POLLUTION PREVENTION

13.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

14 REFERENCES

14.1 Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8260B, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 2, December 1996.

14.2 Purge and Trap of Aqueous Samples, Method 5030B, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 2, December 1996.

14.3 Determinative Chromatographic Separations, Method 8000B, SW-846, Test Methods for Evaluating Solid wastes, Update III, Revision 2, December 1996.

14.4 Analytical Detection Limit Guidance & Laboratory Guide for Determining Method Detection Limits, Wisconsin Department of Natural Resources Laboratory. Certification Program, April 1996, PUBL-TS-056-96

TABLE 1

LODS AND REPORTING LIMITS

WATER SAMPLES

Compound	LOD (µg/L)	Reporting Limit (µg/L)
Dichlorodifluoromethane	0.092	0.50
Chloromethane	0.12	1.0
Vinyl chloride	0.078	0.50
Bromomethane	2.2	5.0
Chloroethane	0.75	5.0
Trichlorofluoromethane	0.12	0.50
1,1,2-Trichlorotrifluoroethane	0.099	0.50
1,1-Dichloroethene	0.15	0.50
Acetone	7.7	20
Carbon disulfide	0.073	0.50
Methylene chloride	0.049	0.50
Methyl-tert-Butyl ether	0.10	0.50
trans-1,2-Dichloroethene	0.13	0.50
n-Hexane	0.095	0.50
1,1-Dichloroethane	0.15	0.50
Diisopropyl ether	0.12	0.50
2,2-Dichloropropane	0.092	0.50
cis-1,2-Dichloroethene	0.15	0.50
2-Butanone (MEK)	6.6	20
Tetrahydrofuran	3.4	10
Bromochloromethane	0.12	0.50
Chloroform	0.11	0.50
1,1,1-Trichloroethane	0.085	0.50
Carbon tetrachloride	0.087	0.50
1,1-Dichloropropene	0.10	0.50
Benzene	0.064	0.50
1,2-Dichloroethane	0.13	0.50
Trichloroethene	0.096	0.50
1,2-Dichloropropane	0.11	0.50
Dibromomethane	0.11	0.50
Bromodichloromethane	0.13	0.50
cis-1,3-Dichloropropene	0.087	0.50
Methyl isobutyl ketone (MIBK)	6.0	20
Toluene	0.12	0.50
trans-1,3-Dichloropropene	0.18	0.50
1,1,2-Trichloroethane	0.072	0.50
Tetrachloroethene	0.10	0.50
1,3-Dichloropropane	0.10	0.50

TABLE 1 (CONT.)

LODS AND REPORTING LIMITS

WATER SAMPLES

Compound	LOD (µg/L)	Reporting Limit (µg/L)
2-Hexanone	7.5	20
Chlorodibromomethane	0.076	0.50
1,2-Dibromoethane	0.087	0.50
Chlorobenzene	0.071	0.50
1,1,1,2-Tetrachloroethane	0.14	0.50
Ethylbenzene	0.10	0.50
m+p-Xylenes	0.10	0.50
o-Xylene	0.097	0.50
Styrene	0.075	0.50
Bromoform	0.12	0.50
Isopropylbenzene	0.066	0.50
1,1,2,2-Tetrachloroethane	0.092	0.50
Bromobenzene	0.092	0.50
1,2,3-Trichloropropane	0.17	1.0
n-Propylbenzene	0.083	0.50
2-Chlorotoluene	0.093	0.50
1,3,5-Trimethylbenzene	0.072	0.50
4-Chlorotoluene	0.068	0.50
tert-Butylbenzene	0.098	0.50
1,2,4-Trimethylbenzene	0.096	0.50
sec-Butylbenzene	0.066	0.50
1,3-Dichlorobenzene	0.081	0.50
p-Isopropyltoluene	0.082	0.50
1,4-Dichlorobenzene	0.061	0.50
n-Butylbenzene	0.071	0.50
1,2-Dichlorobenzene	0.087	0.50
1,2-Dibromo-3-chloropropane	0.19	0.50
1,2,4-Trichlorobenzene	0.076	1.0
Hexachlorobutadiene	0.12	1.0
Naphthalene	0.53	5.0
1,2,3-Trichlorobenzene	0.067	1.0

Waters analyzed in GCIS-1629 and GCIS-1636, March 2007

TABLE 1-1

LODS AND REPORTING LIMITS

SOIL SAMPLES

Compound	LOD (µg/kg)	Reporting Limit (µg/kg)
Dichlorodifluoromethane	4.2	25
Chloromethane	8.4	25
Vinyl chloride	5.0	25
Bromomethane	890	1000
Chloroethane	160	500
Trichlorofluoromethane	5.8	25
1,1,2-Trichlorotrifluoroethane	3.9	25
1,1-Dichloroethene	6.2	25
Acetone	1300	1500
Carbon disulfide	3.4	25
Methylene chloride	4.4	25
Methyl-tert-Butyl ether	9.6	25
trans-1,2-Dichloroethene	5.2	25
n-Hexane	4.4	25
1,1-Dichloroethane	2.4	25
Diisopropyl ether	7.8	25
2,2-Dichloropropane	5.7	25
cis-1,2-Dichloroethene	3.9	25
2-Butanone (MEK)	1000	1500
Tetrahydrofuran	600	1500
Bromochloromethane	4.8	25
Chloroform	5.8	25
1,1,1-Trichloroethane	4.2	25
Carbon tetrachloride	4.3	25
1,1-Dichloropropene	3.4	25
Benzene	2.5	25
1,2-Dichloroethane	6.0	25
Trichloroethene	4.6	25
1,2-Dichloropropane	5.0	25
Dibromomethane	11	25
Bromodichloromethane	4.8	25
cis-1,3-Dichloropropene	4.8	25
Methyl isobutyl ketone (MIBK)	840	1500
Toluene	4.1	25
trans-1,3-Dichloropropene	5.7	25
1,1,2-Trichloroethane	5.0	25
Tetrachloroethene	4.9	25
1,3-Dichloropropane	8.0	25

TABLE 1-1 (CONT.)

LODS AND REPORTING LIMITS

SOIL SAMPLES

Compound	LOD (µg/kg)	Reporting Limit (µg/kg)
2-Hexanone	950	1500
Chlorodibromomethane	6.0	25
1,2-Dibromoethane	6.0	25
Chlorobenzene	2.1	25
1,1,1,2-Tetrachloroethane	4.8	25
Ethylbenzene	1.2	25
m+p-Xylenes	4.5	25
o-Xylene	3.6	25
Styrene	4.2	25
Bromoform	9.4	25
Isopropylbenzene	2.2	25
1,1,2,2-Tetrachloroethane	11	25
Bromobenzene	4.4	25
1,2,3-Trichloropropane	16	50
n-Propylbenzene	1.9	25
2-Chlorotoluene	2.8	25
1,3,5-Trimethylbenzene	3.3	25
4-Chlorotoluene	3.4	25
tert-Butylbenzene	3.0	25
1,2,4-Trimethylbenzene	3.1	25
sec-Butylbenzene	1.9	25
1,3-Dichlorobenzene	3.2	25
p-Isopropyltoluene	3.7	25
1,4-Dichlorobenzene	2.0	25
n-Butylbenzene	4.1	25
1,2-Dichlorobenzene	2.9	25
1,2-Dibromo-3-chloropropane	22	25
1,2,4-Trichlorobenzene	3.5	50
Hexachlorobutadiene	6.2	50
Naphthalene	13	250
1,2,3-Trichlorobenzene	5.0	50

Soils analyzed in GCIS-1637 and GCIS-1639, March 2007

TABLE 2

DEMONSTRATION OF CAPABILITY

WATER

Compound	Spike Amount (µg/L)	Mean Recovery	RSD (%)
Dichlorodifluoromethane	5	102	3.74
Chloromethane	5	99	2.44
Vinyl chloride	5	102	2.30
Bromomethane	5	165	13.8
Chloroethane	5	139	2.54
Trichlorofluoromethane	5	108	4.12
1,1,2-Trichlorotrifluoroethane	5	102	4.26
1,1-Dichloroethene	5	101	4.29
Acetone	50	92	8.46
Carbon disulfide	5	99	2.17
Methylene chloride	5	107	3.60
Methyl-tert-Butyl ether	5	91	4.47
trans-1,2-Dichloroethene	5	101	2.52
n-Hexane	5	100	1.40
1,1-Dichloroethane	5	104	2.01
Diisopropyl ether	5	96	4.72
2,2-Dichloropropane	5	90	3.19
cis-1,2-Dichloroethene	5	99	2.66
2-Butanone (MEK)	50	89	9.27
Tetrahydrofuran	25	84	7.25
Bromochloromethane	5	102	2.30
Chloroform	5	103	2.46
1,1,1-Trichloroethane	5	102	1.85
Carbon tetrachloride	5	104	3.78
1,1-Dichloropropene	5	101	2.14
Benzene	5	101	3.27
1,2-Dichloroethane	5	104	3.00
Trichloroethene	5	100	0.18
1,2-Dichloropropane	5	98	1.55
Dibromomethane	5	96	1.74
Bromodichloromethane	5	99	1.78
cis-1,3-Dichloropropene	5	92	2.77
Methyl isobutyl ketone (MIBK)	50	85	1.89
Toluene	5	97	1.15
trans-1,3-Dichloropropene	5	93	1.56

TABLE 2 (CONT.)

DEMONSTRATION OF CAPABILITY

WATER

Compound	Spike Amount (µg/L)	Mean Recovery	RSD (%)
1,1,2-Trichloroethane	5	97	4.04
Tetrachloroethene	5	103	2.08
1,3-Dichloropropane	5	97	3.45
2-Hexanone	50	84	5.02
Chlorodibromomethane	5	97	2.91
1,2-Dibromoethane	5	94	3.16
Chlorobenzene	5	101	0.90
1,1,1,2-Tetrachloroethane	5	100	0.81
Ethylbenzene	5	102	1.12
m+p-Xylenes	10	101	1.16
o-Xylene	5	98	0.37
Styrene	5	97	2.07
Bromoform	5	92	2.43
Isopropylbenzene	5	99	1.23
1,1,2,2-Tetrachloroethane	5	87	1.00
Bromobenzene	5	98	3.02
1,2,3-Trichloropropane	5	90	2.15
n-Propylbenzene	5	101	2.57
2-Chlorotoluene	5	101	2.00
1,3,5-Trimethylbenzene	5	99	1.81
4-Chlorotoluene	5	100	1.51
tert-Butylbenzene	5	98	3.61
1,2,4-Trimethylbenzene	5	100	2.13
sec-Butylbenzene	5	101	1.69
1,3-Dichlorobenzene	5	100	1.28
p-Isopropyltoluene	5	100	1.11
1,4-Dichlorobenzene	5	99	1.49
n-Butylbenzene	5	102	2.16
1,2-Dichlorobenzene	5	98	1.97
1,2-Dibromo-3-chloropropane	5	84	1.43
1,2,4-Trichlorobenzene	5	95	1.04
Hexachlorobutadiene	5	107	2.34
Naphthalene	5	78	3.96
1,2,3-Trichlorobenzene	5	94	2.21

Waters analyzed in GCIS-1626, March 2007

TABLE 2-1 (CONT.)

DEMONSTRATION OF CAPABILITY

SOIL

Compound	Spike Amount (µg/kg)	Mean Recovery	RSD (%)
Dichlorodifluoromethane	250	81	2.39
Chloromethane	250	95	2.73
Vinyl chloride	250	93	3.11
Bromomethane	250	99	8.16
Chloroethane	250	90	10.1
Trichlorofluoromethane	250	102	4.35
1,1,2-Trichlorotrifluoroethane	250	100	1.62
1,1-Dichloroethene	250	98	2.43
Acetone	2500	104	8.17
Carbon disulfide	250	96	2.32
Methylene Chloride	250	104	2.35
Methyl-tert-Butyl Ether	250	94	3.56
trans-1,2-Dichloroethene	250	99	2.79
n-Hexane	250	97	1.28
1,1-Dichloroethane	250	102	2.21
Diisopropyl Ether	250	95	1.02
2,2-Dichloropropane	250	97	2.96
cis-1,2-Dichloroethene	250	99	2.31
2-Butanone (MEK)	2500	99	7.45
Tetrahydrofuran	250	97	7.43
Bromochloromethane	250	101	1.67
Chloroform	250	101	3.12
1,1,1-Trichloroethane	250	101	1.41
Carbon Tetrachloride	250	105	2.93
1,1-Dichloropropene	250	102	2.06
Benzene	250	103	1.55
1,2-Dichloroethane	250	102	1.90
Trichloroethene	250	100	1.77
1,2-Dichloropropane	250	98	1.58
Dibromomethane	250	98	1.61
Bromodichloromethane	250	98	1.99
cis-1,3-Dichloropropene	250	97	2.62
Methyl Isobutyl Ketone	2500	98	4.91
Toluene	250	95	1.90
trans-1,3-Dichloropropene	250	97	2.41
1,1,2-Trichloroethane	250	98	2.96
Tetrachloroethene	250	101	1.41

TABLE 2-1 (CONT.)

DEMONSTRATION OF CAPABILITY

SOIL

Compound	Spike Amount (µg/kg)	Mean Recovery	RSD (%)
1,3-Dichloropropane	250	101	1.38
2-Hexanone	2500	96	6.67
Chlorodibromomethane	250	98	3.63
1,2-Dibromoethane	250	96	2.74
Chlorobenzene	250	99	0.41
1,1,1,2-Tetrachloroethane	250	98	1.77
Ethylbenzene	250	100	0.79
m+p-Xylenes	500	100	1.90
o-Xylene	250	97	1.25
Styrene	250	98	0.76
Bromoform	250	98	4.53
Isopropylbenzene	250	99	1.19
1,1,2,2-Tetrachloroethane	250	91	2.66
Bromobenzene	250	95	1.16
1,2,3-Trichloropropane	250	94	1.65
n-Propylbenzene	250	97	1.36
2-Chlorotoluene	250	97	2.02
1,3,5-Trimethylbenzene	250	96	2.55
4-Chlorotoluene	250	99	0.66
tert-Butylbenzene	250	95	1.91
1,2,4-Trimethylbenzene	250	96	1.87
sec-Butylbenzene	250	98	1.61
1,3-Dichlorobenzene	250	97	1.79
p-Isopropyltoluene	250	96	1.00
1,4-Dichlorobenzene	250	97	0.97
n-Butylbenzene	500	97	1.46
1,2-Dichlorobenzene	250	97	1.51
1,2-Dibromo-3-chloropropane	250	93	7.69
1,2,4-Trichlorobenzene	250	94	2.17
Hexachlorobutadiene	250	99	1.41
Naphthalene	250	86	2.96
1,2,3-Trichlorobenzene	250	92	2.30

Soils analyzed in GCIS-1639, March 2007

TABLE 3

ABSOLUTE RETENTION TIME ORDER AND C HARACTERISTIC IONS

Compound	Absolute RT (min)	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Dichlorodifluoromethane	1.33	85	87
Chloromethane	1.47	50	52
Vinyl chloride	1.55	62	64
Bromomethane	1.80	94	96
Chloroethane	1.90	64	66
Trichlorofluoromethane	2.11	151	101, 153
1,1,2-Trichloro-1,2,2-trifluoroethane	2.55	101	103, 151, 153
1,1-Dichloroethene	2.59	96	61, 63
Acetone	2.68	58	
Carbon disulfide	2.77	76	78
Methylene chloride	3.03	84	49, 86,
Methyl-tert-Butyl ether	3.19	73	57
trans-1,2-Dichloroethene	3.21	96	61, 98
n-Hexane	3.36	57	55, 86
1,1-Dichloroethane	3.58	63	65, 83
Diisopropyl ether	3.55	87	59, 69, 102
2,2-Dichloropropane	4.01	77	97
cis-1,2-Dichloroethene	4.03	96	61, 98
2-Butanone (MEK)	4.04	72	57
Tetrahydrofuran	4.22	72	71
Bromochloromethane	4.22	128	49, 130
Chloroform	4.25	83	85
Dibromofluoromethane (SURR)	4.38	113	
1,1,1-Trichloroethane	4.38	97	61, 99
Pentafluorobenzene (IS)	4.40	168	
Carbon tetrachloride	4.48	117	119
1,1-Dichloropropene	4.49	75	77, 110
Benzene	4.65	78	
1,2-Dichloroethane	4.72	62	98
1,4-Difluorobenzene (IS)	4.94	114	
Trichloroethene	5.12	95	97, 130, 132
1,2-Dichloropropane	5.33	63	112
Dibromomethane	5.42	93	95, 174
Bromodichloromethane	5.50	83	85, 127
cis-1,3-Dichloropropene	5.83	75	77
Methyl isobutyl ketone (MIBK)	5.92	58	85, 100
Toluene-d8 (SURR)	6.00	98	

TABLE 3 (CONT.)

ABSOLUTE RETENTION TIME ORDER AND CHARACTERISTIC IONS

Compound	Absolute RT (min)	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Toluene	6.05	92	91
trans-1,3-Dichloropropene	6.25	75	77
1,1,2-Trichloroethane	6.39	83	85, 97
Tetrachloroethene	6.43	164	129, 131, 166
1,3-Dichloropropane	6.52	76	78
2-Hexanone	6.53	58	85, 100
Chlorodibromomethane	6.67	129	127
1,2-Dibromoethane	6.78	107	109, 188
Chlorobenzene-d5 (IS)	7.09	117	
Chlorobenzene	7.11	112	77, 114
1,1,1,2-Tetrachloroethane	7.16	131	119, 133
Ethylbenzene	7.15	91	106
m+p-Xylenes	7.24	106	91
o-Xylene	7.55	106	91
Styrene	7.56	104	78
Bromoform	7.74	173	175, 254
Isopropylbenzene	7.80	105	120
4-Bromofluorobenzene (SURR)	7.96	95	174, 176
1,1,2,2-Tetrachloroethane	8.07	83	85, 131
Bromobenzene	8.09	156	77, 158
1,2,3-Trichloropropane	8.12	75	77
n-Propylbenzene	8.11	91	120
2-Chlorotoluene	8.22	91	126
1,3,5-Trimethylbenzene	8.24	105	120
4-Chlorotoluene	8.30	91	126
tert-Butylbenzene	8.48	119	91, 134
1,2,4-Trimethylbenzene	8.53	105	120
sec-Butylbenzene	8.65	105	134
1,3-Dichlorobenzene	8.79	146	111, 148
p-Isopropyltoluene	8.75	119	91, 134
1,4-Dichlorobenzene-d4 (IS)	8.85	152	115, 150
1,4-Dichlorobenzene	8.79	146	111, 148
n-Butylbenzene	9.07	91	92, 134
1,2-Dichlorobenzene	9.16	146	111, 148
1,2-Dibromo-3-chloropropane	9.77	75	155, 157
1,2,4-Trichlorobenzene	10.38	180	145, 182
Hexachlorobutadiene	10.44	225	223, 227
Naphthalene	10.58	128	
1,2,3-Trichlorobenzene	10.77	180	145, 182

TABLE 4

STOCK STANDARD SOLUTIONS

INITIAL CALIBRATION

8260B Liquids, Absolute Part #32001, 2000 µg/mL		
1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane
1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene
1,2,3-Trichlorobenzen	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane
1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane
1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane
1,4-Dichlorobenzene	2,2-Dichloropropane	2-Chlorotoluene
4-Chlorotoluene	Benzene	Bromobenzene
Bromochloromethane	Bromodichloromethane	Bromoform
cis-1,3-Dichloropropene	Carbon tetrachloride	Chloroform
cis-1,2-Dichloroethene	Chlorodibromomethane	Dibromomethane
Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene
m+p-Xylenes	Methylene chloride	Methyl-tert-Butyl ether
Naphthalene	n-Butylbenzene	n-Propylbenzene
o-Xylene	p-Isopropyltoluene	sec-Butylbenzene
Styrene	trans-1,3-Dichloropropene	tert-Butylbenzene
Tetrachloroethene	Toluene	trans-1,2-Dichloroethene
Trichloroethene		

8260B Gases, Absolute Part # 30058, 2000 µg/mL		
Bromomethane	Chloroethane	Chloromethane
Dichlorodifluoromethane	Trichlorofluoromethane	Vinyl chloride

8260B Ketones, Absolute Part # 82492, 20,000 µg/mL		
Acetone	2-Butanone	2-Hexanone
4-Methyl-2-pentanone		

Single Component Solutions
Methyl-tert-Butyl ether, Absolute Part # 70209, 1000 µg/mL
Carbon disulfide, Absolute Part # 70060, 1000 µg/mL
Diisopropyl ether, Absolute Part # 70987, 1000 µg/mL
n-Hexane, Absolute Part # 70962, 1000 µg/mL
Tetrahydrofuran, Absolute Part # 34191, 20,000 µg/mL
1,1,2-Trichlorotrifluoroethane, Absolute Part # 70474, 1000 µg/mL

TABLE 4-1

STOCK STANDARD SOLUTIONS

SECOND SOURCE

8260B Mega Mix Calibration Mix, Restek Part #30633, 2000 µg/mL		
1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane
1,1,2-Trichlorotrifluoroethane	1,1-Dichloroethane	1,1-Dichloroethene
1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane
1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane
1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane
1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
1,3-Dichloropropane	1,4-Dichlorobenzene	2,2-Dichloropropane
2-Chlorotoluene	4-Chlorotoluene	Benzene
Bromobenzene	Bromochloromethane	Bromodichloromethane
Bromoform	cis-1,3-Dichloropropene	Carbon disulfide
Carbon tetrachloride	Chloroform	cis-1,2-Dichloroethene
Chlorodibromomethane	Dibromomethane	Ethylbenzene
Hexachlorobutadiene	Isopropylbenzene	m+p-Xylenes
Methylene chloride	Methyl-tert-Butyl ether	Naphthalene
n-Butylbenzene	n-Propylbenzene	o-Xylene
p-Isopropyltoluene	sec-Butylbenzene	Styrene
trans-1,3-Dichloropropene	tert-Butylbenzene	Tetrachloroethene
Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene
Trichloroethene		

502.2 Calibration Mix #1 (gases), Restek Part # 30042, 2000 µg/mL		
Bromomethane	Chloroethane	Chloromethane
Dichlorodifluoromethane	Trichlorofluoromethane	Vinyl chloride

VOA Calibration Mix #1 (ketones), Restek Part # 30006, 5000 µg/mL		
Acetone	2-Butanone	2-Hexanone
4-Methyl-2-pentanone		

California Oxygenates Mix, Restek Part # 30465, 2000 µg/mL	
Methyl tert-butyl ether	Diisopropyl ether

TABLE 4-2

STOCK STANDARD SOLUTIONS

INTERNAL STANDARDS AND SURROGATES

8260 Internal Standard Mix, Restek Part # 30074, 2500 µg/mL	
Chlorobenzene-d5	1,4-Dichlorobenzene-d4
1,4-Difluorobenzene	Pentafluorobenzene

8260 Surrogate Mix, Restek Part # 30073, 2500 µg/mL		
4-Bromofluorobenzene	Dibromofluoromethane	Toluene-d8

TABLE 5

INTERMEDIATE STANDARD SOLUTION PREPARATION

INITIAL CALIBRATION

Description	Absolute Part #	Stock Conc. (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc. (µg/mL)
54 Liquids	32001	2000	500	50	20
6 Gases	30058	2000	500	50	20
4 Ketones	82492	20000	500	50	200
MTBE	70209	1000	1000	50	20
Carbon disulfide	70060	1000	1000	50	20
Diisopropyl ether	70987	1000	1000	50	20
Hexane	70962	1000	1000	50	20
Tetrahydrofuran	74191	20000	250	50	100
1,1,2-Trichlorotrifluoroethane	70474	1000	500	50	20

NOTES: (1) Solvent Purge and trap methanol.
(2) Compounds may be added or deleted for project/site specific requirements.

TABLE 5-1

INTERMEDIATE STANDARD SOLUTION PREPARATION

SECOND SOURCE

Description	Restek Part #	Stock Conc. (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc. (µg/mL)
Mega Mix	30633	2000	250	25	20
6 Gases	30042	2000	250	25	20
4 Ketones	30006	5000	1000	25	200
Oxygenates	30465	2000	250	25	20

TABLE 5-2

INTERMEDIATE STANDARD SOLUTION PREPARATION

INTERNAL STANDARDS AND SURROGATES

Description	Restek Part #	Stock Conc. (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc. (µg/mL)
8260 Internal Standards	30074	2500	500	50	25
8260 Surrogate Standards	30073	2500	500	50	25

TABLE 6

INITIAL CALIBRATION STANDARDS

PREPARATION IN 10 ML OF REAGENT WATER

Calibration Level	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
µg/L Final in 10 mL	0.5/2.5/5.0	1.0/5.0/10.0	2.0/10.0/20	5/25/50	10/50/100	25/125/2500	50/250/5000
Volume of Makeup Methanol (µL)	200	200	199	197	1965	188	175
Volume of IS/Surr. Solution (µL)(5.12.2)	10	10	10	10	10	10	10
Volume of Standard Solution (µL) (7.5.1)	0.25	0.50	1.0	2.5	5.0	12.5	25

NOTE: Calculation Formula: µg/L

$$\frac{A \times B}{V \times 1000 ng/ug}$$

Where:
A = Volume Standard Solution in µL added to 10 mL
B = Concentration of analyte in Standard Solution in µg/mL
V = Volume in syringe (usually 10 mL) in L (0.01 L)

TABLE 7

INTERNAL STANDARDS AND CORRESPONDING TARGET COMPOUNDS

Pentafluorobenzene		
Dichlorodifluoromethane	Chloromethane	Vinyl chloride
Bromomethane	Chloroethane	Trichlorofluoromethane
1,1,2-Trichlorotrifluoroethane	1,1-Dichloroethene	Acetone
Carbon disulfide	Methylene chloride	Methyl-tert-butyl ether
trans-1,2-Dichloroethene	n-Hexane	1,1-Dichloroethane
Diisopropyl Ether	2,2-Dichloropropane	cis-1,2-Dichloroethene
2-Butanone (MEK)	Tetrahydrofuran	Bromochloromethane
Chloroform	Dibromofluoromethane (SURR)	1,1,1-Trichloroethane
Carbon tetrachloride	1,1-Dichloropropene	Benzene
1,2-Dichloroethane		

1,4-Difluorobenzene		
Trichloroethene	1,2-Dichloropropane	Dibromomethane
Bromodichloromethane	cis-1,3-Dichloropropene	Methyl isobutyl ketone (MIBK)
Toluene-d8 (SURR)	Toluene	trans-1,3-Dichloropropene
1,1,2-Trichloroethane		

Chlorobenzene-d5		
Tetrachloroethene	1,3-Dichloropropane	2-Hexanone
Chlorodibromomethane	1,2-Dibromoethane	Ethylbenzene
m+p-Xylenes	o-Xylene	Styrene
Bromoform	Isopropylbenzene	Bromofluorobenzene (SURR)

1,4-Dichlorobenzene-d4		
1,1,2,2-Tetrachloroethane	Bromobenzene	1,2,3-Trichloropropane
n-Propylbenzene	2-Chlorotoluene	1,3,5-Trimethylbenzene
4-Chlorotoluene	tert-Butylbenzene	1,2,4-Trimethylbenzene
sec-Butylbenzene	1,3-Dichlorobenzene	p-Isopropyltoluene
1,4-Dichlorobenzene	n-Butylbenzene	1,2-Dichlorobenzene
1,2-Dibromo-3-chloropropane	1,2,4-Trichlorobenzene	Hexachlorobutadiene
Naphthalene	1,2,3-Trichlorobenzene	

TABLE 8

CONDITIONS FOR THE PURGE AND TRAP "CLEAN CYCLE"

Step 1, No Purge Tube Attached	
Purge and Trap:	Method "2"
Purge Flow:	Helium, 35 mL/min.
Purge Time:	1.5 minutes
Dry Purge:	0 minutes
Desorb:	0.2 minutes at 0 °C
Bake Time:	0 minutes at 0 °C

GC/MS Conditions: Method and Sequence "Purge"	
Oven Temperature Program	
Initial Temperature:	45 °C
Initial Hold:	0.5 minutes
EM Voltage:	1800

Step 2, Purge Tube Attached	
Purge and Trap:	Method "3"
Purge Flow:	Helium, 35 mL/min.
Purge Time:	5.0 minutes
Dry Purge:	0 minutes
Desorb:	0.2 minutes at 0 °C
Bake Time:	0 minutes at 0 °C

GC/MS Conditions: Method and Sequence "Purge"	
Oven Temperature Program	
Initial Temperature:	45 °C
Initial Hold:	0.5 minutes
EM Voltage:	1800

TABLE 9

BFB MASS INTENSITY CRITERIA

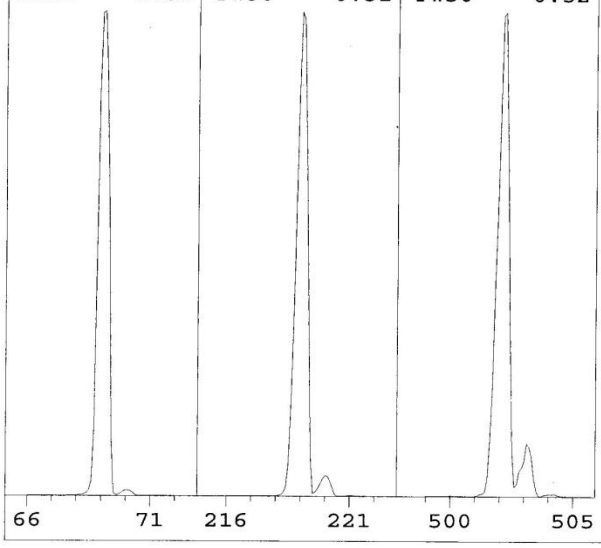
m/z	Required Intensity (Relative Abundance)
50	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	Base Peak, 100% relative abundance
96	5 to 9% of m/z 95
173	Less than 2% of m/z 174
174	Greater than 50% of m/z 95
175	5-9% of m/z 174
176	Greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

FIGURE 1

MAXIMUM SENSITIVITY AUTOTUNE REPORT

HP5971 Maximum Sensitivity Autotune
Instrument: GC/MS Instrument #1
Tue Feb 12 12:26:47 2008 D:\HPCHEM\1\5971\ATUNE.U

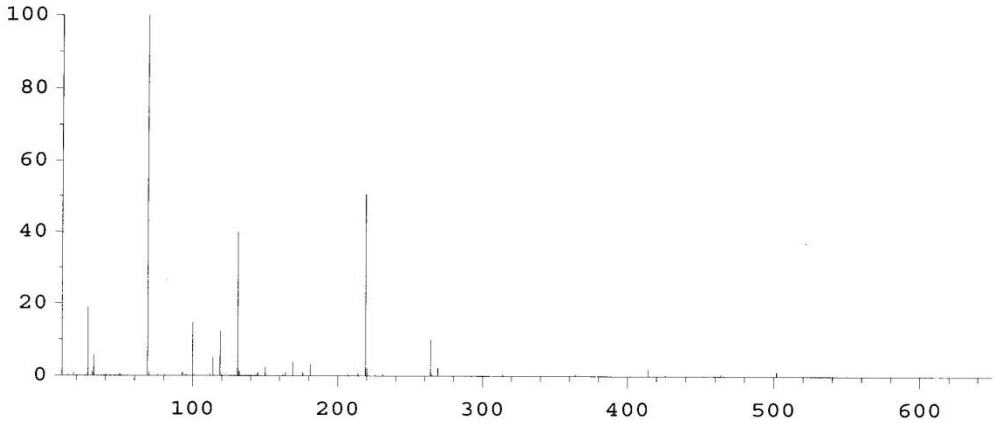
Mass	69.10	Mass	219.00	Mass	502.20
Ab	2108606	Ab	1099103	Ab	28982
Pw50	0.52	Pw50	0.51	Pw50	0.52



EMVolts	1553	AmuGain	597
Xray	8.6	AmuOffs	84
Emission	ON	Wid219	0.026
MS Temp	150	TTI	OFF
Vacuum	38	DC Pol	NEG
Samples	16	Repeller	19.64
Averages	1	IonFocus	36.0
StepSize	0.10	EntLens	4.52
MassGain	185	EntOffs	14.81
MassOffs	2	Filament	2

PFTBA OPEN

Scan: 10.00 - 650.00 Samples: 16 Thresh: 150
227 peaks Base: 69.00 Abundance: 1781248



Mass	Abund	Rel Abund	Iso Mass	Iso Abund	Iso Ratio
69.00	1781248	100.00	70.00	19560	1.10
218.95	904128	50.76	219.95	39224	4.34
502.05	23968	1.35	503.05	2416	10.08

FIGURE 2

TOTAL ION CHROMATOGRAM OF A CCV AND SUMMARY REPORT

Quantitation Report (Not Reviewed)

Data File : D:\HPCHEM\1\DATA\GC-1926\004A.D
Acq On : 12 Feb 2008 2:50 pm
Sample : CCS, 5UG/L
Misc :
MS Integration Params: RTEINT.P
Quant Time: Feb 13 13:29 2008

Vial: 4
Operator: cps
Inst : GC/MS Ins
Multiplr: 1.00

Quant Results File: VOCA0212.RES

Quant Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Initial Calibration
DataAcq Meth : 8260

CPS 2/13/08

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) Pentafluorobenzene	4.53	168	1646282	25.00 ug/l	0.00
30) 1,4-Difluorobenzene	5.08	114	2428392	25.00 ug/l	0.00
40) Chlorobenzene-D5	7.24	117	2190468	25.00 ug/l	0.00
56) 1,4-Dichlorobenzene-D4	8.99	152	1125532	25.00 ug/l	0.00
System Monitoring Compounds					
24) Dibromofluoromethane	4.52	113	738831	22.01 ug/l	0.00
Spiked Amount 25.000			Recovery =	88.04%	
37) Toluene-D8	6.14	98	2578616	25.03 ug/l	0.00
Spiked Amount 25.000			Recovery =	100.12%	
55) Bromofluorobenzene	8.11	95	881882	24.04 ug/l	0.00
Spiked Amount 25.000			Recovery =	96.16%	
Target Compounds					Qvalue
2) Dichlorodifluoromethane	1.42	85	133423	4.94 ug/l	99
3) Chloromethane	1.58	50	90602	4.93 ug/l	89
4) Vinyl Chloride	1.66	62	77674	4.60 ug/l	97
5) Bromomethane	1.91	96	9209	3.82 ug/l #	13
6) Chloroethane	1.99	64	55564	6.36 ug/l	95
7) Trichlorofluoromethane	2.21	101	117100	3.32 ug/l #	93
8) 1,1,2-Trichlorotrifluoroet	2.66	101	143241	4.79 ug/L	96
9) 1,1-Dichloroethene	2.70	96	135926	4.99 ug/l	93
10) Acetone	2.80	58	44047	46.14 ug/L	100
11) Carbon Disulfide	2.89	76	461673	4.85 ug/L	99
12) Methylene Chloride	3.16	84	129724	4.90 ug/l	97
13) Methyl-t-butyl Ether	3.31	73	151105	4.10 ug/L	97
14) t-1,2-Dichloroethene	3.34	96	137303	4.49 ug/l	92
15) n-Hexane	3.48	57	169714	5.19 ug/L	100
16) 1,1-Dichloroethane	3.72	63	197595	4.66 ug/l	99
17) Diisopropyl Ether	3.67	87	88123	4.97 ug/L	96
18) 2.2- Dichloropropane	4.14	77	88433	3.14 ug/l	96
19) c-1,2-Dichloroethene	4.16	96	155263	4.58 ug/l	97
20) 2-Butanone(MEK)	4.18	72	64360	45.48 ug/l	99
21) Tetrahydrofuran	4.35	72	36739	23.98 ug/L	99
22) Bromochloromethane	4.36	128	73342	4.21 ug/l	97
23) Chloroform	4.39	83	207405	4.63 ug/l	97
25) 1,1,1-Trichloroethane	4.52	97	165855	4.43 ug/l	99
26) Carbon tetrachloride	4.60	117	150110	4.49 ug/l	95
27) 1.1-Dichloropropene	4.63	75	175512	4.87 ug/l	99
28) Benzene	4.79	78	522438	4.83 ug/l	99
29) 1,2-Dichloroethane	4.86	62	89431	4.54 ug/l	95
31) Trichloroethene	5.25	95	149765	4.76 ug/l	99

(#) = qualifier out of range (m) = manual integration
004A.D VOCA0212.M Wed Feb 13 13:29:44 2008 Page 1

FIGURE 2 (CONT.)

TOTAL ION CHROMATOGRAM OF A CCV AND SUMMARY REPORT

Quantitation Report (Not Reviewed)

Data File : D:\HPCHEM\1\DATA\GC-1926\004A.D
Acq On : 12 Feb 2008 2:50 pm
Sample : CCS, 5UG/L
Misc :
MS Integration Params: RTEINT.P
Quant Time: Feb 13 13:29 2008

Vial: 4
Operator: cps
Inst : GC/MS Ins
Multiplr: 1.00
Quant Results File: VOCA0212.RES

Quant Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Initial Calibration
DataAcq Meth : 8260

	Compound	R.T.	QIon	Response	Conc Unit		Qvalue
32)	1,2-Dichloropropane	5.47	63	122527	4.95 ug/l		96
33)	Dibromomethane	5.56	93	76899	4.57 ug/l		96
34)	Bromodichloromethane	5.65	83	152464	4.72 ug/l		100
35)	c-1,3-Dichloropropene	5.97	75	181341	4.86 ug/l		99
36)	Methyl Isobutyl Ketone (MI	6.07	58	235719	51.79 ug/l		98
38)	Toluene	6.19	92	387541	5.13 ug/l		96
39)	1,1,2-Trichloroethane	6.53	83	83438	4.72 ug/l		98
41)	t-1,3-Dichloropropene	6.39	75	127746	4.69 ug/l	#	89
42)	Tetrachloroethene	6.57	164	155189	5.04 ug/l		96
43)	1,3-Dichloropropane	6.67	76	160881	4.92 ug/l		96
44)	2-Hexanone	6.67	58	222153	53.74 ug/l	#	95
45)	Dibromochloromethane	6.82	129	127664	4.65 ug/l		96
46)	1,2-Dibromoethane	6.93	107	110160	4.78 ug/l	#	98
47)	Chlorobenzene	7.26	112	439888	5.17 ug/l		98
48)	1,1,1,2-Tetrachloroethane	7.32	131	141899	4.92 ug/l		97
49)	Ethylbenzene	7.30	91	682203	5.14 ug/l		98
50)	m+p-Xylene	7.38	106	571758	10.35 ug/l		96
51)	o-Xylene	7.70	106	275747	5.18 ug/l		99
52)	Styrene	7.71	104	449245	5.19 ug/l		99
53)	Bromoform	7.90	173	83417	4.66 ug/l	#	98
54)	Isopropylbenzene	7.94	105	611509	5.28 ug/l		100
57)	1,1,2,2-Tetrachloroethane	8.22	83	105229	4.98 ug/l		94
58)	Bromobenzene	8.25	156	189176	5.01 ug/l		98
59)	1,2,3-Trichloropropane	8.28	75	82167	4.94 ug/l		86
60)	n-Propyl benzene	8.26	91	811071	5.32 ug/l		99
61)	2-Chlorotoluene	8.37	91	501878	5.13 ug/l		97
62)	1,3,5-Trimethylbenzene	8.39	105	524641	5.18 ug/l		97
63)	4-Chlorotoluene	8.45	91	450035	5.19 ug/l		100
64)	t-Butyl benzene	8.63	119	516364	5.46 ug/l		95
65)	1,2,4-Trimethylbenzene	8.68	105	535928	5.19 ug/l		99
66)	sec-Butyl benzene	8.80	105	792268	5.33 ug/l		98
67)	1,3-Dichlorobenzene	8.95	146	359797	5.11 ug/l		99
68)	p-Isopropyl toluene	8.90	119	643468	5.31 ug/l		99
69)	1,4-Dichlorobenzene	9.02	146	347429	5.05 ug/l		96
70)	n-Butyl benzene	9.21	91	603802	5.33 ug/l		98
71)	1,2-Dichlorobenzene	9.31	146	307081	5.14 ug/l		99
72)	1,2-Dibromo-3-chloropropan	9.92	157	20317	4.76 ug/l		98
73)	1,2,4-Trichlorobenzene	10.52	180	231459	5.23 ug/l		96
74)	Hexachlorobutadiene	10.59	225	137900	5.45 ug/l		95
75)	Naphthalene	10.74	128	313529	4.72 ug/l	#	97
76)	1,2,3-Trichlorobenzene	10.93	180	180977	4.83 ug/l		98

(#) = qualifier out of range (m) = manual integration
004A.D VOCA0212.M Wed Feb 13 13:29:44 2008 Page 2

FIGURE 2 (CONT.)

TOTAL ION CHROMATOGRAM OF A CCV AND SUMMARY REPORT

Quantitation Report

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Data File : D:\HPCHEM\1\DATA\GC-1926\004A.D                    Vial: 4
Acq On    : 12 Feb 2008   2:50 pm                          Operator: cps
Sample    : CCS, 5UG/L                                     Inst    : GC/MS Ins
Misc      :                                                Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: Feb 13 13:29 2008                   Quant Results File: VOCA0212.RES

Method       : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title        : ECCS 8260 LIST
Last Update  : Wed Feb 13 13:09:09 2008
Response via : Initial Calibration
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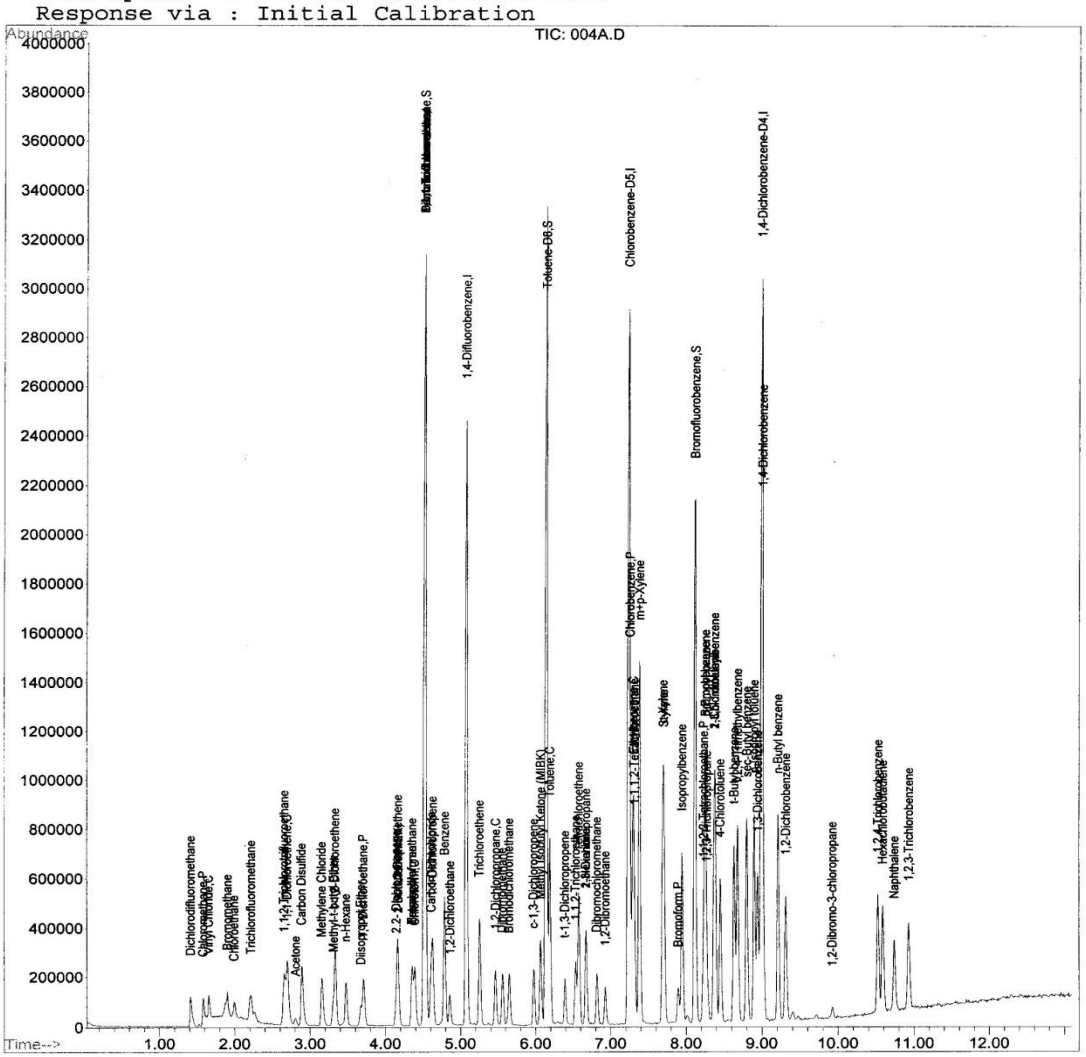

004A.D VOCA0212.M Wed Feb 13 13:29:45 2008 Page 3

FIGURE 3

DATA SYSTEM SUMMARY OF % DIFFERENCE AND RESPONSE FACTOR FOR CONTINUING CALIBRATION VERIFICATION

Evaluate Continuing Calibration Report

Data File : D:\HPCHEM\1\DATA\GC-1926\004A.D
Acq On : 12 Feb 2008 2:50 pm
Sample : CCS, 5UG/L
Misc :
MS Integration Params: RTEINT.P

Vial: 4
Operator: cps
Inst : GC/MS Ins
Multiplr: 1.00

Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Multiple Level Calibration

pass cps 2/13/08

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.06min
Max. RRF Dev : 20% Max. Rel. Area : 150%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.000	1.000	0.0	113	0.00
2		Dichlorodifluoromethane	0.410	0.405	1.2	112	0.00
3	P	Chloromethane	0.279	0.275	1.4	111	0.02
4	C	Vinyl Chloride	0.257	0.236	8.2	113	0.00
5		Bromomethane	0.037	0.028	24.3#	102	0.00
6		Chloroethane	0.138	0.169	-22.5#	120	0.01
7		Trichlorofluoromethane	0.536	0.356	33.6#	76	0.00
8		1,1,2-Trichlorotrifluoroeth	0.454	0.435	4.2	111	0.00
9	C	1,1-Dichloroethene	0.413	0.413	0.0	115	0.00
10		Acetone	0.015	0.013	13.3	112	0.00
11		Carbon Disulfide	1.445	1.402	3.0	112	0.00
12		Methylene Chloride	0.406	0.394	3.0	112	0.00
13		Methyl-t-butyl Ether	0.560	0.459	18.0	92	0.00
14		t-1,2-Dichloroethene	0.464	0.417	10.1	101	0.00
15		n-Hexane	0.497	0.515	-3.6	120	0.02
16	P	1,1-Dichloroethane	0.644	0.600	6.8	107	0.02
17		Diisopropyl Ether	0.269	0.268	0.4	114	0.00
18		2.2- Dichloropropane	0.427	0.269	37.0#	71	0.00
19		c-1,2-Dichloroethene	0.514	0.472	8.2	102	0.00
20		2-Butanone(MEK)	0.022	0.020	9.1	103	0.00
21		Tetrahydrofuran	0.023	0.022	4.3	108	0.00
22		Bromochloromethane	0.265	0.223	15.8	98	0.00
23	C	Chloroform	0.681	0.630	7.5	106	0.00
24	S	Dibromofluoromethane	0.510	0.449	12.0	101	0.00
25		1,1,1-Trichloroethane	0.568	0.504	11.3	98	0.02
26		Carbon tetrachloride	0.507	0.456	10.1	102	0.00
27		1.1-Dichloropropene	0.547	0.533	2.6	110	0.00
28		Benzene	1.644	1.587	3.5	108	0.00
29		1,2-Dichloroethane	0.299	0.272	9.0	99	0.02
30	I	1,4-Difluorobenzene	1.000	1.000	0.0	111	0.00
31		Trichloroethene	0.324	0.308	4.9	107	0.00
32	C	1,2-Dichloropropane	0.255	0.252	1.2	113	0.00
33		Dibromomethane	0.173	0.158	8.7	100	0.00
34		Bromodichloromethane	0.333	0.314	5.7	104	0.00
35		c-1,3-Dichloropropene	0.384	0.373	2.9	110	0.00
36		Methyl Isobutyl Ketone (MIB	0.046	0.049	-6.5	119	0.00
37	S	Toluene-D8	1.060	1.062	-0.2	112	0.00
38	C	Toluene	0.805	0.798	0.9	114	0.00
39		1,1,2-Trichloroethane	0.182	0.172	5.5	107	0.00

(#) = Out of Range
004A.D VOCA0212.M Thu Feb 14 13:00:30 2008 Page 1

FIGURE 3 (CONT.)

DATA SYSTEM SUMMARY OF % DIFFERENCE AND RESPONSE FACTOR FOR CONTINUING CALIBRATION VERIFICATION

Evaluate Continuing Calibration Report

Data File : D:\HPCHEM\1\DATA\GC-1926\004A.D Vial: 4
Acq On : 12 Feb 2008 2:50 pm Operator: cps
Sample : CCS, 5UG/L Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.06min
Max. RRF Dev : 20% Max. Rel. Area : 150%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
41		t-1,3-Dichloropropene	0.311	0.292	6.1	99	0.00
42		Tetrachloroethene	0.351	0.354	-0.9	109	0.00
43		1,3-Dichloropropane	0.373	0.367	1.6	107	0.00
44		2-Hexanone	0.046	0.051	-10.9	122	0.00
45		Dibromochloromethane	0.313	0.291	7.0	99	0.00
46		1,2-Dibromoethane	0.263	0.251	4.6	108	0.00
47	P	Chlorobenzene	0.971	1.004	-3.4	114	0.00
48		1,1,1,2-Tetrachloroethane	0.329	0.324	1.5	113	0.00
49	C	Ethylbenzene	1.514	1.557	-2.8	114	0.00
50		m+p-Xylene	0.631	0.653	-3.5	112	0.00
51		o-Xylene	0.607	0.629	-3.6	114	0.00
52		Styrene	0.988	1.025	-3.7	115	0.00
53	P	Bromoform	0.205	0.190	7.3	100	0.00
54		Isopropylbenzene	1.323	1.396	-5.5	117	0.00
55	S	Bromofluorobenzene	0.419	0.403	3.8	108	0.00
56	I	1,4-Dichlorobenzene-D4	1.000	1.000	0.0	110	0.00
57	P	1,1,2,2-Tetrachloroethane	0.469	0.467	0.4	111	0.00
58		Bromobenzene	0.838	0.840	-0.2	114	0.00
59		1,2,3-Trichloropropane	0.370	0.365	1.4	131	0.00
60		n-Propyl benzene	3.387	3.603	-6.4	114	0.00
61		2-Chlorotoluene	2.174	2.230	-2.6	113	0.00
62		1,3,5-Trimethylbenzene	2.248	2.331	-3.7	112	0.00
63		4-Chlorotoluene	1.924	1.999	-3.9	115	0.00
64		t-Butyl benzene	2.102	2.294	-9.1	116	0.00
65		1,2,4-Trimethylbenzene	2.295	2.381	-3.7	115	0.00
66		sec-Butyl benzene	3.301	3.520	-6.6	119	0.00
67		1,3-Dichlorobenzene	1.563	1.598	-2.2	115	0.00
68		p-Isopropyl toluene	2.694	2.859	-6.1	114	0.00
69		1,4-Dichlorobenzene	1.528	1.543	-1.0	109	0.00
70		n-Butyl benzene	2.515	2.682	-6.6	119	0.00
71		1,2-Dichlorobenzene	1.326	1.364	-2.9	113	0.00
72		1,2-Dibromo-3-chloropropane	0.095	0.090	5.3	108	0.00
73		1,2,4-Trichlorobenzene	0.984	1.028	-4.5	117	0.00
74		Hexachlorobutadiene	0.563	0.613	-8.9	122	0.00
75		Naphthalene	1.475	1.393	5.6	109	0.00
76		1,2,3-Trichlorobenzene	0.832	0.804	3.4	109	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 0
004A.D VOCA0212.M Thu Feb 14 13:00:31 2008 Page 2

FIGURE 4

CALCULATION PAGE FOR AVERAGE RESPONSE FACTORS AND STATISTICS

Response Factor Report GC/MS Ins

Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Initial Calibration

PAP CDS 2/13/08

Calibration Files
1 =012A.D 2 =013A.D 3 =014A.D
4 =015A.D 5 =016A.D 6 =017A.D

		Compound	1	2	3	4	5	6	Avg	%RSD
1)	I	Pentafluorobenzene	----------ISTD----------							
2)		Dichlorodifluoromet	0.403	0.402	0.407	0.411	0.425	0.413	0.410	1.87
3)	P	Chloromethane	0.277	0.286	0.279	0.282	0.284	0.274	0.279	2.17
4)	C	Vinyl Chloride	0.262	0.268	0.273	0.236	0.263	0.252	0.257	5.25
5)		Bromomethane	0.034	0.037	0.047	0.031	0.040	0.035	0.037	14.37
6)		Chloroethane	0.106	0.167		0.159		0.128	0.138	18.11
7)		Trichlorofluorometh	0.581	0.493	0.572	0.529	0.538	0.534	0.536	5.90
8)		1,1,2-Trichlorotrif	0.486	0.470	0.477	0.443	0.437	0.436	0.454	5.01
9)	C	1,1-Dichloroethene	0.421	0.441	0.423	0.408	0.417	0.385	0.413	4.38
10)		Acetone	0.022	0.014	0.015	0.013	0.014	0.014	0.015	19.65
11)		Carbon Disulfide	1.602	1.491	1.460	1.418	1.427	1.371	1.445	5.94
12)		Methylene Chloride	0.443	0.402	0.389	0.397	0.417	0.399	0.406	4.53
13)		Methyl-t-butyl Ethe	0.555	0.594	0.542	0.568	0.551	0.546	0.560	3.16
14)		t-1,2-Dichloroethen	0.484	0.476	0.460	0.469	0.459	0.454	0.464	2.60
15)		n-Hexane	0.562	0.472	0.482	0.485	0.495	0.482	0.497	6.05
16)	P	1,1-Dichloroethane	0.684	0.640	0.676	0.633	0.641	0.614	0.644	4.13
17)		Diisopropyl Ether	0.277	0.269	0.285	0.266	0.260	0.257	0.269	3.51
18)		2.2- Dichloropropan	0.465	0.450	0.432	0.426	0.407	0.405	0.427	5.53
19)		c-1,2-Dichloroethen	0.525	0.520	0.519	0.522	0.514	0.498	0.514	2.05
20)		2-Butanone(MEK)	0.025	0.025	0.022	0.022	0.021	0.020	0.022	8.39
21)		Tetrahydrofuran	0.021	0.026	0.022	0.023	0.023	0.023	0.023	6.07
22)		Bromochloromethane	0.244	0.287	0.285	0.259	0.260	0.259	0.265	5.91
23)	C	Chloroform	0.686	0.692	0.702	0.677	0.693	0.659	0.681	2.55
24)	S	Dibromofluoromethan	0.508	0.516	0.511	0.506	0.504	0.505	0.510	1.07
25)		1,1,1-Trichloroetha	0.633	0.533	0.569	0.583	0.560	0.548	0.568	5.80
26)		Carbon tetrachlorid	0.521	0.502	0.509	0.509	0.510	0.496	0.507	1.57
27)		1.1-Dichloropropene	0.579	0.536	0.558	0.552	0.539	0.532	0.547	3.09
28)		Benzene	1.726	1.695	1.617	1.671	1.663	1.585	1.644	3.80
29)		1,2-Dichloroethane	0.279	0.298	0.306	0.312	0.307	0.293	0.299	3.68
30)	I	1,4-Difluorobenzene	----------ISTD----------							
31)		Trichloroethene	0.345	0.326	0.338	0.320	0.321	0.305	0.324	4.15
32)	C	1,2-Dichloropropane	0.272	0.255	0.260	0.248	0.248	0.248	0.255	3.43
33)		Dibromomethane	0.187	0.174	0.174	0.176	0.168	0.167	0.173	4.42
34)		Bromodichloromethan	0.338	0.336	0.339	0.336	0.334	0.319	0.333	2.24
35)		c-1,3-Dichloroprope	0.409	0.398	0.367	0.380	0.371	0.386	0.384	3.81
36)		Methyl Isobutyl Ket	0.043	0.045	0.045	0.045	0.047	0.049	0.046	4.09
37)	S	Toluene-D8	1.050	1.060	1.071	1.054	1.062	1.064	1.060	0.64
38)	C	Toluene	0.967	0.813	0.827	0.778	0.773	0.741	0.805	9.85
39)		1,1,2-Trichloroetha	0.176	0.194	0.184	0.180	0.176	0.182	0.182	3.38
40)	I	Chlorobenzene-D5	----------ISTD----------							
41)		t-1,3-Dichloroprope	0.331	0.283	0.301	0.327	0.308	0.312	0.311	5.20

(#) = Out of Range ### Number of calibration levels exceeded format ###
VOCA0212.M Wed Feb 13 13:17:30 2008 Page 1

FIGURE 4 (CONT.)

CALCULATION PAGE FOR AVERAGE RESPONSE FACTORS AND STATISTICS

Response Factor Report GC/MS Ins

Method : D:\HPCHEM\1\METHODS\VOCA0212.M (RTE Integrator)
Title : ECCS 8260 LIST
Last Update : Wed Feb 13 13:09:09 2008
Response via : Initial Calibration

Calibration Files
1 =012A.D 2 =013A.D 3 =014A.D
4 =015A.D 5 =016A.D 6 =017A.D

		Compound	1	2	3	4	5	6	Avg	%RSD
42)		Tetrachloroethene	0.374	0.369	0.336	0.361	0.343	0.341	0.351	4.68
43)		1,3-Dichloropropane	0.362	0.401	0.368	0.383	0.372	0.368	0.373	3.91
44)		2-Hexanone	0.045	0.043	0.045	0.046	0.047	0.050	0.046	4.84
45)		Dibromochloromethan	0.306	0.321	0.307	0.326	0.307	0.311	0.313	2.46
46)		1,2-Dibromoethane	0.272	0.261	0.261	0.259	0.268	0.258	0.263	1.95
47)	P	Chlorobenzene	0.999	1.017	0.965	0.983	0.980	0.943	0.971	3.74
48)		1,1,1,2-Tetrachloro	0.367	0.335	0.323	0.319	0.333	0.314	0.329	5.85
49)	C	Ethylbenzene	1.643	1.528	1.535	1.523	1.528	1.469	1.514	5.32
50)		m+p-Xylene	0.707	0.633	0.642	0.646	0.614	0.605	0.631	6.78
51)		o-Xylene	0.634	0.612	0.608	0.613	0.604	0.602	0.607	2.71
52)		Styrene	1.006	0.974	0.972	0.993	1.022	0.992	0.988	2.28
53)	P	Bromoform	0.221	0.190	0.203	0.211	0.203	0.200	0.205	4.72
54)		Isopropylbenzene	1.394	1.338	1.310	1.327	1.329	1.313	1.323	3.29
55)	S	Bromofluorobenzene	0.406	0.420	0.413	0.416	0.437	0.426	0.419	2.41
56)	I	1,4-Dichlorobenzene-D	----------ISTD----------							
57)	P	1,1,2,2-Tetrachloro	0.504	0.487	0.481	0.465	0.424	0.466	0.469	5.40
58)		Bromobenzene	0.988	0.820	0.826	0.814	0.820	0.796	0.838	8.03
59)		1,2,3-Trichloroprop	0.423	0.393	0.384	0.308	0.359	0.361	0.370	9.72
60)		n-Propyl benzene	3.616	3.439	3.531	3.480	3.311	3.248	3.387	5.42
61)		2-Chlorotoluene	2.402	2.231	2.192	2.167	2.105	2.086	2.174	5.55
62)		1,3,5-Trimethylbenz	2.375	2.284	2.345	2.292	2.183	2.143	2.248	4.50
63)		4-Chlorotoluene	1.995	2.014	1.929	1.918	1.887	1.863	1.924	3.15
64)		t-Butyl benzene	2.162	2.091	2.092	2.184	2.042	2.068	2.102	2.45
65)		1,2,4-Trimethylbenz	2.521	2.289	2.397	2.279	2.197	2.209	2.295	5.47
66)		sec-Butyl benzene	3.563	3.347	3.407	3.254	3.219	3.192	3.301	4.51
67)		1,3-Dichlorobenzene	1.756	1.639	1.591	1.527	1.490	1.481	1.563	6.85
68)		p-Isopropyl toluene	2.729	2.656	2.756	2.776	2.679	2.668	2.694	2.38
69)		1,4-Dichlorobenzene	1.674	1.567	1.555	1.564	1.464	1.445	1.528	5.71
70)		n-Butyl benzene	2.564	2.451	2.722	2.485	2.460	2.480	2.515	3.97
71)		1,2-Dichlorobenzene	1.380	1.380	1.363	1.333	1.296	1.258	1.326	3.88
72)		1,2-Dibromo-3-chlor	0.077	0.107	0.095	0.092	0.098	0.097	0.095	9.71
73)		1,2,4-Trichlorobenz	1.069	1.019	1.035	0.966	0.937	0.921	0.984	5.84
74)		Hexachlorobutadiene	0.580	0.597	0.549	0.555	0.560	0.547	0.563	3.32
75)		Naphthalene	1.630	1.562	1.443	1.412	1.357	1.441	1.475	6.29
76)		1,2,3-Trichlorobenz	0.898	0.833	0.881	0.814	0.785	0.799	0.832	5.07

(#) = Out of Range ### Number of calibration levels exceeded format ###
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FIGURE 5

EXTRACTION LOG

Environmental Chemistry Consulting Services
VOA Soil Extraction Log

Log Page Number _____

Method: _____ Extraction Date: _____ Analyst: _____

ECCS Sample Number	Sample ID	Initial Jar Wt. (g)	Final Jar Wt. (g)	Initial MEOH (ml)	Wt. Soil (g)	Final MEOH (ml)
Sand Blank						

	Manufacturer	Lot Number	Density @ 20°C
Methanol, P&T Grade			0.791 g/ml
Reagent Water			

- ☐ Initial vortex
- ☐ Sonicate for 20 minutes
- ☐ Final vortex

NOTE: Wisconsin soil samples must be shaken for two minutes rather than vortexed.

Comments: _____

Responsible Party: _____ Date: _____

Environmental Chemistry Consulting Services, Inc.

2525 Advance Road · Madison, WI 53718 · Phone (608) 221-8700 · FAX (608) 221-4889

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede prior revisions as of the effective date of this SOP.

Reviewed By:

Chris Sauer — 06/20/12

Chris Sauer, GC/MS Team Leader — Date

Michael Linskens — 06/20/12

Michael Linskens, Quality Manager — Date

Approved By:

06/20/12

Nick Nigro, President — Date

POLYCYCLIC AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) USING SELECTIVE ION MONITORING (SIM)

BASED ON METHOD 8270D

1 SCOPE AND APPLICATION

1.1 This method is based on Method 8270D, which is used to determine semi-volatile organic compounds in a variety of matrices. This method is applicable to water, soil, and waste samples. Part per billion (ppb) concentrations of the polycyclic aromatic hydrocarbons (PAH) can be determined in soils. Part per trillion (ppt) concentrations can be determined in waters. Concentrations determined in wastes vary depending upon matrix affects and the levels of interferences encountered.

Compound	CAS No.
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(*a*)anthracene	56-55-3
Benzo(*a*)pyrene	50-32-8
Benzo(*b*)fluoranthene	205-99-2
Benzo(*e*)pyrene	192-97-2
Benzo(*ghi*)perylene	191-24-2
Benzo(*k*)fluoranthene	207-08-9
Chrysene	218-01-9
Dibenz(*ah*)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(*1,2,3-cd*)pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0
1-Methylnaphthalene	90-12-0
2-Methylnaphthalene	91-57-6

1.2 The target compounds are all part of a class of polycyclic aromatic hydrocarbon compounds known as PAHs. PAHs are naturally occurring compounds that are most commonly associated with petroleum related products, coal, and wood combustion.

1.3 Compound identification is done by matching retention time and extracted ion chromatograms of each individual standard reference compared to compounds in the unknown sample. Each reference standard has a primary quantitation ion with two or three secondary identification ions.

1.4 This method is restricted to use by, or under the supervision of, analysts experienced in the use of HP MSD systems. The analyst must understand SIM data generated by the MS and how to use the extracted ion chromatograms for identification and quantitation.

2 SUMMARY OF METHOD

2.1 This method provides extraction and GC/MS conditions for the analysis of a broad range of PAHs from soil and water.

2.2 Soil and solid waste samples are dried with anhydrous sodium sulfate, and then extracted with a 90% dichloromethane/10% acetone mixture using a self-contained mini-extraction.

2.3 Waters and liquid wastes are extracted by either of two methods. Water method A (PRE-002) is self contained and uses hexane as the extraction solvent with no concentration. Water method B (PRE-001) extracts water with dichloromethane in a separatory funnel and concentrated with a Turbovap® concentrator.

2.4 An aliquot of the soil, water, or waste extract is transferred to an injection vial and 2 µL of the extract is injected into the GC/MS system. A capillary column in the gas chromatograph (GC) is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS). The MS is operated in the SIM mode and only the responses of specific ions of the PAHs are measured.

2.5 Identification of target analytes is accomplished by comparing the relative response of specific target and qualifier ions of authentic standards. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using standard curve calculation methodology.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Poor quality matches of qualifier ion ratios relative to the target ion used for quantitation may indicate the presence of interferences in the sample.

4.2 Analysis of method and reagent blanks provides information about the presence of contaminants in the extraction procedure. When potential interfering peaks are noted in method blanks, the analyst should analyze additional blanks to identify the source of contamination and eliminate the problem.

4.3 Contamination may occur when a sample containing low concentrations of PAHs is analyzed immediately after a sample containing high concentrations of PAHs. After

analysis of a sample containing high concentrations of PAHs, an instrument blank should be analyzed to check for cross contamination. Cross-contamination is minimized in the extraction procedure for soils with single use glassware.

4.4 Visual screening of the sample extracts prior to GC/MS analysis is advantageous for identifying samples containing high concentrations of PAHs and then calculating necessary sample dilutions. Soil sample extracts that are dark and discolored usually indicate high levels of PAHs and an initial dilution should be performed on the extract. Water samples known to contain high levels of PAHs may be concentrated to a final volume of 10 mL rather than the typical 2 mL final volume.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and nitrile gloves must be worn while samples, standards, solvents, and reagents are being handled during this procedure. Lab coats are recommended.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 GC/MS Instrumentation

Gas Chromatograph: HP 5890 with split/splitless injector
Detector: HP 5971 or 5972 mass selective detector or equivalent
Autosampler: Leap Technologies CTC A200S
Column: RTX-5ms 30 m x 0.32 mm, ID 0.25 µm film, Restek part number 12624
Guard Column: 5 m IP deactivated, Restek part number 10044

6.1.1 GC/MS Supplies List

6.1.1.1 Seals: Dual Vespel ring inlet seal, Restek Cat. # 21239 or similar

6.1.1.2 Septa: LB-2 septa 11mm, Supelco # 164742

6.1.1.3 Ferrules: 1/16 x 0.5mm Vespel/ graphite Restek Cat. #20231/ 20249

6.1.1.4 Liners: Sky Liner gooseneck single taper with wool, 4mm x 6.5 x 78.5, Restek part number 23303.5

6.2 Computer Hardware: HP Compaq DC7600 or equivalent

6.3 Computer Software:

6.3.1.1 Microsoft Windows 2000 operating system or equivalent current version

6.3.1.2 Microsoft Office 2007 or equivalent current version

6.3.1.3 Agilent MSD Productivity Chemstation with EnviroQuant

6.3.1.4 Promium Element LIMS

6.4 Labware

6.4.1 Dispenser: EMD Optifix® or equivalent, capable of accurately delivering 10.0 mL of solvent

6.4.2 Balances:

6.4.2.1 Top Loader capable of weighing to 0.01 gram

6.4.2.2 Analytical capable of weighing to 0.0001 gram

6.4.3 Micro-syringes: 10, 25, 100, 250, 500, and 1,000 µL, Gas-Tight®

6.4.4 Eppendorf repeater with various size disposable Combitips®

6.4.5 2 mL amber GC injection vials with Teflon®/silicon lined caps

6.4.6 Volumetric glassware: various sizes, (Class A)

6.4.7 Glass disposable Pasteur pipettes: 5 ¾" and 9" lengths

6.4.8 Volumetric pipettes: various sizes, 1 to 50 mL capacity (Class A)

7 REAGENTS AND STANDARDS

7.1 Solvents

7.1.1 Acetone - pesticide quality or equivalent

7.1.2 Carbon disulfide - pesticide quality or equivalent

7.1.3 Dichloromethane - pesticide quality or equivalent

7.1.4 90% dichloromethane/10% acetone: With a 2 L graduated cylinder measure 3600 mL of dichloromethane and 400 mL of acetone. Mix the two solvents in an empty 4 L dichloromethane solvent bottle. Record the preparation in LIMS under Laboratory>Standards.

7.2 Solid Reagents: Not applicable

7.3 Acids and Bases: Not applicable

7.4 Stock Standards:

7.4.1 Internal Standards: The internal standards are acenaphthene-d_{10}, chrysene-d_{12}, and perylene-d_{12}. The neat materials are purchased from CDN Isotopes.

7.4.2 Surrogate Stock: The surrogate, *p*-terphenyl-d is purchased as neat material from CDN Isotopes, part # D-87.

7.4.3 Stock solutions of PAHs are purchased from Absolute Standards (primarily used for quantitation) or Restek (primarily used as second source confirmation) at certified concentrations. Sixteen of the PAHs are purchased as a mix; each at a concentration of 2000 µg/mL. Benzo(*e*)pyrene is purchased as an individual solution at a concentration of 2000 µg/mL. 1-Methylnaphthalene and 2-methylnaphthalene are purchased as a mixed solution with each compound at a concentration of 2000 µg/mL. Table 4 details the Absolute or Restek part numbers and lists the PAHs included in these stock standards. When in unopened ampoules, these standards may be used up to the expiration date provided by the vendor.

7.5 Intermediate Standards

7.5.1 Intermediate Surrogate Standard: (*p*-terphenyl-d_{14}, 2000 µg/mL): Weigh 0.2000 g of the neat material into a glass scintillation vial using an analytical balance. Add 8 mL of carbon disulfide and 8 mL of dichloromethane to the vial. Cap and sonicate the mixture until the *p*-terphenyl-d_{14} is completely dissolved. Quantitatively transfer the solution from the vial to a 100 mL volumetric using a glass Pasteur pipette. Rinse the vial with three 2 mL portions of dichloromethane and add these to the flask. Add an additional 12 mL of carbon disulfide to the flask and bring to volume with dichloromethane. The resulting solution should be 20% carbon disulfide in dichloromethane. The resulting concentration of the surrogate standard is 2000 µg/mL (See Table 4). Assign an expiration date of one year and store refrigerated.

7.5.2 Intermediate Calibration Standard: An intermediate standard at a concentration of 25 µg/mL is prepared by diluting stock solutions. Into a 100 mL volumetric, add approximately 50 mL 90/ 10 dichloromethane/acetone solution. Add 1.25 mL of each of the following 2000 ug/mL standards: (1) 16 component PAH mix, (2) methyl naphthalene mix, (3) benzo(*e*)pyrene, and (4) *p*-terphenyl-d_{14} (Section 7.5.1). Fill to volume with 90/10. Table 5 summarizes the preparation of this standard. Assign an expiration date of one year and store refrigerated.

7.5.3 Intermediate Internal Standard Solution (750 µg/mL): Weigh 0.0750 g of each compound (Section 7.4.1) into separate glass scintillation vials using an analytical balance. Add 5 mL of carbon disulfide and 5 mL of dichloromethane to each vial.

Cap and sonicate each mixture until the compounds are completely dissolved. Quantitatively transfer the solutions to a 100 mL volumetric flask with a glass Pasteur pipet, rinsing the vials with three 2 mL portions of dichloromethane. Add an additional 15 mL of carbon disulfide to the volumetric flask and dilute to volume with dichloromethane. The final solvent should be 30% carbon disulfide in dichloromethane. The resulting stock solution will contain each internal standard at a concentration of 750 µg/mL (See Table 4). Assign an expiration date of one year and store refrigerated.

7.5.4 Intermediate Second Source: Prepare the intermediate second source by transferring 250ul of the 2000 µg/mL Restek stock standard into a 100 mL volumetric flask. Fill to volume with 90/10, for a concentration of 5000 ng/mL. Table 5 summarizes the preparation of this standard. Assign an expiration date of one year and store refrigerated.

7.6 Calibration Standards

7.6.1 The working calibration standards are prepared at eight levels (5, 20, 50, 100, 200, 500, 1000, and 2000 ng/mL) by diluting the intermediate PAH standard solution (Section 7.5.2).

7.6.2 2000 ng/mL standard: Into a 100 mL volumetric flask containing a small amount of 90% dichloromethane/10% acetone, add 8 mL of the intermediate calibration standard (Section7.5.2). Bring to volume with 90% dichloromethane/10% acetone.

7.6.3 Table 6 describes the preparation of the remaining working calibration standards.

7.6.4 Transfer the prepared standards into 40 mL VOA vials. Assign an expiration date of one year and store refrigerated.

7.7 Surrogate Spike Solutions:

7.7.1 Soil Surrogate Spiking Solution: Into a 50 mL volumetric flask, transfer 1.25 mL of the intermediate surrogate solution (Section 7.5.1). Fill to volume with acetone for a final concentration of 50 µg/mL.

7.7.2 Water Surrogate Spiking Solution: Into a 50 mL volumetric flask, transfer 0.125 mL of the intermediate surrogate solution (Section 7.5.1). Fill to volume with acetone for a final concentration of 5.0 µg/mL.

7.7.3 Transfer each solution to labeled 40 mL VOA vials. Assign an expiration date of one year and store refrigerated.

7.8 LCS Spike Mix: The LCS spike mix is prepared at 10 µg/mL by diluting the stock standards (Section 7.4). Into a 50 mL volumetric flask, add 0.25 mL each stock standard. Bring to volume with acetone. Assign an expiration date of one year and store refrigerated.

7.9 MS/MSD Spike Mix: See Section 7.8.

7.10 LOD spike mix:

7.10.1 Soil LOD Spike Mix (2000 ng/mL): The 2000 ng/ml calibration standard (section 7.6) is used to prepare LOD samples for soils. Spike with 50 µl to 5 grams of silica sand and extract with 10 ml of solvent. The resulting concentration of the LOD samples is 20 µg/kg.

7.10.2 Water LOD Spike Mix (200 ng/mL): Prepare the water LOD spike mix by adding 80 µl of the 25 µg/ml intermediate calibration standard (section 7.5.2) to approximately 5 mL of acetone in a 10 mL volumetric flask. Fill to the mark with acetone. Spike with 200 µl of the spike mix to 1 L resulting in a concentration of .04 µg/L for the LOD samples.

7.11 Second Source Standard: The second source standards are prepared at two levels. Prepare the 100 ng/mL standard by transferring 2.0 mL of the 5000 ng/mL standard (Section 7.5.4) into a 100 mL volumetric flask. Dilute to volume with 90/10. Prepare the 1000 ng/mL standard by transferring 20 mL of the 5000 ng/mL standard (Section 7.5.4) into a 100 mL volumetric flask. Dilute to volume with 90/10. Transfer to 40 mL VOA vials. Assign an expiration date of one year and store refrigerated.

7.12 Working Internal Standard: The working internal standard solution is prepared by diluting the intermediate internal standard (Section 7.5.3). Using a 10 mL volumetric pipette add 10 mL of the intermediate internal standard solution to a 100 mL volumetric flask. Fill to volume with 90/10 dichloromethane/ acetone. The resulting concentration of the working internal standard solution is 75 µg/mL (See Table 5). Assign an expiration date of one year and store refrigerated.

7.13 DFTPP Tuning Standard: The tuning standard (5.0 µg/mL) is prepared by diluting the stock standard purchased from Absolute Standards (500 µg/mL). Into a 100 mL volumetric flask, transfer 1.0 ml of the stock. Bring to volume with 90/10. A 2 µL injection of the tuning standard is injected resulting in 10 ng of DFTPP delivered to the MSD. Assign an expiration date of one year and store refrigerated.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Water samples are collected in 1 L amber bottles with Teflon®-lined caps. The client is advised to collect one sample in triplicate for analysis of matrix spike samples. Water samples are typically shipped on ice in a cooler. Once received by the laboratory, the water samples are stored in a refrigerator at 4 °C. Water samples are unpreserved and must be extracted within 7 days after collection.

8.2 Soil samples are collected in 4 oz wide mouth amber jars with Teflon®-lined caps. The samples are typically shipped on ice in a cooler. Once received by the laboratory, the soil samples are stored in a refrigerator at 4 °C. Soil samples are unpreserved and must be extracted within 14 days after collection.

8.3 Store sample extracts in a freezer at -15 °C or below and analyze within 40 days of extraction.

9 PROCEDURE

9.1 Preparation of Samples – Choose the appropriate preparation method below.

9.1.1 Water samples

9.1.1.1 PRE-001, Separatory Funnel Extraction

9.1.1.2 PRE-002, Self-Contained Water Extraction

9.1.2 Soil/sediment samples

9.1.2.1 PRE-003, Micro-Scale Soil Extraction

9.1.3 Wipe Samples

9.1.3.1 PRE-007, Wipe Sample Extraction

9.1.4 Waste

9.1.4.1 PRE-006, Waste Dilution

9.2 Clean-up and/or Derivatization: Clean-up and derivatization procedures are not applicable to this method.

9.3 Instrument Conditions

9.3.1 GC/MS Pump Down: Allow the GC/MS system to stabilize under high vacuum when calibrating from a vented state. Before initial calibration, allow at least 4 hours for the MS to stabilize after pump-down.

9.3.2 The following GC and GCMS conditions are customizable to optimize system performance and are intended as a reference only.

9.3.3 GC Conditions

Head Pressure:	Constant flow off, 5 PSI at 80 °C
Column Flow:	1.5 mL/minute
Split Flow:	35 mL/minute
Purge Valve:	Initial off
Purge Valve On Time:	1.5 minutes
Transfer Line Temperature:	320 °C
Injector Temperature:	350 °C

GC Temperature Program

Initial Temperature:	80 °C

Initial Hold:	4.0 minutes
1st Ramp:	22 °C/minute
1st Final Temperature:	150 °C
1st Hold Time:	1.0 minutes
2nd Ramp:	8 °C/minute
2nd Final Temperature:	300 °C
2nd Hold Time:	2 minutes
3rd Ramp:	22 °C/minute
3rd Final Temperature	340 °C
3rd Final Hold Time:	2.0 minutes

9.3.4 MS Conditions

Tune:	Maximum Sensitivity Autotune		
EM Voltage:	1600 (200 above Autotune)		
Scan Mode:	Selective Ion Monitoring		
Resolution	Low		
Solvent Delay	Approximately 3.5 minutes		
SIM Group:	1		
Start Time:	3.5 minutes		
Mass/Dwell Time(ms):	164/20	162/20	128/20
	151/20	142/20	141/20
	166/20	154/20	152/20
	179/20	165/20	153/20
	178/20	202/20	222/20
	236/20	240/20	244/20
	200/20		
SIM Group:	2		
Start Time:	16 minutes		
Mass/Dwell Time(ms):	264/35	260/35	252/35
	253/35	125/35	278/35
	139/35	279/35	276/35
	138/35	277/35	228/35
	229/35		

9.4 Preventive Maintenance/Troubleshooting

9.4.1 Preventative maintenance should be performed prior to the start of each analytical sequence. This includes clipping the front end of the guard column and replacing the septa, inlet liner, inlet seal and their associated o-rings and ferrules.

9.4.2 System performance can be evaluated by running low level and mid level ICAL standards known as CRLs. If general guidelines are not met for CRL standards refer to the subsequent topics in this section for further troubleshooting.

9.4.2.1 Low level CRL: Generally L-1 of the ICAL. Evaluate this low level standard for acceptable peak shape and signal to noise ratio for target compounds.

9.4.2.2 Mid level CRL: Generally L-5 of the ICAL. Evaluate this mid level standard for acceptable minimum areas for target compounds, surrogates internal standards. This CRL is also used to update retentions times of analytes prior to the start of the ICAL.

9.4.2.3 Tune performance check: Evaluate this tune standard for peak tailing, compound degradation, and MS tune performance. Refer to section 9.6.1.2 of this SOP for specific acceptance criteria regarding the tune performance check.

9.4.3 If the guidelines established above have not been met, further instrument maintenance may be required to optimize system performance. The following sections outline potential steps in optimizing the GC/MS system.

9.4.3.1 Evaluate the guard column for sufficient length. If less than one meter of the guard column is left, it is recommended that it be replaced. Prior to installing a new guard column, one meter should be clipped from the analytical column.

9.4.3.2 If replacing the guard column does not correct the problem, the analytical column may then need to be replaced.

9.4.3.3 If problems still persist in the GC/MS system, refer to the next section regarding MS preventative maintenance.

9.4.4 Less routinely, the MS source should be cleaned, filaments examined/changed, and electron multipliers replaced. This may aid in the optimization of the overall GC/MS system.

9.4.5 Advanced MS troubleshooting and other topics.

9.4.5.1 Detection of leaks in the GC/MS System: the presence of a base peak at m/z 28 (N_2) that is higher than m/z 69 (base peak of PFTBA) in the tune report indicates the presence of a gross leak in the GC/MS vacuum system. A common source of a leak is a loose transfer line nut sealing the GC capillary column to the MS transfer line. Less commonly, a break or improper alignment of the gasket between the MS source and the vacuum manifold may be the source of the leak.

9.4.5.2 Leak checking: Leak checking may be done by lightly spraying an air duster around areas of the MS that pose the most chance for a leak. These areas include around the gasket of the vacuum manifold, the seal between the MS and the MS interface, and the transfer line nut. Most commercially available air dusters (air in a can) contain difluoroethane, which will be quickly sucked into the MS system at any potential leak point. Actively scanning the MS while spraying the air duster will yield base peaks at m/z 51 and 65 at the point of any potential leak.

9.4.5.3 Water in the GC/MS system: The presence of a base peak at m/z 18 (H_2O) that is higher than m/z 69 in the tune report indicates excessive water remains in the MS manifold. The MS vacuum system does not efficiently remove water and this condition indicates that a long equilibration time is needed prior to the initial calibration. To aid in accelerating the equilibration process, the GC oven can be ramped to 115 °C during the pump down process. Manually injecting methanol or acetone can also aid in removing water.

9.4.5.4 Electron multiplier voltage: Raising the electron multiplier voltage by 200 V should approximately double the abundance of the m/z 69 ion in the tune report for a properly functioning electron multiplier. Over time this ratio will decrease. Nominal increase of the m/z 69 ion abundance as the voltage is increased in the MS is an indicator that the electron multiplier is damaged or worn out and requires replacement. An electron multiplier voltage higher than 2700 V in the tune report indicates that the multiplier needs replacement and/or the MS source needs cleaning.

9.4.5.5 Peak shape/resolution of PFTBA (perfluorotributylamine) calibration peaks: The appearance of the PFTBA peaks (m/z 69, 219, 502) used to calibrate the MS should be symmetric without any shoulders. Isotope masses of these same peaks (m/z 70, 220, 503) should be present and indicated in the tune report. Non-symmetric peak shape or the non-detection of isotope masses usually indicates that the MS source needs to be cleaned. Refer to section 9.7.1.1 of this SOP for more specific criteria when evaluating the PFTBA spectrum.

9.4.5.6 Standard spectra autotune: In the event that a maximum sensitivity autotune program does not yield acceptable spectra a standard spectra autotune program may be employed to tune the MS. This autotune program is designed to adjust ion ratios to match those found in mass spectral library reference spectra, but does not typically provide high MS sensitivity. As a consequence, the MS lenses (i.e. the entrance lens offset, entrance lens, ion focus repeller) may need adjustment to provide high MS sensitivity while also keeping the relative intensities of m/z 69, 219, & 502 within acceptable limits.

9.4.6 All maintenance performed on the GC/MS system should be performed by a chemist skilled in GC/MS maintenance and recorded in the GC and/or MS maintenance logs.

9.5 Retention Time Windows

9.5.1 Relative retention time of the sample component must be within ± 0.06 minutes of the standard component. The search window that the integration algorithm uses to identify peaks as a target analyte is set at ± 0.3 minutes.

9.5.2 If retention times vary or are increasing from injection to injection, the analyst must assure all target analytes are being properly identified. System maintenance may be required.

9.6 Instrumental Analysis

9.6.1 Tuning

9.6.1.1 Maximum sensitivity autotune: The mass spectrometer is tuned prior to calibration using the maximum sensitivity autotune program. This autotune program is designed to adjust ion ratios to match those found in mass spectral library reference spectra while also providing high MS sensitivity. A valid autotune should provide peak widths < 0.60 amu with mass assignments not differing by more than 0.20 amu for masses 69, 219, and 502 from the PFTBA tuning compound. The relative intensities for m/z 69, 219, and 502 should be 100%, 25-45%, and 0.5-1.5%, respectively. Isotope masses should be present for m/z 70, 220, and 503. Figure 3 shows a typical report for a successful maximum sensitivity autotune.

NOTE: If a maximum sensitivity autotune program does not yield an acceptable tune, a standard spectra autotune program may be used to tune the MS. Refer to the Preventative Maintenance/Troubleshooting section of this SOP for further details regarding this tune program.

9.6.1.2 Tune performance check: The tune performance check is a standard used to evaluate GC/MS performance. DFTPP (decafluorotriphenylphosphine) is used to validate MS performance by evaluating relative mass intensities of DFTPP ions. GC column performance and injection port inertness is also validated by calculating the tailing factors of benzidine and pentachlorophenol as well as the breakdown of DDT to DDE and DDD.

9.6.1.2.1 Inject 2 µL of a 5 µg/mL GC/MS tuning standard (Section 7.13).

9.6.1.2.2 Refer to Table 7 for required DFTPP acceptance criteria.

9.6.1.2.3 Benzidine and pentachlorophenol should not exceed a tailing factor of 2 as given by the following equation:

$$TailingFactor = \frac{BC}{AB}$$

9.6.1.2.4 The equation compares the width of the back half of the peak to the width of the front half of the peak at 10% height of the peak. See Figure 4 for an example tailing factor calculation.

9.6.1.2.5 Degradation of DDT to DDE and DDD should not exceed 20%.

9.6.1.3 If the acceptance criteria are not met, corrective action should be taken. This may include system maintenance or retuning the instrument prior to continuation of analysis.

9.6.2 Calibration

9.6.2.1 The ICAL is performed using the internal standard technique. Typically eight different levels of calibration standards are used to plot calibration curves using a quadratic regression fit with the weight on the inverse of the concentration. An acceptable calibration curve has a correlation coefficient (R) of 0.995 or greater.

NOTE: If evaluating the calibration curve based on the coefficient of determination (R^2), the R^2 value must be 0.990 or greater.

9.6.2.2 Table 3 provides a list of characteristic primary and secondary ions for each of the target compounds, internal standards and surrogates.

9.6.2.3 To each 2 mL injection vial, add 20 µL of the working internal standard solution (Section7.12) with a syringe. Transfer 800 µL of each calibration standard to the vial. Make sure all vials to be analyzed are prepared the same and properly labeled. Cap and invert to mix.

NOTE: Once prepared, ICAL standards and CCV vials can be subdivided using 250 µL inserts with 2 mL injection vials.

9.6.2.4 Inject each calibration standard, collect the data and tabulate the area response of the characteristic ions against the concentration for each target analyte and each internal standard. Select the quadratic curve fit analysis from the calibration options for each compound with the weight on the inverse of the concentrations.

Quadratic regression with inverse of concentration weighting

$$Y = AX^2 + BX + C$$

Where: Y = Peak area ratio of each analyte

$$\text{Ratio} = \frac{\text{Peak Area of Target Analyte}}{\text{Peak Area of Associated Internal Standard}}$$

A = Second order constant term (quadratic term)
B = First order constant term (linear term)
C = Constant term
X = Concentration of each target analyte in ng/mL
Weighting Factor = $\frac{1}{X}$

9.7 Sample Analysis

9.7.1 Samples are analyzed in a group referred to as a GC sequence, which is designated by the sequence number given by LIMS. A typical GC sequence begins with CRL samples and a tune performance check. If initial instrument checks are acceptable, the sequence is followed by an instrument blank (IBL), the ICAL, second source (SCV) standards, and initial calibration verification (ICV) standards. Samples extracts interspersed with CCV and tune performance checks, on a one per 10 basis, follow. The sequence ends with a CCV when the entire sequence has been injected, or when quantitative and/or qualitative QC criteria are no longer acceptable.

9.7.2 Add 20 µL of the internal standard solution (Section 7.12) to a properly labeled 2 mL injection vial. Transfer 800 µL of each sample to the vial. Preparation of vials in sets of no more than five at a time is recommended. Prepare each vial (standard, sample or QC sample) the same. Inject the samples and collect and process the data using a chromatography workstation. Internal standard limits are -50% to 200% from the first injected ICV or CCV standard. If recoveries are outside of that range, samples must to be re-injected.

9.7.3 If a response exceeds the theoretical concentration of the highest standard, dilute the sample extract and reanalyze. Dilute such that the concentration is in the upper half of the standard curve if possible.

9.7.4 A calibrated system requires analysis of CCVs to remain valid. CCV standards must be injected after every ten samples or less and at the end of the analysis sequence. Two CCVs concentrations are used (100 and 1000 ng/mL) because quadratic curves are employed. The response for each compound must not exceed a 20% difference when compared to the theoretical value of the calibration standard. When the limit is exceeded, inspect the GC system to determine the cause and perform whatever maintenance is necessary before re-calibrating and proceeding with sample analysis. All samples that were injected after the last acceptable CCV should be re-injected, or appropriately qualified in accordance with GEN-015, Qualification of Data.

$$Percent\ Difference = \frac{R2 - R1}{R1} \times 100$$

Where: R1 = Theoretical Concentration.
R2 = Calculated Concentration from CCV analyses.

9.7.5 Qualitative analysis

9.7.5.1 The qualitative identification of each target analyte is based on retention time, and on comparison of the extracted ion chromatograms of the sample with the characteristic extracted ion chromatograms from reference spectra in the current method. The current reference spectra should be generated from the current ICAL using the conditions of the method and/or by using library reference spectra. The characteristic ions for this method are listed in Table 3. Compounds are identified as present when the following criteria are met.

9.7.5.1.1 The intensities of the characteristic ions of a target analyte maximize in the same scan or within one scan of each other.

9.7.5.1.2 Selection of a peak as a target analyte by the data system occurs where the identification is based on the presence of the target ions specific for the target analyte at the target analyte-specific retention time.

9.7.5.1.3 The relative intensities of the characteristic ions agree within 30% of when compared to the reference spectrum. As an example, for an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.

9.7.6 Quantitation

9.7.6.1 Once a compound has been identified, the quantitation of that compound is based on the integrated abundance from the extracted ion chromatogram of the primary characteristic ion. The concentration in ng/mL of the compounds found in the sample extract is calculated by the chromatography workstation using reverse extrapolation from the standard curve generated in Section 9.7.2.

9.7.6.2 The concentration of water samples in µg/L, or soil samples in µg/kg is then calculated as follows:

$$Concentration\ (\mu g/L) = \frac{A_x \times D \times V_e \times \frac{1\ \mu g}{1000\ ng}}{V_s}$$

Where: A_x = Concentration of compound determined in ng/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL
V_s = Volume of sample extracted in liters

$$Concentration\ (\mu g/kg) = \frac{A_x \times D \times V_e \times \frac{1\ \mu g}{1000\ ng}}{W_s}$$

Where: A_x = Concentration of compound determined in ng/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL
W_s = Weight of sample extracted in kg

9.8 Data package and review

9.8.1.1 Refer to GEN-016, Data Review Procedures for preparation and review of each sequence data package.

9.8.1.2 Manual integrations must be properly documented in accordance with GEN-018.

9.8.1.3 Prior to reporting results via LIMS, false positives must be removed by Q-deletion.

9.9 Calculations

9.9.1 Once a compound has been positively identified, the quantitation of that compound is based on the integrated abundance from the extracted ion chromatogram of the primary characteristic ion. The concentration in ng/mL of each compound found in the sample extract is calculated by the chromatography workstation using reverse extrapolation. The standard curve regression is established by plotting the amount against the response ratio using a quadratic regression curve fit from the ICAL as described in 9.6.2..

9.9.2 The concentration of the sample in µg/L, or µg/kg, is then calculated as follows:

$$Concentration\ (\mu g/L) = \frac{A_x \times D \times V_e}{V_s}$$

Where: A_x = Concentration of compound in the extract in µg/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL
V_s = Volume of sample extracted in liters

$$Concentration\ (\mu g/kg) = \frac{A_x \times D \times V_e}{W_s}$$

Where: A_x = Concentration of compound in the extract in µg/mL
D = Dilution factor, if applicable
V_e = Volume of extract in mL

W_s = Weight of sample extracted in kg

10 QUALITY CONTROL

10.1 Refer to Method 8000 for general quality control procedures for chromatography methods.

10.2 An analytical batch consists of 20 or fewer samples. Batch quality control samples should be analyzed with each set with the following frequency:

Blanks - One per 20 or fewer samples, minimum one per day
LCSs - One per 20 or fewer samples, minimum one per day
MS/MSDs - One MS/MSD per 20 or fewer samples, minimum one set per day

Note: If an MS/MSD cannot be prepared because of limited sample volume, a LCS duplicate must be prepared.

10.3 Method blanks consist of an aliquot of laboratory reagent water or silica sand that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. If target analytes or interferences are present at concentrations that impact the analytical results for samples, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.4 LCSs consist of an aliquot of laboratory reagent water or silica sand spiked with the target analytes, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. LCS control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. If the recovery or RPD (if LCS duplicate is analyzed) of any of the target analytes is outside control limits, the samples (including quality control samples) should be re-extracted or appropriately qualified in accordance with GEN-015, Qualification of Data.

10.5 MS/MSD samples consist of duplicate aliquots of sample spiked with the target analytes, prepared and processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure. MS/MSD control limits for precision and accuracy are established on at least a yearly basis through the use of at least 20 data points. MS/MSD control limits are advisory. If the recovery or RPD of any of the target analytes is outside control limits, data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.6 Initial calibration (ICAL) is performed using the internal standard technique by injecting a minimum of 5 of the available calibration standards. The lowest calibration point must be at or below the reporting limit. An acceptable calibration curve has a coefficient of determination (r^2) of 0.990 or greater.

10.7 The working calibration curve must be verified on each working day and after every

10 or less samples by the injection of two CCV standards. If the response for any analyte varies from the theoretical concentration by more than 20%, a new calibration curve must be prepared or data appropriately qualified in accordance with GEN-015, Qualification of Data.

10.8 Surrogates are added to every sample and QC sample. Surrogate control limits are generated on at least a yearly basis. If a surrogate recovery is outside of control limits, the sample should be re-extracted and re-analyzed, if possible. If not, the data should be appropriately qualified in accordance with GEN-015, Qualification of Data.

10.9 Two levels of second source calibration verification (SCV) standards must be analyzed with every initial calibration. The accepted limits are 80-120% for all analytes. If an SCV fails, immediate corrective action is required before proceeding with sample analysis. Affected data should be qualified according to GEN-015, Qualification of Data.

10.10 Internal standards are added to every injection vial. The response of the internal standards must not vary by < 50% or > 200% from the initial response of the mid-point standard in the initial calibration. If a limit is exceeded, the sample must to be re-aliquoted and re-injected.

10.11 A tuning check with DFTPP is required before initial analysis proceeds and at least every 12 hours thereafter. Tuning criteria are listed in Table 7.

11 METHOD PERFORMANCE

11.1 The limit of detection (LOD) for PAHs has been determined for waters and soils from the analysis of eight replicates fortified at 0.01 µg/L and 10 µg/kg, respectively. The LODs and report limits are presented in Table 1.

11.2 A demonstration of capability (DOC) was performed for water and soil by analyzing 4 replicate samples for each. The summary of DOCs for water and soil is listed in Table 2.

12 CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

12.1 Contingencies for out-of-control data should be evaluated on a case-by-case basis. A Corrective Action Form (CAF) must be completed for those times that acceptable QC results cannot be achieved. The CAF must be completed by the analyst and filed with the Quality Manager. Analytical results shall be qualified as necessary.

13 WASTE MANAGEMENT / POLLUTION PREVENTION

13.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

14 REFERENCES

14.1 Semi-volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Method 8270b, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 2, September 1994.

14.2 Micro-scale Solvent Extraction (MSE), Method 3570, SW-846, Test Methods for Evaluating Solid Wastes, Revision), November 2002.

14.3 Separatory Funnel Extraction, Method 3510, SW-846, Test Methods for Evaluating Solid Wastes, Update III Revision 2, September 1994.

TABLE 1

LOD STUDY

Compound	Sand[1] (µg/kg)	Water[2] (µg/L)
Acenaphthene	1.763	0.00214
Acenaphthylene	1.552	0.00174
Anthracene	5.819	0.00335
Benzo(a)anthracene	2.824	0.00268
Benzo(a)pyrene	3.724	0.00158
Benzo(b)fluoranthene	2.377	0.00186
Benzo(e)pyrene	1.319	0.00251
Benzo(ghi)perylene	1.176	0.00225
Benzo(k)fluoranthene	3.387	0.00232
Chrysene	1.026	0.00219
Dibenzo(ah)anthracene	3.713	0.00264
Fluoranthene	1.957	0.00137
Fluorene	1.984	0.00249
Indeno(1,2,3-cd)pyrene	5.690	0.00455
1-Methylnaphthalene	2.765	0.00337
2-Methylnaphthalene	2.622	0.00353
Naphthalene	2.211	0.00634
Phenanthrene	1.696	0.00390
Pyrene	2.403	0.00194
p-Terphenyl-d_{14}	2.646	0.00229

NOTES: (1) Soils were prepared in batch A202034 and analyzed in sequence A2B0905
(2) Waters were prepared using PRE-001, batch A202035, and analyzed in sequence A2B0905.

TABLE 2

DOCS

Compound	SILICA SAND[1] Conc. µg/kg	Average	% RSD	WATER[2] Conc. µg/L	Average	% RSD
Acenaphthene	400	399	4.86	0.4	0.296	7.69
Acenaphthylene	400	380	6.02	0.4	0.298	7.39
Anthracene	400	418	5.95	0.4	0.317	6.73
Benzo(a)anthracene	400	437	5.08	0.4	0.358	4.43
Benzo(a)pyrene	400	463	6.49	0.4	0.304	9.30
Benzo(b)fluoranthene	400	375	5.49	0.4	0.349	7.81
Benzo(e)pyrene	400	386	4.84	0.4	NA	NA
Benzo(ghi)perylene	400	384	5.29	0.4	0.275	29.1
Benzo(k)fluoranthene	400	404	4.40	0.4	0.342	3.95
Chrysene	400	392	4.78	0.4	0.352	7.18
Dibenzo(ah)anthracene	400	388	6.57	0.4	0.282	21.0
Fluoranthene	400	391	5.51	0.4	0.354	2.54
Fluorene	400	414	4.92	0.4	0.324	2.86
Indeno(1,2,3-cd)pyrene	400	389	10.14	0.4	0.344	9.79
1-Methylnaphthalene	NA	NA	NA	0.4	NA	NA
2-Methylnaphthalene	NA	NA	NA	0.4	NA	NA
Naphthalene	400	378	5.21	0.4	0.285	6.15
Phenanthrene	400	392	5.71	0.4	0.352	4.21
Pyrene	400	390	6.53	0.4	0.347	4.91
p-Terphenyl-d_{14}	500	557	1.87	0.5	0.472	1.93

NOTES: (1) Soils were prepared in batch A201021 and analyzed in sequence A2A0801
(2) Waters were prepared using PRE-001, batches A204085, A204009, and A202035.

NA= NOT AVAILABLE AT TIME OF SOP GENERATION

TABLE 3

ELUTION ORDER WITH APPROXIMATE RETENTION TIMES AND INTERNAL STANDARD USED FOR CALIBRATION

Compound	**Retention Time**	**Respective ISTD**
Naphthalene		1
2-Methylnaphthalene	4.65	1
1-Methylnaphthalene	5.54	1
Acenaphthylene	5.68	1
Acenaphthene-d_{10} (ISTD 1)	6.95	NA
Acenaphthene	7.24	1
Fluorene	7.28	1
Phenanthrene	8.29	1
Anthracene	10.52	1
Fluoranthene	10.64	2
Pyrene	13.79	2
p-Terphenyl-d_{14}	14.42	2
Benzo(a)anthracene	15.12	2
Chrysene-d_{12} (ISTD 2)	18.08	NA
Chrysene	18.13	2
Benzo(b)fluoranthene	18.20	3
Benzo(k)fluoranthene	21.2	3
Benzo(e)pyrene	21.27	3
Benzo(a)pyrene	21.91	3
Perylene-d_{12} (ISTD 3)	22.04	NA
Benzo(ghi)perylene	22.2	3
Dibenzo(ah)anthracene	24.71	3
Indeno(1,2,3-cd)pyrene	24.65	3
	25.08	

TABLE 3 (CONTINUED)

CHARACTERISTIC MASSES (M/Z) AND RELATIVE ABUNDANCES

Compound	Primary Quantitation Ion	Secondary Qualifier Ion(s)	Typical % Relative Abundance of Qualifier Ion(s)
Acenaphthene	154	153, 152	108, 52
Acenaphthylene	152	151, 153	19, 13
Anthracene	178	179	15
Benzo(a)anthracene	228	229	74
Benzo(a)pyrene	252	253, 125	24, 12
Benzo(b)fluoranthene	252	253, 125	25, 132
Benzo(e)pyrene	252	253, 125	30, 17
Benzo(ghi)perylene	276	138, 277	85, 23
Benzo(k)fluoranthene	252	253, 125	25, 13
Chrysene	228	229	74
Dibenzo(ah)anthracene	278	139, 279	16, 27
Fluoranthene	202	200	19
Fluorene	166	165	92
Indeno(1,2,3-cd)pyrene	276	138, 227	80, 25
1-Methylnaphthalene	142	141	86
2-Methylnaphthalene	142	141	86
Naphthalene	128	129	11
Phenanthrene	178	179	15
Pyrene			
	202	200	19
INTERNAL STANDARDS			
Acenapthene-d_{10}			93
Chrysene-d_{12}	164	162	25
Perylene-d_{12}	240	236	22
	264	260	
SURROGATE STANDARD			
p-terphenyl-d_{14}			22
	244	122	

TABLE 4

STOCK STANDARD CONCENTRATIONS

STOCK STANDARD SOLUTION MIXTURE:
Absolute, CLP Semi-Volatiles PAH Standard, Catalog #10017,
2,000 µg/mL each component

Acenaphthene	Benzo(ghi)perylene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Benzo(k)fluoranthene	Naphthalene
Anthracene	Chrysene	Phenanthrene
Benzo(a)anthracene	Dibenz(ah)anthracene	Pyrene
Benzo(a)pyrene	Fluoranthene	
Benzo(b)fluoranthene	Fluorene	

INDIVIDUAL STOCK SOLUTIONS:

Compound	Vendor	Part #	Conc. (µg/mL)
Benzo(e)pyrene,	Absolute	90506	2000
1-Methylnaphthalene	Absolute	90289	2000
2-Methylnaphthalene	Absolute	90289	2000

SECOND SOURCE:
RESTEK, 8270 Calibration Mix #5, Revised, CAT#31995
2000 µg/mL each component

Acenaphthene	Benzo(ghi)perylene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Benzo(k)fluoranthene	1-Methylnaphthalene
Anthracene	Chrysene	2-Methylnaphthalene
Benzo(a)anthracene	Dibenzo(a,h)anthracene	Naphthalene
Benzo(a)pyrene	Fluoranthene	Phenanthrene
Benzo(b)fluoranthene	Fluorene	Pyrene

TABLE 4 (CONTINUED)

STOCK AND WORKING SURROGATE SOLUTIONS

Neat Material: *p*-Terphenyl-d_{14}, CDN Isotopes Part D-87, 98.8 atom %D

Compound	Weight[1] (grams)	Final Volume (mL)	Final Concentration (µg/mL)	Final Solvent
p-Terphenyl-d_{14}	0.2000	100	2,000	80% dichloromethane/ 20% carbon disulfide

Working Surrogate Solution -Soils

Compound	2000 µg/mL Stock Used (mL)	Final Volume (mL)	Final Concentration (µg/mL)	Final Solvent
p-Terphenyl-d_{14}	2.5	100	50	acetone

Working Surrogate Solution -Waters

Compound	2000 µg/mL Stock Used (mL)	Final Volume (mL)	Final Concentration (µg/mL)	Final Solvent
p-Terphenyl-d_{14}	0.25	100	5.0	acetone

NOTE: (1) Neat Material: *p*-Terphenyl-d_{14}, CDN Isotopes Part D-87, 98.8 atom %D

TABLE 4 (CONTINUED)

STOCK AND WORKING INTERNAL STANDARD SOLUTIONS

Stock Internal Standard Solution

NEAT STANDARDS:			
Compound	**Vendor**	**Part #**	**Isotopic Enrichment**
Acenaphthene-d_{10}	CDN Isotopes	D-42	98.8 atom %D
Chrysene-d_{12}	CDN Isotopes	D-402	98.8 atom %D
Perylene-d_{12}	CDN Isotopes	D-670	98.8 atom %D

Compound	**Weight (grams)**	**Final Volume (mL)**	**Final Concentration (µg/mL)**	**Final Solvent**
Acenaphthene-d_{10}	0.0750	100	750	80% dichloromethane/ 20% carbon disulfide
Chrysene-d_{12}	0.0750	100	750	
Perylene-d_{12}	0.0750	100	750	

Working Internal Standard Solution

Compound	**750 µg/mL Stock Standard Used (mL)**	**Final Volume (mL)**	**Final Concentration (µg/mL)**	**Final Solvent**
Acenaphthene-d_{10}	10	100	75	90/10 DCM/ acetone
Chrysene-d_{12}	10	100	75	
Perylene-d_{12}	10	100	75	

TABLE 5

INTERMEDIATE CALIBRATION STANDARD

Compound	Part#	Initial Conc. (µg/mL)	Volume Used (mL)	Final Volume (mL)	Final Conc. (µg/mL)
p-Terphenyl –d_{14}	Section 7.5.1	2,000	1.25	100	25
16 PAHs	Absolute 10017	2,000	1.25	100	25
Benzo(e)pyrene	Absolute 71016	2,000	1.25	100	25
1 & 2-Methylnaphthalene	Absolute 90289	2,000	1.25	100	25

.

INTERMEDIATE SECOND SOURCE

Compound	Part#	Initial Conc. (µg/mL)	Volume Used (mL)	Final Volume (mL)	Final Conc. (µg/mL)
8310 PAH Mixture	Restek 31841	500	0.50	50	5.0

All solutions prepared in 90/10 dichloromethane/ acetone.

TABLE 6

CALIBRATION STANDARDS

ICAL Level	8	7	6	5	4	3	2	1
Final Concentration (ng/mL)	2000	1000	500	200	100	50	20	5
Stock Solution ID	7.5.2	7.5.2	7.5.2	7.5.2	7.5.2	7.5.2	7.5.2	7.5.2
mL Added	8	8	2	0.8	0.8	0.2	0.08	20
Final volume (mL)	100	200	100	100	200	100	100	100

All solutions prepared in 90/10 dichloromethane/ acetone.

FIGURE 1

METHOD 8270D

TUNING CRITERIA

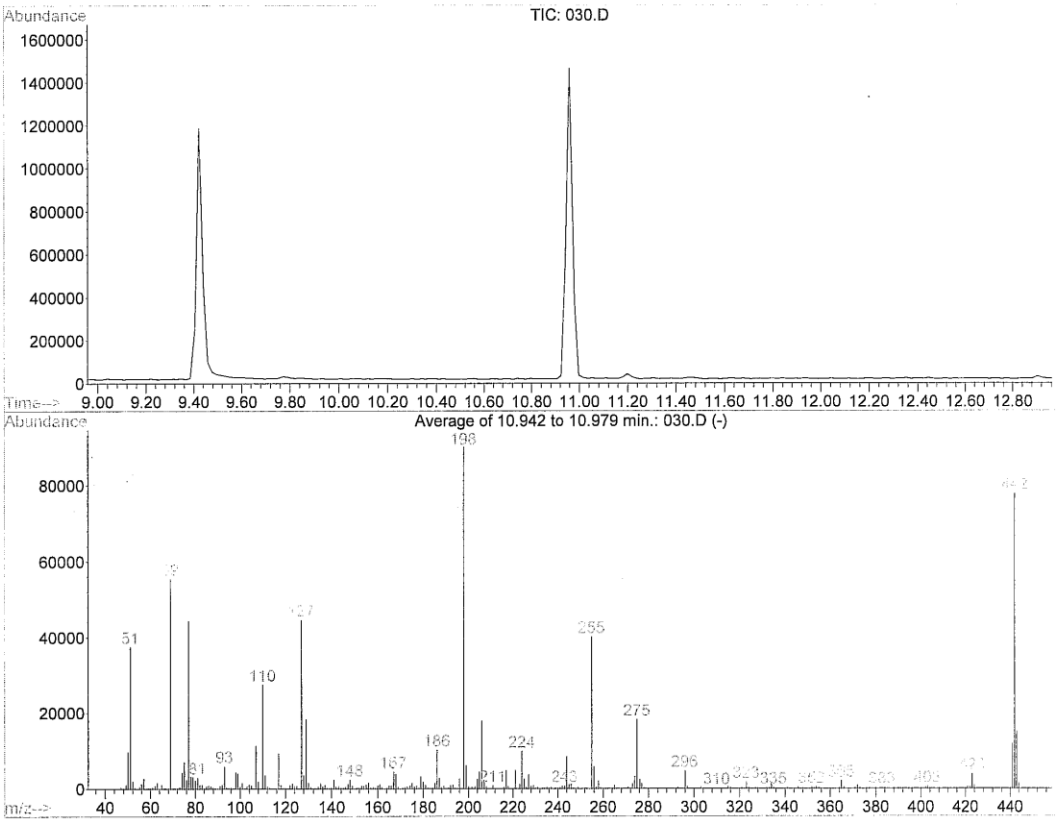
Mass Ion Abundance Criteria	
51	10-80% of Base Peak
68	< 2% of mass 69
70	< 2% of mass 69
127	10-80% of Base Peak
197	< 2% of mass 198
198	Base peak, or > 50% of Mass 442
199	5-9% of mass 198
275	10-60% of Base Peak
365	> 1% of mass 198
441	present but < 24% of mass 442
442	Base Peak, or > 50% of mass 198
443	15-24% of mass 442

From Method 8270D

FIGURE 2
TYPICAL DFTPP TUNING REPORT

DFTPP

Data File : C:\HPCHEM\1\DATA\A2D2301\030.D Vial: 30
Acq On : 24 Apr 2012 1:36 am Operator: BC
Sample : A2D2301-TUN3 Inst : 3341A0110
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P
Method : C:\HPCHEM\1\METHODS\QA2D2301.M (RTE Integrator)
Title : Alkylated PAHs and PAHs by SIM GC/MS



AutoFind: Scans 405, 406, 407; Background Corrected with Scan 402

Target Mass	Rel. to Mass	Lower Limit%	Upper Limit%	Rel. Abn%	Raw Abn	Result Pass/Fail
51	198	10	80	41.6	37532	PASS
68	69	0.00	2	0.2	130	PASS
69	198	0.00	100	61.6	55515	PASS
70	69	0.00	2	0.2	131	PASS
127	198	10	80	49.5	44660	PASS
197	198	0.00	2	0.0	0	PASS
198	198	100	100	100.0	90192	PASS
199	198	5	9	6.8	6122	PASS
275	198	10	60	20.2	18237	PASS
365	198	1	100	2.3	2058	PASS
441	442	0.01	24	15.2	11791	PASS
442	198	50	100	86.2	77757	PASS
443	442	15	24	19.4	15067	PASS

030.D QA2D2301.M Wed Apr 25 08:23:33 2012

FIGURE 3
TYPICAL CCV QUANTITATION REPORT

Quantitation Report (Not Reviewed)

Data File : C:\HPCHEM\1\DATA\A2D2301\040.D
Acq On : 24 Apr 2012 7:07 am
Sample : A2D2301-CCV4
Misc :
MS Integration Params: RTEINT.P
Quant Time: Apr 25 8:23 2012

Vial: 40
Operator: BC
Inst : 3341A0110
Multiplr: 1.00
Quant Results File: QA2D2301.RES

Quant Method : C:\HPCHEM\1\METHODS\QA2D2301.M (RTE Integrator)
Title : Alkylated PAHs and PAHs by SIM GC/MS
Last Update : Mon Apr 23 15:54:47 2012
Response via : Initial Calibration
DataAcq Meth : PAHSIM

Internal Standards	R.T.	QIon	Response	Conc Units	Dev(Min)
1) Acenaphthene-d10	6.75	164	795930	1875.00 ng/ml	0.00
10) Chrysene-d12	17.08	240	966121	1875.00 ng/ml	0.00
16) Perylene-d12	20.93	264	733975	1875.00 ng/ml	0.00
System Monitoring Compounds					
13) p-Terphenyl	14.28	244	331891	995.57 ng/ml	0.02
Spiked Amount 250.000			Recovery = 398.23%		
Target Compounds					Qvalue
2) Naphthalene	4.42	128	846832	988.60 ng/ml	100
3) 2-Methylnaphthalene	5.23	142	548439	1006.18 ng/ml	100
4) 1-Methylnaphthalene	5.35	142	509212	986.77 ng/ml	100
5) Acenaphthylene	6.51	152	820238	1040.26 ng/ml	100
6) Acenaphthene	6.80	153	503438	1009.25 ng/ml	99
7) Fluorene	7.76	166	527102	1033.18 ng/ml	100
8) Phenanthrene	9.87	178	691822	1032.99 ng/ml	100
9) Anthracene	10.00	178	693152	1069.73 ng/ml	99
11) Fluoranthene	12.99	202	638341	958.12 ng/ml	100
12) Pyrene	13.57	202	665613	985.85 ng/ml	100
14) Benzo(a)anthracene	17.06	228	495577	1060.76 ng/ml	100
15) Chrysene	17.15	228	482007	1012.78 ng/ml	100
17) Benzo(b)fluoranthene	19.99	252	480419	1037.88 ng/ml	99
18) Benzo(k)fluoranthene	20.06	252	485734	1007.26 ng/ml	100
19) Benzo(e)pyrene	20.65	252	428692	1017.58 ng/ml	100
20) Benzo(a)pyrene	20.77	252	440125	1058.53 ng/ml	100
21) Dibenz(ah)anthracene	23.45	278	391412	1074.45 ng/ml	99
22) Indeno(1,2,3-cd)pyrene	23.35	276	409656	1086.38 ng/ml	99
23) Benzo(ghi)perylene	23.86	276	464334	1058.80 ng/ml	99

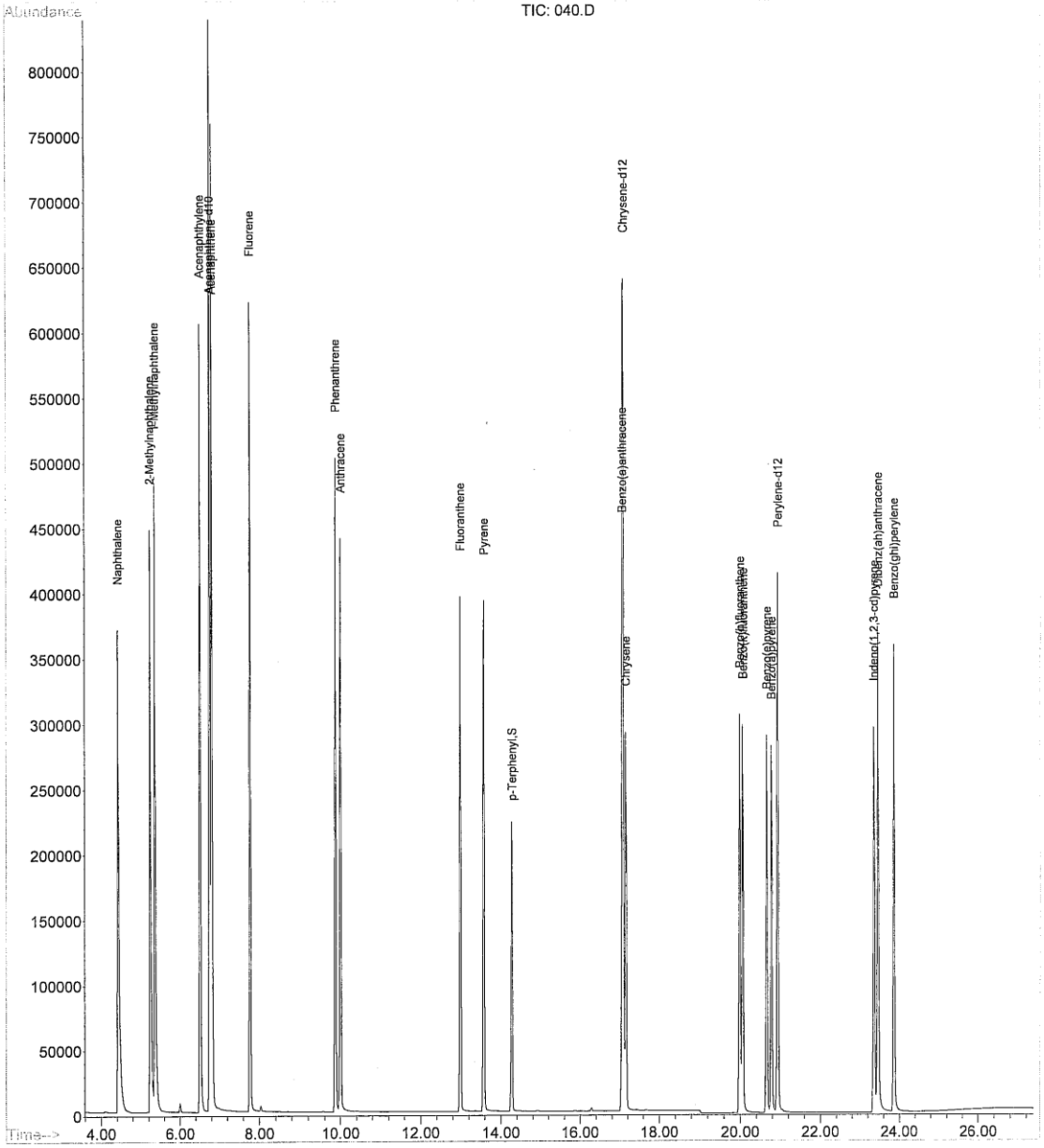
(#) = qualifier out of range (m) = manual integration
040.D QA2D2301.M Wed Apr 25 08:23:20 2012 Page 1

FIGURE 4
TYPICAL CCV CHROMATOGRAM

Quantitation Report

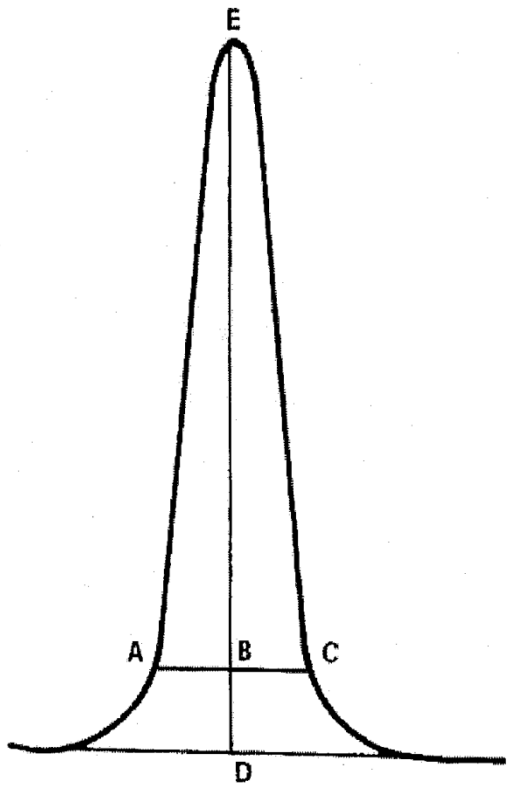
```
Data File : C:\HPCHEM\1\DATA\A2D2301\040.D                Vial: 40
Acq On    : 24 Apr 2012   7:07 am                     Operator: BC
Sample    : A2D2301-CCV4                              Inst    : 3341A0110
Misc      :                                           Multiplr: 1.00
MS Integration Params: RTEINT.P
Quant Time: Apr 25  8:23 2012              Quant Results File: QA2D2301.RES

Method       : C:\HPCHEM\1\METHODS\QA2D2301.M (RTE Integrator)
Title        : Alkylated PAHs and PAHs by SIM GC/MS
Last Update  : Mon Apr 23 15:54:47 2012
Response via : Initial Calibration
```



040.D QA2D2301.M Wed Apr 25 08:23:20 2012 Page 2

FIGURE 5
TAILING FACTOR CALCULATION



$$TailingFactor = \frac{BC}{AB}$$

Example Calculation: Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm

$$AB = 11\ mm$$
$$BC = 12\ mm$$

$$Therefore:\ TailingFactor = \frac{12}{11} = 1.1$$

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede prior revisions as of the effective date of this SOP.

Reviewed By:

Chris Sauer, GC/MS Team Leader — Date: 08/09/13

Michael Linskens, Quality Manager — Date: 08/09/13

Approved By:

Nick Nigro, President — Date: 08/09/13

SELF-CONTAINED WATER EXTRACTION

METHOD 3511

1 SCOPE AND APPLICATION

1.1 Method 3511 is a procedure for extracting selected semivolatile organic compounds from aqueous matrices. The approach minimizes solvent usage, thereby reducing the supply costs, health and safety issues, and waste generated.

1.2 This method is applicable to the isolation and concentration of water-insoluble and slightly water-soluble organics in preparation for a variety of chromatographic procedures.

1.3 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2 SUMMARY OF METHOD

2.1 A measured volume of sample, usually 400 mLs, at a specified pH (See Table 1), is extracted with an appropriate solvent (See Table 1) using a 500 mL amber bottle.

2.2 The extract is dried, cleaned up as necessary, and immediately ready to be analyzed by the definitive method.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts or elevated baselines in the extracted ion chromatograms. Reagent blanks are analyzed with every analysis batch to monitor for potential interferences with a goal of the procedure being interference free.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves must be worn while samples, standards, solvents, and reagents are being handled during this procedure.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 Amber glass narrow mouth bottles: 1000 mL, 500 mL or 250 mL

6.2 Vials:

6.2.1 12 mL storage vials with Teflon® lined screw cap

6.2.2 20 mL glass scintillation vials

6.3 Syringes: Various sizes, 10-1000 µL, Gastight

6.4 Repeater Plus with Combitips of various sizes (Eppendorf or equivalent)

6.5 Glass disposable transfer pipettes - 5 3/4" and 9"

6.6 Assorted laboratory glassware

6.7 Optifix solvent dispensers capable of dispensing accurate volumes (EM Science or equivalent)

6.8 Wide range pH indicator paper, 1 to 14

6.9 Refrigerator capable of maintaining 4 °C

6.10 Freezer capable of maintaining temperatures below -15 °C

6.11 Fume hood capable of maintaining flow of 100 linear feet per minute

6.12 Muffle furnace capable of maintaining 400 ^{o}C

7 REAGENTS

7.1 Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit

its use without lessening the accuracy of the determination. Reagents should be stored in glass to prevent the leaching of contaminants from plastic containers.

7.2 Solvents

7.2.1 Acetone, CH_3COCH_3 - pesticide quality or equivalent

7.2.2 Iso-octane, C_8H_{18} – pesticide quality or equivalent

7.2.3 De-ionized (DI) water, organic free

7.2.4 Hexane, C_6H_{14} – pesticide quality or equivalent

7.3 Solid Reagents

7.3.1 Sodium chloride (NaCl) - reagent grade

7.3.1.1 Sodium chloride is baked in a muffle furnace at 400 °C for a minimum of 4 hours and is stored in sealed glass containers prior to use. Label each container with the LIMS ID.

7.3.2 Sodium sulfate (Na_2SO_4) – reagent grade

7.3.2.1 Sodium sulfate is baked in a muffle furnace at 400 °C for a minimum of 4 hours and is stored in sealed glass containers prior to use. Label each container with the LIMS ID.

7.4 Acids and Bases

7.4.1 10 N sodium hydroxide (NaOH) solution – VWR Scientific

7.4.2 Concentrated sulfuric acid (H_2SO_4), EM GR grade

7.4.3 12 N H_2SO_4 - Caution: excessive heat is generated when preparing this acid.

7.4.3.1 Slowly add 333 mL of concentrated H_2SO_4 to 400 mL of de-ionized (DI) water in a 1 L volumetric flask placed in iced water. Fill to the mark with DI water and invert. Allow to cool and fill to the mark with DI again. Transfer the contents to a one liter bottle. Document the preparation in LIMS, label appropriately, and assign a 1 year expiration date.

7.5 Surrogate spiking solution

7.5.1 See Table 1 for surrogate spiking information for each definitive method.

7.6 Laboratory control sample (LCS)/matrix spike/matrix spike duplicate (MS/MSD)

spiking solution

7.6.1 See Table 1 for LCS and MS/MSD spiking information for each definitive method.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Aqueous samples should be collected in 1 L amber glass bottles with Teflon-lined caps and refrigerated at 4 °C after collection. Check the determinative method SOP for additional preservation requirements. Request one of the samples to be collected in duplicate for MS/MSD analysis.

8.2 Aqueous samples should be extracted within 7 days of collection. Store extracts in a freezer at -15 °C or below and analyze within 40 days of extraction.

9 PROCEDURE

9.1 See Table 1 for specific definitive method information.

9.2 Remove the samples to be extracted, and the surrogate and matrix spiking solutions from cold storage and allow to come to room temperature.

9.3 Prepare a minimum of one blank, LCS, and MS/MSD with each set of 20 or less water samples extracted per day. Use DI water for the blank and LCS. See Table 1 for volume used. If no sample volume is provided for MS/MSD, an LCS duplicate must be prepared with the batch.

NOTE: If a single extraction is being performed for multiple definitive methods, prepare separate samples for the LCS, MS, and MSD per each definitive method.

9.4 Glassware used during the extraction process is generally single use and can be used as is. Glassware that is not single use must be pre-rinsed with acetone or another appropriate solvent prior to use.

9.5 Transfer 400 mLs of sample to a 500 mL narrow mouth bottle containing 140-150 grams of purified NaCl.

9.6 Alternate sample volumes may be extracted to accommodate project specific requirements. However, the amount of NaCl added needs to be proportionate to the volume of water used.

Bottle Size	Volume	NaCl Weight
250 mL	200 g	70 - 75 g
500 mL	400 g	140 – 150 g
1000 mL	800 g	280 – 300 g

9.7 Check the pH of the samples with wide-range pH paper and, if necessary, adjust the pH to 5-9 using 12 N sulfuric acid or 10 N sodium hydroxide unless footnote indicated differently in the Initial pH column of Table 1. If adjusted, record the pH in LIMS. Also record the amount of acid or base used.

NOTE: The pH check is required for DRO but pH adjustment is not.

9.8 Cap and shake the bottle to dissolve most of the NaCl. Not all of the NaCl will dissolve.

9.9 Add the appropriate surrogate standard solution(s) (See Table 2) to all unknowns and quality control samples.

9.10 Add the appropriate LCS/MS/MSD spiking solution(s) (See Table 2) to the LCS, MS, and MSD.

9.11 Add the appropriate amount of solvent (See Table 1) to every sample and shake vigorously for a minimum of 45 seconds.

NOTE: The amount of extraction solvent may be altered to meet project specific objectives. If an alternate solvent volume is used, the surrogate and LCS/MS/MSD spiking volumes (See Table 1) should be proportionately adjusted. All sample, solvent, and spiking volumes must be documented in LIMS and the batch bench sheet.

9.12 Allow the sample to set for a minimum of 10 minutes and repeat the shaking again for a minimum of 45 seconds.

9.13 Allow sample to set for a minimum of 30 minutes. Then add DI water to bring the solvent up into the neck of the extraction vessel. Then let the sample set for another 10 minutes.

9.14 Transfer most of the solvent extract to a 20-mL scintillation vial containing a small amount of Na_2SO_4. The solvent is not concentrated prior to sample analysis.

NOTE: Do not transfer any of the sample water to the scintillation vial.

NOTE: If an emulsion occurs, pull the emulsion up into a disposable pipet and squirt back into the bottle. Doing this action several times will usually break up the emulsion adequately to obtain solvent to inject. Also try breaking the emulsion mechanically by shaking the disposable pipet back and forth through the emulsion.

9.15 The sample is now ready to be cleaned up, if necessary, or analyzed by the determinative method.

10 QUALITY CONTROL

10.1 Any reagent blanks, matrix spikes, or replicate samples should be subjected to exactly the same analytical procedures as those used on actual samples.

10.2 An analytical batch consists of 20 or fewer samples. Quality control samples should be analyzed with each set with the following frequency:

Blanks - One per 20 or fewer samples, minimum one per day
LCSs - One per 20 or fewer samples, minimum one per day
MS/MSDs - One MS/MSD per 20 or fewer samples, minimum one set per day

Note: If an MS/MSD cannot be prepared because of limited sample volume, an LCS duplicate must be prepared.

10.3 Method blanks consist of an aliquot of laboratory reagent water processed through every step of the extraction process.

10.4 Laboratory control samples consist of an aliquot of laboratory reagent water spiked with the determinative method target compounds, prepared and processed through every step of the extraction process.

10.5 Matrix spike/matrix spike duplicate samples consist of duplicate aliquots of sample spiked with the determinative method target compounds, prepared and processed through every step of the process.

10.6 Surrogates are added to every sample and QC sample in the batch in accordance with the determinative method.

11 METHOD PERFORMANCE

11.1 Refer to the determinative methods for performance data.

12 WASTE MANAGEMENT / POLLUTION PREVENTION

12.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

13 REFERENCES

13.1 Method 3511; Organic Compounds in Water by Micro-extraction, SW-846, Test Methods for Evaluating Solid Waste, Third Edition; U.S. EPA, OSWER; November 2002.

TABLE 1

SPECIFIC EXTRACTION CONDITIONS FOR VARIOUS DETERMINATIVE METHODS

Determinative Method	Initial pH	Initial Vol. (mLs)	Salted[1]	Initial Solvent	Final Extract Vol.
8015 DRO	- [2]	400	Yes	Hexane	5
8081A	5-9	400	Yes	Iso-octane	10
8082	5-9	400	Yes	Iso-octane	5
8141A	5-9	400	Yes	Toluene	5
8270D Alkylated PAHs	5-9	800	Yes	Hexane	5

[1] Amount of salt used is based on initial volume in mLs. See Section 9.6.
[2] The pH must be checked and documented, but pH adjustment is unnecessary.

TABLE 2

SURROGATE AND LCS/MS/MSD INFORMATION

Determinative Method	Surrogate Spike Concentration (µg/mL)	Surrogate Spike Amount (µL)	LCS/MS/MSD Spike Concenration (µg/mL)	LCS/MS/MSD Spike Amount (µL)
8015 DRO	To be defined	To be defined	To be defined	To be defined
8081A (standard list)	6.0	100	0.8/1.6/3.2/8.0	200
8081A (Mix 2)	6.0	100	1/2	200
8081A (toxaphene)	6.0	100	400	100
8081A (tech. chlordane)	6.0	100	80	50
8082 (1242)	6.0	50	50	100
8082 (1248)	6.0	50	50	100
8082 (1254)	6.0	50	50	100
8082 (1260)	6.0	50	50	100
8141A Pesticides Mix 1	20	100	4/10/20	250
8141A Pesticides Mix 2	20	100	2/4/10/20	250
8141A Pesticides Mix 3	20	100	2/4/10/20	250
8141A Pesticides FPD	20	100	10/20/50	100
8270D Alkylated PAHs	5	250	10	50

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede any prior revisions effective immediately as dated.

Reviewed By:

_____	09/16/11
Karl Olm, Operations Manager	Date
_____	09/16/11
Michael Linskens, Quality Manager	Date

Approved By:

_____	09/16/11
Nick Nigro, President	Date

METHOD 3570

SELF-CONTAINED SOIL EXTRACTION

1 SCOPE AND APPLICATION

1.1 This method describes a procedure for isolating organic compounds from soil and sediment samples.

1.2 This method is applicable to the isolation and concentration of organic compounds in preparation for a variety of chromatographic procedures.

1.3 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2 SUMMARY OF METHOD

2.1 Soil and sediment samples are dried with sodium sulfate and extracted with a solvent as listed in Table 1.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts or elevated baselines in the extracted ion chromatograms. Reagent blanks are analyzed with every analysis batch to monitor for potential interferences with a goal of the procedure being interference free.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves should be worn while samples, standards, solvents, and reagents are being handled during this procedure.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 Balances:

6.1.1 Top loader - capable of weighing to 0.01 g

6.2 Vials:

6.2.1 12 mL storage vials with Teflon® lined screw cap

6.2.2 20 mL glass scintillation vials

6.2.3 40 mL VOA vials

6.2.4 60 mL VOA vials

6.3 Syringes: Various sizes, 10-1000 µL, Gastight

6.4 Repeater Plus with Combitips of various sizes (Eppendorf or equivalent)

6.5 Glass disposable transfer pipettes - 5 3/4" and 9" and rubber bulbs

6.6 Assorted laboratory glassware

6.7 Stainless steel spatulas

6.8 Optifix solvent dispensers capable of dispensing accurate volumes (EM Science or equivalent)

6.9 Refrigerator capable of maintaining 4 °C

6.10 Freezer capable of maintaining temperatures below -15 °C

6.11 Muffle furnace capable of maintaining 400 ^{o}C

7 REAGENTS

7.1 Reagent grade chemicals shall be used in all tests. Other grades may be used provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Reagents should be stored in glass to prevent the leaching of contaminants from plastic containers.

7.2 Solvents

7.2.1 Dichloromethane, CH_2Cl_2 - pesticide quality or equivalent

7.2.2 Acetone, CH_3COCH_3 - pesticide quality or equivalent

7.2.3 Iso-octane, C_8H_{18} – pesticide quality or equivalent

7.2.4 Hexane, C_6H_{14} – pesticide quality or equivalent

7.2.5 Solvent mixes

7.2.5.1 80% Iso-octane/20% acetone: Combine 3200 mL of iso-octane with 800 mL of acetone in a 4 L solvent bottle. Document the preparation in LIMS, label appropriately, and assign a 1 year expiration date.

7.2.5.2 90% Dichloromethane/10% acetone: Combine 3600 mL of dichloromethane with 400 mL of acetone in a 4 L solvent bottle. Document the preparation in LIMS, label appropriately, and assign a 1 year expiration date.

7.3 Solid Reagents

7.3.1 Sodium sulfate (Na_2SO_4) – reagent grade

7.3.1.1 Sodium sulfate is baked in a muffle furnace at 400 °C for a minimum of 4 hours and is stored in sealed glass containers prior to use. Label each container with the LIMS ID.

7.3.2 Sand

7.3.2.1 Sand is baked in a muffle furnace at 400 °C for a minimum of 4 hours and is stored in sealed glass containers prior to use. Label each container with the LIMS ID.

7.4 Acids and Bases: Not applicable to this method

7.5 Surrogate spiking solution

7.5.1 See Table 1 for surrogate spiking information for each definitive method.

7.5.2 Refer to the definitive method for surrogate preparation instructions.

7.6 Laboratory control sample (LCS)/matrix spike/matrix spike duplicate (MS/MSD) spiking solution

7.6.1 See Table 1 for LCS and MS/MSD spiking information for each definitive method.

7.6.2 Refer to the definitive method for LCS and MS/MSD spiking solution preparation instructions.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Soil samples should be collected in amber glass jars with Teflon-lined caps and refrigerated at 4 °C after collection. Soil samples collected for 8141A may be collected in plastic Ziploc® bags for onsite analysis if regulatory rules allow.

8.2 Soil samples should be extracted within 14 days of collection. Soil samples for most compounds of interest can be frozen for longer periods until extraction if regulatory rules allow. Store extracts in a freezer at -15 °C or below and analyze within 40 days of extraction.

9 PROCEDURE

9.1 See Table 1 for specific definitive method information.

9.2 Remove the samples to be extracted, and the surrogate and matrix spiking solutions from cold storage and allow to come to room temperature.

9.3 Prepare a minimum of one blank, LCS, and MS/MSD with each set of 20 or fewer samples extracted per day. Use silica sand for the blank and LCS.

NOTE: If a single extraction is being performed for multiple definitive methods, prepare separate samples for the LCS, MS, and MSD per each definitive method.

9.4 Soil samples are typically not homogenous. The sample should be mixed as thoroughly as possible prior to weighing. Eliminate stones and other debris from samples.

9.4.1 Weigh 5.0 g of sample into a LIMS labeled and tared 20 mL scintillation vial. Add 5 or more grams of anhydrous sodium sulfate to dry the sample and mix well. Wet silt or clay soils may require over 10 g of sodium sulfate to dry the sample.

NOTE: A larger vial can be used if necessary.

9.4.2 Drying the sample completely to a free-flowing powder consistency with sodium sulfate is CRITICAL. A poorly dried sample will lead to poor recoveries of target analytes.

9.4.2.1 Occasionally a sample will not dry adequately in the 20 mL vial. Re-weigh the sample in a 40 mL or 60 mL VOA vial and mix with additional sodium sulfate to obtain a dry sample. If this procedure is used the extraction

solvent volume will have to be increased resulting in increased limits of detection. The amount of surrogate added to this sample is also adjusted accordingly. Record the information on the batch bench sheet in LIMS.

NOTE: If the drying procedure isn't working effectively, cap the vial and allow it to sit on the bench anywhere from 30 minutes to overnight.

9.5 Add the appropriate surrogate standard solution(s) (See Table 1) to all unknowns and quality control samples.

NOTE: If a single extraction is being performed for multiple definitive methods, the surrogate(s) for each method must be added.

9.6 Add the appropriate LCS/MS/MSD spiking solution(s) (See Table 1) to the LCS, MS, and MSD samples.

NOTE: If a single extraction is being performed for multiple definitive methods, prepare separate samples for the LCS, MS, and MSD per each definitive method.

9.7 Check that the Optifix is set precisely by measuring with a 10 mL Class A volumetric flask. Record the check on the batch bench sheet in LIMS.

9.8 Add 10.0 mL of appropriate extraction solvent (See Table 1), shake for 30 seconds, and allow settling for 2 minutes. Shake again for 30 seconds.

9.9 Allow samples to settle for a minimum of 10 minutes. The samples are now ready for analysis.

NOTE: Sample extracts (i.e. solvent) may be transferred to LIMS labeled 12 mL amber storage vials, if desired.

9.10 Samples are stored frozen by LIMS extraction batch number in the sample extract freezer.

10 QUALITY CONTROL

10.1 Any reagent blanks, matrix spikes, or replicate samples should be subjected to exactly the same analytical procedures as those used on actual samples.

10.2 An analytical batch consists of 20 or fewer samples. Quality control samples should be analyzed with each set with the following frequency:

Blanks - One per 20 or fewer samples, minimum one per day
LCSs - One per 20 or fewer samples, minimum one per day
MS/MSDs - One MS/MSD per 20 or fewer samples, minimum one set per day

10.3 Method blanks consist of an aliquot of sand processed through every step of the extraction process.

10.4 Laboratory control samples consist of an aliquot of sand spiked with the determinative method target compounds, prepared and processed through every step of the extraction process.

10.5 Matrix spike/matrix spike duplicate samples consist of duplicate aliquots of sample spiked with the determinative method target compounds, prepared and processed through every step of the process.

10.6 Surrogates are added to every sample and QC sample in the batch in accordance with the determinative method.

11 METHOD PERFORMANCE

11.1 Refer to the determinative methods for performance data.

12 WASTE MANAGEMENT / POLLUTION PREVENTION

12.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

13 REFERENCES

13.1 Method 3570; Micro-Scale Solvent Extraction (MSE), Test Methods for Evaluating Solid Waste, Third Edition; U.S. EPA, OSWER; November 2002.

TABLE 1

SPECIFIC EXTRACTION CONDITIONS FOR VARIOUS DETERMINATIVE METHODS

Determinative Method	Surrogate Spike Concentration (µg/mL)	Surrogate Spike Amount (µL)	LCS/MS/MSD Spike Concentration (µg/mL)	LCS/MS/MSD Spike Amount (µL)	Extraction Solvent	Final Extract Vol.
8015 DRO		To be defined		To be defined	Hexane	10
8081A (standard list)	6.0	100	0.8/1.6/3.2/8.0	200	80/20 I/A	10
8081A (Mix 2)	6.0	100	1/2	200	80/20 I/A	10
8081A (toxaphene)	6.0	100	400	50	80/20 I/A	10
8081A (tech. chlordane)	6.0	100	80	50	80/20 I/A	10
8082 (1242)	6.0	100	100	100	80/20 I/A	10
8082 (1248)	6.0	100	100	100	80/20 I/A	10
8082 (1254)	6.0	100	100	100	80/20 I/A	10
8082 (1260)	6.0	100	100	100	80/20 I/A	10
8141A Pesticides Mix 1	20	100	4/10/20	500	80/20 I/A	10
8141A Pesticides Mix 2	20	100	2/4/10/20	500	80/20 I/A	10
8141A Pesticides Mix 3	20	100	2/4/10/20	500	80/20 I/A	10
8141A Organophosphates (FPD)	20	100	10/20/50	100	80/20 I/A	10
8270D Pesticides	10	100	20[1]	100[1]	80/20 I/A	10
8270D Alkylated PAHs	50	50	10	200	90/10 M/A	10
8270D Pyrethroids Mix 1	50	50	25	100	80/20 I/A	10
8270D Pyrethroids Mix 2	50	50	17.8/20/23.8	100	80/20 I/A	10
8095 Nitro-Aromatics (NPD)	400	50	100	200	80/20 I/A	10

[1] For 8270D Pesticides, LCS/MS/MSD samples must be spiked with both Mix 1 and Mix 2 spiking solutions. The concentration of the spiking standards and the amount to be spiked is the same.

80/20 I/A = 80% iso-octane/20% acetone
90/10 M/A = 90% dichloromethane/10% acetone

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede any prior revisions effective immediately as dated.

Reviewed By:

	09/16/11
Karl Olm, Operations Manager	Date
	09/16/11
Michael Linskens, Quality Manager	Date

Approved By:

	09/16/11
Nick Nigro, President	Date

SULFUR CLEANUP

1 SCOPE AND APPLICATION

1.1 Elemental sulfur may be encountered in soil, sediment, and water samples, marine algae, and some industrial wastes. The solubility of sulfur in various solvents is very similar to the organochlorine and organophosphorus pesticides. Therefore, the sulfur interference follows along with the pesticides through the normal extraction and cleanup techniques.

1.2 Sulfur is identified in the chromatogram by a large unsymmetrical peak typically starting at about the elution time of Aroclor 1260. Other sulfur peaks may appear and the chromatogram may also appear to have a broad hump usually centered between the retention times of the two surrogates.

1.3 This method is restricted to use by or under the supervision of trained analysts.

1.4 This method is usually applicable to EPA Methods 8081 and 8082.

2 SUMMARY OF METHOD

2.1 Sample extracts are treated with elemental mercury.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Not Applicable

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash must be worn while sample extracts and mercury are being handled during this procedure.

5.3 Liquid mercury is toxic and should always be handled with great care. Use of a hood is recommended. Always place samples and mercury to be added to samples in a secondary container to contain any potential spills. All spills must be cleaned up immediately. Mercury spill kits are located near the storage area for mercury. Never use a vacuum or broom to clean up spilled mercury as these methods will increase

exposure.

5.4 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.5 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 Vials:

6.1.1 12 mL storage vials with Teflon® lined screw caps

6.2 Glass disposable transfer pipettes - 5 3/4" and 9" and rubber bulbs

6.3 Freezer capable of maintaining temperatures below -15 °C

7 REAGENTS

7.1 Elemental mercury (Hg), triple distilled or equivalent.

8 PROCEDURE

8.1 Transfer approximately 2 mL of sample extract to a 12 mL vial with a Teflon lined cap.

8.2 Add a small amount of liquid mercury to each sample to be cleaned up. The plastic bottle has a restrictor cap to allow mercury to be added directly to the extract vial without the use of a disposable pipet.

NOTE: Liquid mercury is toxic and should always be handled with great care. Use of a hood is recommended, and cleanup of any mercury spills is done immediately. Always place samples and mercury to be added to samples in a secondary container to contain any possible spills. All spills must be cleaned up immediately.

8.3 Cap vial and shake vigorously for 2 to 5 minutes. Repeat shaking as necessary. A black precipitate (mercuric sulfide) will begin to form if sulfur is present. Allow to settle and shake again for another 2 to 5 minutes.

8.4 Allow to settle and check for the presence of metallic liquid mercury. If present, the cleanup is complete. If not, transfer the extract to a new 12 mL storage vial, add more mercury and repeat above. There needs to be visible liquid mercury present to make sure all the sulfur has been removed.

8.5 Carefully transfer the cleaned extract to a new 12 mL storage vial, label and move to freezer storage. The vial may need to be centrifuged to consolidate the black precipitate at the bottm before transferring the solvent.

8.6 Place a mercury treated label on each vial containing mercury and set aside for disposal. Vials containing mercury should never be mixed with regular extract vials placed in the freezer.

9 QUALITY CONTROL

9.1 Quality control samples including blanks and associated matrix spike samples should be subjected to exactly the same procedure.

10 METHOD PERFORMANCE

10.1 Refer to the determinative methods for performance data.

11 WASTE MANAGEMENT / POLLUTION PREVENTION

11.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

11.2 Mercury treated sample extracts must be disposed of as follows. The extracts including the black powder formed and the remaining liquid mercury are poured into a container labeled mercury waste. This is all done under a hood. Cap the mercury waste container and continue to store in the hood. The mercury waste container can be properly disposed of at the City of Madison Clean Sweep Program for small business.

12 REFERENCES

12.1 Mitchell D. Erickson, Analytical Chemistry of PCBs, 2nd Edition, Chapter 6, p 228.

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede any prior revisions effective immediately as dated.

Reviewed By:

Karl Olm, Operations Manager	02/18/11 Date
Michael Linskens, Quality Manager	02/18/11 Date

Approved By:

Nick Nigro, President	02/18/11 Date

WIPE SAMPLE EXTRACTION

1 SCOPE AND APPLICATION

1.1 This method describes a procedure for extraction of organic compounds from wipe samples for a variety of chromatographic procedures.

1.2 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2 SUMMARY OF METHOD

2.1 Wipe samples are extracted with an appropriate solvent, cleaned up, if necessary and analyzed with the appropriate definitive method as listed in Table 1.

3 DEFINITIONS AND ACRONYMS

3.1 There are many terms and acronyms used throughout this document. Check the definitions and acronyms sections of the Quality Manual for complete explanations.

4 INTERFERENCES

4.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing hardware that lead to discrete artifacts or elevated baselines in the extracted ion chromatograms. Reagent blanks are analyzed with every analysis batch to monitor for potential interferences with a goal of the procedure being interference free.

5 SAFETY

5.1 Employees must abide by the policies and procedures in the ECCS Chemical Hygiene Plan (CHP), and this document. Refer to the CHP for more detailed safety information or for information not listed in this document.

5.2 Eye protection that protects against splash and appropriate gloves should be worn while samples, standards, solvents, and reagents are being handled during this procedure.

5.3 Employees must handle glassware and equipment carefully in order to prevent injury and accidents. Any damaged or broken glassware is to be discarded or moved to the glass repair box.

5.4 ECCS maintains a Material Safety Data Sheet (MSDS) for every chemical used in the laboratory. The MSDS file is kept in the main laboratory.

6 APPARATUS AND MATERIALS

6.1 12 mL storage vials with Teflon® lined screw cap

6.2 Syringes: Various sizes, 10-1000 µL, Gastight

6.3 Glass disposable transfer pipettes - 5 3/4" and 9" and rubber bulbs

6.4 Refrigerator capable of maintaining 4 °C

6.5 Freezer capable of maintaining temperatures below -15 °C

7 REAGENTS

7.1 Reagent grade chemicals shall be used in all tests. Other grades may be used provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Reagents should be stored in glass to prevent the leaching of contaminants from plastic containers.

7.2 Solvents

7.2.1 Dichloromethane, CH_2Cl_2 - pesticide quality or equivalent

7.2.2 Acetone, CH_3COCH_3 - pesticide quality or equivalent

7.2.3 Iso-octane, C_8H_{18} – pesticide quality or equivalent

7.2.4 Hexane, C_6H_{14} – pesticide quality or equivalent

7.2.5 Solvent mixes

7.2.5.1 80% Iso-octane/20% acetone: Combine 3200 mL of iso-octane with 800 mL of acetone in a 4 L solvent bottle. Document the preparation in LIMS, label appropriately, and assign a 1 year expiration date.

7.2.5.2 90% Dichloromethane/10% acetone: Combine 3600 mL of dichloromethane with 400 mL of acetone in a 4 L solvent bottle. Document the preparation in LIMS, label appropriately, and assign a 1 year expiration date.

7.3 Solid Reagents: Not applicable to this method

7.4 Acids and Bases: Not applicable to this method

7.5 Surrogate spiking solution

7.5.1 See Table 1 for surrogate spiking information for each definitive method.

7.5.2 Refer to the definitive method for surrogate preparation instructions.

7.6 Laboratory Control Sample (LCS)/Matrix Spike/Matrix Spike Duplicate (MS/MSD) Spiking Solution: Not applicable to this method.

8 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

8.1 Wipe samples should be collected in amber glass jars with Teflon-lined caps and refrigerated at 4 °C after collection.

8.2 Wipe samples should be extracted within 14 days of collection. Store extracts in a freezer at -15 °C or below and analyze within 40 days of extraction.

9 PROCEDURE

9.1 See Table 1 for specific definitive method information.

9.2 Remove the samples to be extracted and the surrogate spiking solution from cold storage and allow to come to room temperature.

9.3 Prepare a minimum of one reagent blank sample per batch of 20 or less samples.

NOTE: The reagent blank need not be prepared if the client has not provided a sample of the wipe media.

9.4 Add the appropriate surrogate standard solution(s) (See Table 1) to each sample jar.

NOTE: If a single extraction is being performed for multiple definitive methods, the surrogate(s) for each method should be added.

9.5 Quantitatively transfer 50 mL of the appropriate extraction solvent (See Table 1) to the sample jar with a 50 mL pipette.

9.6 Shake for 30 seconds and allow settling for 2 minutes. Shake again for 30 seconds.

9.7 Allow settling for a minimum of 10 minutes. The extracts are now ready for analysis.

NOTE: If the extract is to be analyzed for PCBs, an additional sulfuric acid cleanup step will likely be required. If the cleanup is necessary, refer to “PRE-004, Sulfuric Acid Cleanup.”

9.8 Transfer the extracts (i.e. solvent) to LIMS labeled 12 mL amber storage vials.

9.9 Extracts are stored frozen by LIMS extraction batch number in the sample extract

freezer.

10 QUALITY CONTROL

10.1 The reagent blanks, if prepared, should be subjected to exactly the same analytical procedures as those used on actual samples.

10.2 An analytical batch consists of 20 or fewer samples. Quality control samples should be analyzed with each set with the following frequency:

10.3 Blanks - One per 20 or fewer samples, minimum one per day.

NOTE: The reagent blank need not be prepared if the client has not provided a sample of the wipe media.

10.4 Surrogates are added to every sample and QC sample in the batch in accordance with the determinative method. Surrogates are added to be used as injection markers for the determinative method.

11 METHOD PERFORMANCE

11.1 Refer to the determinative methods for performance data.

12 WASTE MANAGEMENT / POLLUTION PREVENTION

12.1 All waste will be disposed of in accordance with federal, state, and local regulations. This method has been prepared to minimize the waste produced and the potential for pollution of the environment. All ECCS employees shall follow this method and the guidance provided in the ECCS Health and Safety manual.

13 REFERENCES

13.1 ASTM D6661-10, Standard Practice for Field Collection of Organic Compounds from Surfaces Using Wipe Sampling, ASTM, 2010.

TABLE 1

SPECIFIC EXTRACTION CONDITIONS FOR VARIOUS DETERMINATIVE METHODS

Determinative Method	Surrogate Spike Concentration (µg/mL)	Surrogate Spike Amount (µL)	Extraction Solvent	Final Extract Vol.
8015 DRO		To be defined	Hexane	50
8081A (standard list)	6.0	500	80/20 I/A	50
8081A (Mix 2)	6.0	500	80/20 I/A	50
8081A (toxaphene)	6.0	500	80/20 I/A	50
8081A (tech. chlordane)	6.0	500	80/20 I/A	50
8082 (1242)	6.0	500	80/20 I/A	50
8082 (1248)	6.0	500	80/20 I/A	50
8082 (1254)	6.0	500	80/20 I/A	50
8082 (1260)	6.0	500	80/20 I/A	50
8141A Pesticides Mix 1	20	500	80/20 I/A	50
8141A Pesticides Mix 2	20	500	80/20 I/A	50
8141A Pesticides Mix 3	20	500	80/20 I/A	50
8141A Organophosphates (FPD)	20	500	80/20 I/A	50
8270D Pesticides	10	500	80/20 I/A	50
8270D Alkylated PAHs	50	250	90/10 M/A	50
8270D Pyrethroids Mix 1	50	250	80/20 I/A	50
8270D Pyrethroids Mix 2	50	250	80/20 I/A	50
8095 Nitro-Aromatics (NPD)	400	250	80/20 I/A	50

80/20 I/A = 80% iso-octane/20% acetone
90/10 M/A = 90% dichloromethane/10% acetone

The signatures below indicate the following individuals have reviewed this document in its entirety and authorize its use to supersede any prior revisions effective immediately as dated.

Reviewed By:

Karl Olm, Operations Manager	02/18/11 Date
Michael Linskens, Quality Manager	02/18/11 Date

Approved By:

Nick Nigro, President	02/18/11 Date

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STANDARD OPERATING PROCEDURE

The Determination of Total Organic Carbon Using the Walkley-Black Procedure

Reference Methods: Methods of Soil Analysis, Walkley-Black

SOP NUMBER:	S-GB-I-037-Rev.03
EFFECTIVE DATE:	Date of Final Signature
SUPERSEDES:	S-GB-I-037-Rev.02

APPROVAL

Nils Melberg, Laboratory General Manager — Date: 1/07/11

Kate Grams, Laboratory Quality Manager — Date: 12/20/10

Chad Rusch, Department Manager — Date: 12/20/2010

PERIODIC REVIEW

SIGNATURES BELOW INDICATE NO CHANGES HAVE BEEN MADE SINCE APPROVAL

Signature	Title	Date

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1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to describe the method used to determine the concentration of Total Organic Carbon (TOC) in soil samples compliant with the Walkley-Black procedure.

2. Scope and Application

This SOP pertains to sediments, soils and sludges. This method is based on Methods of Soil Analysis, Walkley-Black. The applicable range is 400 to 32,000 mg/kg.

3. Summary of Method

An aliquot of a dried and homogenized solid sample is put into a COD vial and caped. The sealed tubes are heated in a hot block at 150°C. After two hours, the tubes are removed, cooled and measured spectrophotometrically at 620 nm.

4. Interferences

4.1 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other processing apparatus that lead to discrete artifacts. All of these materials must be routinely demonstrated to be free from interferences under conditions of the analysis by running laboratory method blanks as described in the Quality Control section. Specific selection of reagents may be required to avoid introduction of contaminants.

4.2 Chloride and iron give positive interference. Mercuric sulfate in the digestion tubes complexes the chlorides.

5. Safety

5.1 All samples, standards, and reagents should be treated as hazardous. Safety glasses, gloves, and lab coats are to be worn. The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by a safe technique. Special care should be taken when handling the high concentration acids and oxidizing reagents used for sample digestion.

5.2 The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of any chemical. A reference file of Material Safety Data Sheets (MSDS) and a formal safety plan are made available to all personnel involved in chemical analysis and should be consulted prior to handling samples and standards.

5.3 Excess reagents, samples and method process wastes are characterized and disposed of in an acceptable manner. For further information on waste management consult the current version of S-GB-S-006, *Waste Handling and Management*.

5.4 The laboratory Chemical Hygiene Plan/Health and Safety Plan contains additional information on pollution prevention.

6. Definitions

6.1 Total Organic Carbon (TOC): All carbon atoms covalently bonded in organic molecules. To measure TOC, all the inorganic carbon is removed by the addition of acid; the result is that only organic carbon is left.

6.2 Additional definitions can be found in Section 10 of the Pace Analytical Services, Inc. Quality Manual.

7. Sample Collection, Preservation and Handling

Table 1. SAMPLE COLLECTION, PRESERVATION, SHIPMENT, AND STORAGE

Matrix	Method	Container(s)	Preservation	Shipment Conditions	Lab Storage Conditions
Solid	Walkley Black	Clean 4oz glass containers	None 28 days	On ice 4+/- 2° Celsius	4^{0}C

8. Reagents and Standards

8.1 Reagents

8.1.1 15,000mg/L COD Vials

8.1.2 Reagent Water – Deionized water (DI water)

8.2 Standards

8.2.1 Potassium Hydrogen Phthalate ($KHC_8H_4O_4$) – Neat, dry at 105°C for 1 hour.

8.1.2.1 One primary source for calibration and CCVs.

8.1.2.2 Secondary source for ICV and spikes.

8.2.2 Laboratory Control Spike/Laboratory Control Spike Duplicate – Potassium Hydrogen Phthalate at a concentration of 400mg/L (calculates out to16,000 mg/kg assuming 0.05g to 2mL).

8.2.3 4,000mg/L TOC standard from 0.85g of Neat Potassium Hydrogen Phthalate to 100mL with DI water.

8.2.4 800mg/L TOC standard from 2mL of 4,000mg/L TOC standard to 10mL with DI water.

8.2.5 Calibration Curve: Made up of the following six standards, 10, 20, 50, 200, 400, 800 mg/L.

9. Equipment and Supplies

Table 2. EQUIPMENT

Equipment	Manufacturer*	Model(s)*
Top loading Balance	OHAUS	AP 110S
Spectrophotometer	Hach	DR2000
COD reactor block	Hach	45600
Adjustable pipettor	Finnpipette	
Adjustable pipettor	Chemisphere	02111245
Sample cells	Hach	Cat# 13537-02
Drying Oven (103-105°C)	Precision Scientific Group	17
Mortar and Pestle	Coors	60316, 60317
Vented Hood	Hamilton or Equivalent	
100 mL volumetric flasks	Pyrex	5660 100
1000 mL volumetric flask	Pyrex	5640 1L
Wire racks	Fisher	Cat# 14802

* Or equivalent

Table 3. SUPPLIES

Supplies	Manufacturer*	Vendor*	Catalog #*
COD digestion vials	Chemetrics	Fisher	K-7370S
Latex gloves	Diamond Grip	Fisher	11-462-67D
Thermal gloves	Fisher	Fisher	19-013-541
Finntip 5mL tips	Thermolabsystems	VWR	53515-886
Eppendorf 1000 uL Pipette tips	Eppendorf	Fisher	21-372

10. Calibration and Standardization

10.1 Prepare a calibration curve using a minimum of five standards and a blank: see standards. Add 2.0 mL of each curve standard to a digestion tube and digest per section 11.

10.2 Turn on Spectrophotometer as per instrument manual and set to 620 nm. Let warm up at least 20 minutes.

10.3 Wipe the outside of each vial with tissue paper to remove any fingerprints. Place Level 0 calibration standard into the spectrophotometer and zero the instrument.

10.4 Place the standard cells into the spectrophotometer and record standard absorbance at 620 nm into the excel spreadsheet.

10.5 Plot absorbance versus concentration using the WB Spec. Excel spreadsheet. The data is stored under R:/WetChem/Data/WB/year/month/date analyzed.xls. Note: The zero point is included in the regression of the curve.

10.6 A linear regression analysis of the absorbance values against the corresponding concentrations must yield a correlation coefficient of >0.995. The y-intercept must be less than the Pace Reporting Limit.

10.6.1 A new calibration curve should be prepared yearly at minimum or whenever the continuing calibration standard does not pass control criteria. Create ICV, ICB, and RL standards. Run and record as in section 11. The ICV, ICB, and RL standards must be run immediately following creation of a new curve.

11. Procedure

11.1 Sample Preparation.

11.1.1 Physical Preparation

11.1.1.1 Air-dry and grind to a size that the sample will pass through a 0.5-mm sieve.

11.1.1.2 Mix the sample thoroughly before selecting a portion for analysis.

11.1.1.3 Discard any foreign objects such as sticks, leaves, and rocks.

NOTE: Document all sample sizes, standards and reagents used in the digestion on the analytical benchsheet.

11.2 Analytical

11.2.1 Label Chemetrics COD digestion vials

11.2.2 Unseal the vials and carefully weigh out 0.05 g using a calibrated balance. Place the 0.05 g of soil into a vial. Pipette 1.95 mLs of Nanopure water into a vial such that it forms a layer on top of the reagents contained in the vial.

11.2.3 Prepare ICV, ICB, CCV, CCB, MB, LCS, MS, and MSD. See Section 12 for control limits and frequency.

11.2.4 Carefully seal the vial. During digestion, the reagents and sample are raised to a point just below boiling. Improperly sealed vials may leak or break.

11.2.5 Thoroughly mix the contents of the sealed vial by shaking. CAUTION: The vial will get very hot during mixing. It is recommended that vials be mixed either in racks or with the use of insulated gloves. Eye protection MUST be worn.

11.2.6 Place the digestion vials in the reactor block at 150°C ± 2°C for 2 hours.

11.2.7 Cool about ½ hours. Then invert vials to mix.

11.2.8 Cool to room temperature. Allow any suspended precipitate to settle.

11.2.9 Turn on Spectrophotometer as per instrument manual and set to 620 nm. Let warm up at least 20 minutes.

11.3 Wipe the outside of each vial with tissue paper to remove any fingerprints. Place ICB into the spectrophotometer and zero the instrument. Then, place the sample vials into the spectrophotometer and record sample and QC absorbance at 620 nm into the excel spreadsheet.

11.3.1 Using the excel file and calibration equation, calculate the sample results in mg/L TOC, and report the final results in LIMS.

12. Calculations

12.1 $$\frac{\text{(mg/L TOC from the curve) X (Final Volume (mL))}}{\text{(Weight in (g))}} = \text{TOC (mg/Kg)}$$

12.2 TOC (%) = (concentration in mg/kg / 10,000)

12.3 Accuracy:

A laboratory control spike / laboratory control spike duplicate is analyzed for each analytical batch of 20 or fewer samples.

$$\text{LCS, \% Recovery} = \frac{\text{TOC, mg/kg}}{\text{True Value mg/Kg}} \times 100$$

12.4 Precision:

The precision is calculated based on the recovery of the sample / sample duplicate result. A sample duplicate is performed at a frequency of 10% or one per batch which ever is more frequent and must meet laboratory specific limits for precision.

Relative percent difference (RPD) calculation:

$$\text{\% RPD} = \frac{|S - SD|}{(S+SD)/2} \times 100$$

S = Sample Value
SD = Sample Duplicate Value

13. Quality Control:

13.1 Refer to the most current version of the Pace Quality Manual Appendix I *Quality Control Calculations* and SOP S-GB-Q-009 *Common Laboratory Calculations and Statistical Evaluation of Data* for equations and calculation details.

13.2 **Initial Calibration Verification (ICV)**

13.2.1 The ICV must be analyzed immediately after calibration.

13.2.2 Concentration must be within ± 10% of the true value. The true value is 400 mg/L. When measurements are outside the control limits, the analysis must be terminated, the problem corrected, and the calibration re-verified.

13.2.3 The lot number of the KHP used to make the ICV must be different from that of the calibration curve standards.

13.3 **Continuing Calibration Verification (CCV)**

13.3.1 The CCV is analyzed after every 10 samples.

13.3.2 Concentration must be within ± 10% of the true value. The true value is 400 mg/L. When measurements are outside the control limits, the analysis must be terminated, the problem corrected, and the calibration re-verified. If the reset CCV fails recalibrate and reanalyze all samples back to the last acceptable CCV.

13.3.2.1 If the CCV is greater than the control limit and the samples are non-detects, the sample may be reported without a flag.

13.4 **Initial Calibration Blank (ICB) and Continuing Calibration Blank (CCB)**

13.4.1 The ICB must be analyzed after the ICV. The CCB must be analyzed after the CCV.

13.4.2 The value must be < PRL. When measurements are above the PRL, terminate analysis, correct the problem, verify the calibration, and reanalyze all analytical samples analyzed since the last compliant calibration blank.

13.4.2.1 If the sample concentration is greater than ten times the concentration in the ICB or CCB, the samples do not need to be reanalyzed.

13.4.2.2 If the samples are non-detections and the ICB or CCB fails high, the samples do not need to be reanalyzed.

13.5 **Reporting Limit Verification Standard (RLVS)** – A standard prepared at the concentration of the Pace Reporting Limit. It is analyzed after the calibration, recovery 60-140% of true value. If outside the limits, reanalyze once. If still outside the limits, recalibrate.

13.6 **Method Blank (MB)**

13.6.1 A MB is carried through all prep procedures and analyzed with a frequency of 5% or one per batch of up to 20 environmental samples.

13.6.2 The absolute value must be < PRL.

13.6.2.1 When measurements are above the PRL, terminate analysis, correct the problem, verify the calibration, and reanalyze all analytical samples analyzed since the last compliant calibration blank

13.6.2.2 Method blank criteria is evaluated and flagged with appropriate data qualifiers to the MDL when MDL reporting is required.

13.6.2.3 Qualify data with the appropriate data qualifier if sample results are less than 10 times the absolute value detected in the blank and are not a non-detection.

13.6.2.4 Additionally, method blank acceptance may be based on project specific criteria or regulatory limits .

13.7 Laboratory Control Sample (LCS)

13.7.1 The LCS is carried through all preparation procedures with frequency of 5% or one per batch of up to 20 environmental samples. A Laboratory Control Spike Duplicate (LCSD) must be analyzed at the same frequency.

13.7.2 The recovered concentration must be within default limits of ± 20%. The true value is 400 mg/L.

13.7.2.1 When measurements are outside the control limits, check for errors in calculations, standards preparation and spiking. If an error or problem is found and can be corrected by amending the calculations and the results falls within the limits, accept the data and report without a qualifier flag.

13.7.2.2 If no errors are found and sufficient sample is available, re-prepare the LCS (and/or LCSD) and all associated samples. If the recovery is within the limits in the analysis, accept the second set of data. If the recovery is still out side the limits after re-analysis, contact the PM to determine the resolution. If the client does not require additional work, report the data, applying an appropriate flag to the samples associated with the non-compliant LCS.

13.7.2.3 If sufficient sample volume is not available, report the sample data with appropriate data qualifier on each of the samples associated with the non-compliant LCS (and/or LCSD). Contact the project manager regarding the occurrence.

13.7.3 The precision between the LCS and LCSD must a be =/< 20% RPD.

13.7.3.1 When measurements are outside the control limits, check for errors in calculations, standards preparation and spiking. If an error or problem is found and can be corrected by amending the calculations and the results falls within the limits, accept the data and report without a qualifier flag.

13.7.3.2 If no calculation errors are found when measurements are outside the control limits, flag the parent sample with appropriate data qualifier.

13.7.4 The lot number of the KHP used to make the CCV is not the same for the LCS.

13.8 **Matrix Spike (MS)** (8.14) **and Matrix Spike Duplicate (MSD)** (8.14)

13.8.1 One pair per up to 10 environmental samples or 10% frequency whichever is more frequent.

13.8.2 Both QC samples must be calculated for accuracy and precision.

13.8.3 The recovered concentration must be within default limits of ± 20%. The true value is 400 mg/L.

13.8.3.1 If four times the concentration of the spike is less than the analyte concentration of the parent, accuracy need not be calculated.

13.8.3.2 When measurements are outside the control limits, check for errors in calculations, standards preparation and spiking. If an error or problem is found and can be corrected by amending the calculations and the results falls within the limits, accept the data and report without a qualifier flag.

13.8.3.3 If no calculation errors are found when measurements are outside the control limits, flag the parent sample with appropriate data qualifier.

13.8.4 The precision between the MS and MSD must a be =/< 20% RPD.

13.8.4.1.1 When measurements are outside the control limits, check for errors in calculations, standards preparation and spiking. If an error or problem is found and can be corrected by amending the calculations and the results falls within the limits, accept the data and report without a qualifier flag.

13.8.4.1.2 If no calculation errors are found when measurements are outside the control limits, flag the parent sample with appropriate data qualifier.

13.8.5 The sample used for MS/MSD pair is either determined by the client or selected at random from client samples as sample volume allows. No field, filter, trip or equipment blanks can be used for MS/MSD.

13.8.6 The lot number of the KHP used to make the CCV is not the same for the MS and MSD.

13.9 When preparation of a sample exceeds 28 days past the time of collection, notify the project manager before proceeding. If a sample is run past 28 days after collection, flag the result with appropriate data qualifier.

13.10 If a sample was diluted due to matrix effects and the result is a non-detect, the result must be qualified with appropriate data qualifier.

13.11 See attachments Table A and Table B for a summary of QC.

14. Method Performance

There are several requirements that must be met to insure that this procedure generates accurate and reliable data. A general outline of requirements has been summarized below. Further specifications may be found in the Laboratory Quality Manual and specific Standard Operating Procedures.

14.1 The analyst must read and understand this procedure with written documentation maintained in his/her training file.

14.2 An initial demonstration of capability (IDOC) must be performed per S-ALL-Q-020, *Orientation and Training Procedure*s. A record of the IDC will be maintained in his/her QA file with written authorization from the Laboratory Manager and Quality Manager.

14.3 Continuing demonstration of capability (IDC) must be performed per S-ALL-Q-020, *Orientation and Training Procedure*s. A record of the CDOC will be maintained in his/her QA file with written authorization from the Laboratory Manager and Quality Manager.

14.4 An annual method detection limit (MDL) study will be completed per S-ALL-Q-004, *Method Detection Limit Studies*, for this method and whenever there is a major change in personnel or equipment. The results of these studies are retained in the quality assurance office.

14.5 Periodic performance evaluation (PE) samples are analyzed per S-ALL-Q-010, *PE/PT Program*, to demonstrate continuing competence. All results are stored in the QA office.

14.6 Linear Dynamic Range Study - A linear dynamic range study must be conducted at least once. The study is conducted by analyzing increasing concentrations (at least 3 levels) until the results generated exceed ±10% difference from the true value. The highest concentration within the 10% criteria is the maximum of the linear range for that element.

14.7 Once the linear dynamic range study determination is performed, keep the data, and then every six months verify with a single high point.

15. Pollution Prevention and Waste Management

15.1 The quantity of chemicals purchased is based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes reflect anticipated usage and reagent stability.

15.2 Excess reagents, samples and method process wastes are characterized and disposed of in an acceptable manner. For further information on waste management consult the current version of ALL-S-002, *Waste Handling*.

16. References

16.1 Methods of Soil Analysis, 1982 Second Edition, Method 29-3.5.2.1 Walkley-Black Procedure.

16.2 Nelson D W, Sommers L E. A Rapid and Accurate Method for Proceedings of the. Indiana Academy of Science, 1975, 84: 456-462.

16.3 EPA Manual 600 4-79-020, March 1983, Method 410.4, 40CFR Part 136

16.4 PASI Quality Manual, current revision

17. Tables, Diagrams, Flowcharts, Appendices, Addenda etc.

17.1 Table A – Quality Control

17.2 Table B – Analyst/Technician Data Assessment

17.3 Flowchart

17.4 Attachment 1 - Walkley Black Organic Carbon Preparation Log

17.5 Attachment II – Walkley Black Organic Carbon Analytical Log

18. Revisions

Revision Number	Reason for Change	Date
KM-I-004.Rev.00	Converted SOP to PASI format. Added laboratory charted control limits.	8Aug2005
GB-I-037-Rev.00	Converted from Kimberly to Green Bay. 9.1.7 Changed expiration date of Ferrous Sulfate. 11.1.7 Added acceptable range for ferrous sulfate titrant standardization. Clarified 12.1.1.1 and 12.2.1.1.	12Sept2006
S-GB-I-037-REV.01	Updated signature page. Deleted Section 7. Renumbered document. Section 13.3 – Updated Method Blank acceptance criteria Section 14 – Updated SOP references. Updated Attachments	24July2008
S-GB-I-037-Rev.02	Updated body of document to Hach Spec Method Updated Attachments	10Sept2009
S-GB-I-037-Rev.03	Updated SOP refereces for Waste Management SOP to S-GB-S-006 Waste Management and Handling. Table B,1 MB 20X rule changed to 10X.	13Dec2010

Table A. QUALITY CONTROL

Preparation Method ⇨ Quality Control Measure ⇩	**Walkley Black**
Method Blank	One per batch of samples, up to 20 environmental samples, whichever is more frequent.
Laboratory Control Spike and Duplicate	One per batch of samples, up to 20 environmental samples, whichever is more frequent. A LCSD is required if MS/MSD is not performed.
Matrix Spike / Matrix Spike Duplicate	One pair per batch of samples, up to 10 environmental samples, whichever is more frequent.
Initial Calibration	Minimum of 5 standards plus blank. Must be performed every time before samples are analyzed.
RL Standard	After the calibration and monthly at minimum.
Calibration Verification (ICV/CCV)	ICV – analyzed after calibration but before samples. CCV – analyzed after every 10 samples.
Calibration Blank (ICB/CCB)	ICB – analyzed after ICV. CCB – analyzed after every CCV pair.

Table B. ANALYST/TECHNICIAN DATA ASSESSMENT

Analytical Method Acceptance Criteria⇨ Data Assessment Measure ⇩	**Walkley Black If these conditions are not achieved ⇒**
Method Blank	• 1
Accuracy & Precision Matrix Spike Samples	• 2
Accuracy & Precision Laboratory Control Spikes	• 3
Initial Calibration	• 4
RLVS standard	• 5
Initial / Continuing Calibration Verification	• 6
Initial / Continuing Calibration Blank	• 7

1. In the absence of project specific requirements, sample detects less than 10 times the method blank contamination level is reported with the appropriate data qualifier. Sample detects greater than 10 times the method blank contamination are reported without qualification.

2. In the absence of project specific or method requirements, in-house generated limits will be used. If the concentration of the spike is less than 25% of the concentration of the parent, dilute parent to a level that the subsequent spike concentration will be greater than 25% the parent and so the parent concentration is above the EQL. Rerun the parent, MS, and MSD at this new dilution. If the MS and/or MSD fails at the diluted concentration, appropriately flag the parent sample. If the parent, MS, or MSD is greater than the top standard in the curve, dilute and reanalyze the parent, MS, and MSD following the above guidance. If the concentration of the spike is greater than 25% of the concentration of the parent, appropriately flag the parent sample if either the MS and/or MSD fails. If the MS and MSD fails precision control limits flag the parent with the appropriate (precision) data qualifier.

3. If sample volume does not allow re-analysis the entire prep/analytical batch of samples shall be flagged with the appropriate accuracy and appropriate precision qualifiers to reflect the deficiencies.

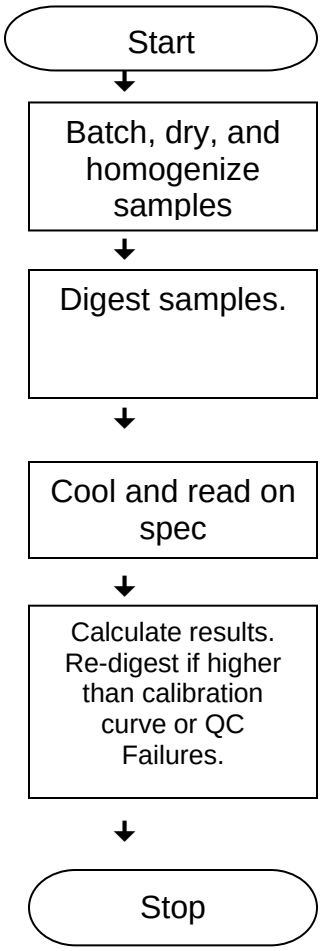
4. If correlation coefficient is less than 0.995 perform maintenance and recalibrate.

5. It is analyzed after the calibration, recovery 60-140% of true value. If outside the limits, reanalyze once. If still outside the limits, recalibrate.

6. If ICV/CCV is outside the control limits reanalyze the ICV/CCV to verify the instrument is out of control. If the 2nd analysis is outside control limits, perform maintenance and recalibrate. Samples that bracket the out of control standards must be reanalyzed. If the ICV/CCV recovers greater than the control limit and the samples bracketing the out of control ICV/CCV are non-detects, the results may be reported without a flag.

7. If ICB/CCB is outside the control limits reanalyze the ICB/CCB to verify the instrument is out of control. If the 2nd analysis is outside control limits, perform maintenance and recalibrate. Samples that bracket the out of control standards must be reanalyzed. Samples that are > 10X the concentration in the CCB the samples do not have to be reanalyzed.

FLOWCHART


Start
Batch, dry, and homogenize samples
Digest samples.
Cool and read on spec
Calculate results. Re-digest if higher than calibration curve or QC Failures.
Stop

Attachment I: Walkley Black Organic Carbon Preparation Log

Preparation Total Organic Carbon by Walkley Black

Analyst:
Preparation Date:
Oven: Precision, Model 17, SN:21AR-10
Oven Temp:
103°C (+/-2°C)
In Oven:
Out of Oven:

WETA Batch: -
HBN: -

Sample ID:	Sample ID:	Sample ID:
MB	NA	NA
LCS	NA	
LCSD	NA	
NA	NA	
MS	NA	
MSD	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	
NA	NA	

F-GB-I-187-Rev.01 (20Dec2010) Walkley Black Prep Log
Green Bay Laboratory

Attachment II: Walkley Black Organic Carbon Analytical Log

Analysis Total Organic Carbon by Walkley Black

Analyst:	-	**WETA Batch:**	-	**HBN:** -	
Analysis Date:	-	**Digestion Block:**	HACH COD Reactor SN:890700308		
Block Temp:		**Instrument:**	40WTA1	HACH DR 2000/SN:960300039446	
150°C (+/- 5°C)		**Digestion Vial Lot**			
Digestion Started:		**Number:**	10807		
Digestion Finished:		**Balance ID:**	40BAL7		

Standards: Potassium Hydrogen Phthalate (C8H5KO4)
Primary: 800mg/L C -
Secondary: 800mg/L C -

Sample ID:	Initial Weight (g)	Final Vol. (mL)	Absorb @ 620nm	Raw Conc. (mg/L)	Final Conc. (mg/Kg)	Standard TV (mg/L)	% Recovery	Limits	Standard Vol (mL)
CCV1	-	-	-	#VALUE!	NA	400	#VALUE!	90-110%	1.0 Primary
CCB1	-	-	-	#VALUE!	NA	0	#VALUE!	<10	DI Water
MB			-	#VALUE!	#VALUE!	0	#VALUE!	<10	DI Water
LCS			-	#VALUE!	#VALUE!	400	#VALUE!	80-120%	1.0 Secondary
LCSD			-	#VALUE!	#VALUE!	400	#VALUE!	80-120%	1.0 Secondary
NA			-	#VALUE!	#VALUE!	-	-		
MS			-	#VALUE!	#VALUE!	400	#VALUE!	80-120%	1.0 Secondary
MSD			-	#VALUE!	#VALUE!	400	#VALUE!	80-120%	1.0 Secondary
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
CCV2	-	-	-	#VALUE!	NA	400	#VALUE!	90-110%	1.0 Primary
CCB2	-	-	-	#VALUE!	NA	0	#VALUE!	<10	DI Water
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
CCV3	-	-	-	#VALUE!	NA	400	#VALUE!	90-110%	1.0 Primary
CCB3	-	-	-	#VALUE!	NA	0	#VALUE!	<10	DI Water
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
NA			-	#VALUE!	#VALUE!	-	-		
CCV4	-	-	-	#VALUE!	NA	400	#VALUE!	90-110%	1.0 Primary
CCB4	-	-	-	#VALUE!	NA	0	#VALUE!	<10	DI Water

Calculation: (Absorb @620nm - Intercept)/Slope = mg/L TOC
[(mg/L TOC)*Final Vol (mL)]/Initial Weight (g) = mg/Kg TOC

Comments:

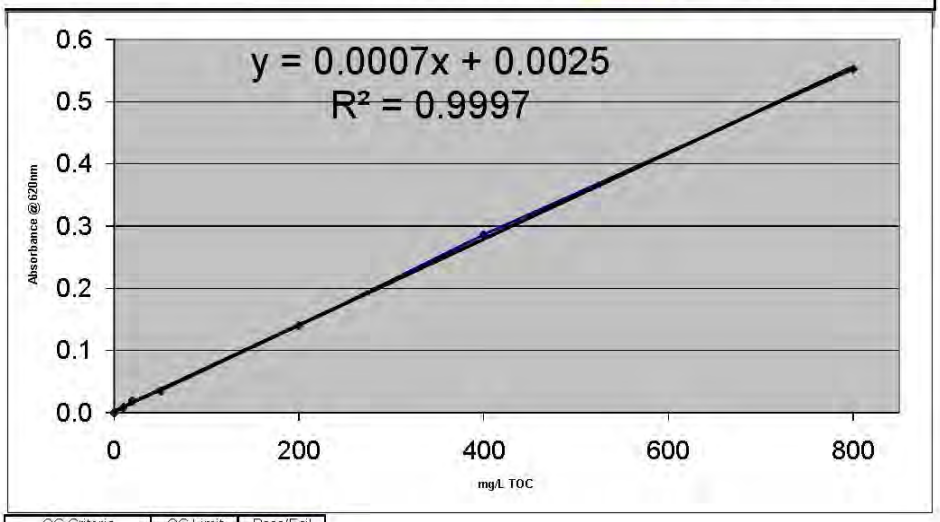
F-GB-I-188-Rev.01 (20Dec2010) Walkley Black Analytical Benchsheet
Green Bay Laboratory

Calibration Total Organic Carbon by Walkley Black

Analyst:			
Calibration Date:		**Digestion Block:**	HACH COD Reactor SN:890700308
Block Temp:		**Instrument:**	40WTA1 HACH DR 2000/SN:960300039446
150°C (+/- 5°C)		**Digestion Vial Lot**	
Digestion Started:		**Number:**	
Digestion Finished:		**Balance ID:**	40BAL7

Standards: Potassium Hydrogen Phthalate (C8H5KO4)
Primary: 800mg/L C -
Secondary: 800mg/L C -

Standard ID	Conc. mg/L	Std Used	Std. Vol. Used (mL)	DI Water Vol. (mL)	Final Vol. (mL)	Absorb @ 620nm	mg/L Result	% Recovery	
Cal 1	0	DI Water	0.000	2.0	2.0	0.000	-3.6	NA	
Cal 2	10	Primary	0.025	1.975	2.0	0.008	7.9	78.6	Slope
Cal 3	20	Primary	0.075	1.925	2.0	0.019	23.6	117.9	0.0007
Cal 4	50	Primary	0.125	1.875	2.0	0.035	46.4	92.9	
Cal 5	200	Primary	0.5	1.5	2.0	0.140	196.4	98.2	Intercept
Cal 6	400	Primary	1.0	1.0	2.0	0.286	405.0	101.3	0.0025
Cal 7	800	Primary	2.0	0.0	2.0	0.552	785.0	98.1	
ICV	400	Secondary	1.0	1.8	2.0	0.279	395.0	98.8	
ICB	0	DI Water	0.0	2.0	2.0	0.000	-3.6	NA	
RLVS	10	Primary	0.025	1.975	2.0	0.010	10.7	107.1	
CCV	400	Primary	0.200	1.8	2.0	0.279	395.0	98.8	
CCB	0	DI Water	0.0	2.0	2.0	-0.001	-5.0	NA	



QC Criteria	QC Limit	Pass/Fail
R^2	>0.9949	
ICV	+/-10%	Pass
ICB	<RL	Pass
RLVS	+/-40%	Pass
CCV	+/-10%	Pass
CCB	<RL	Pass

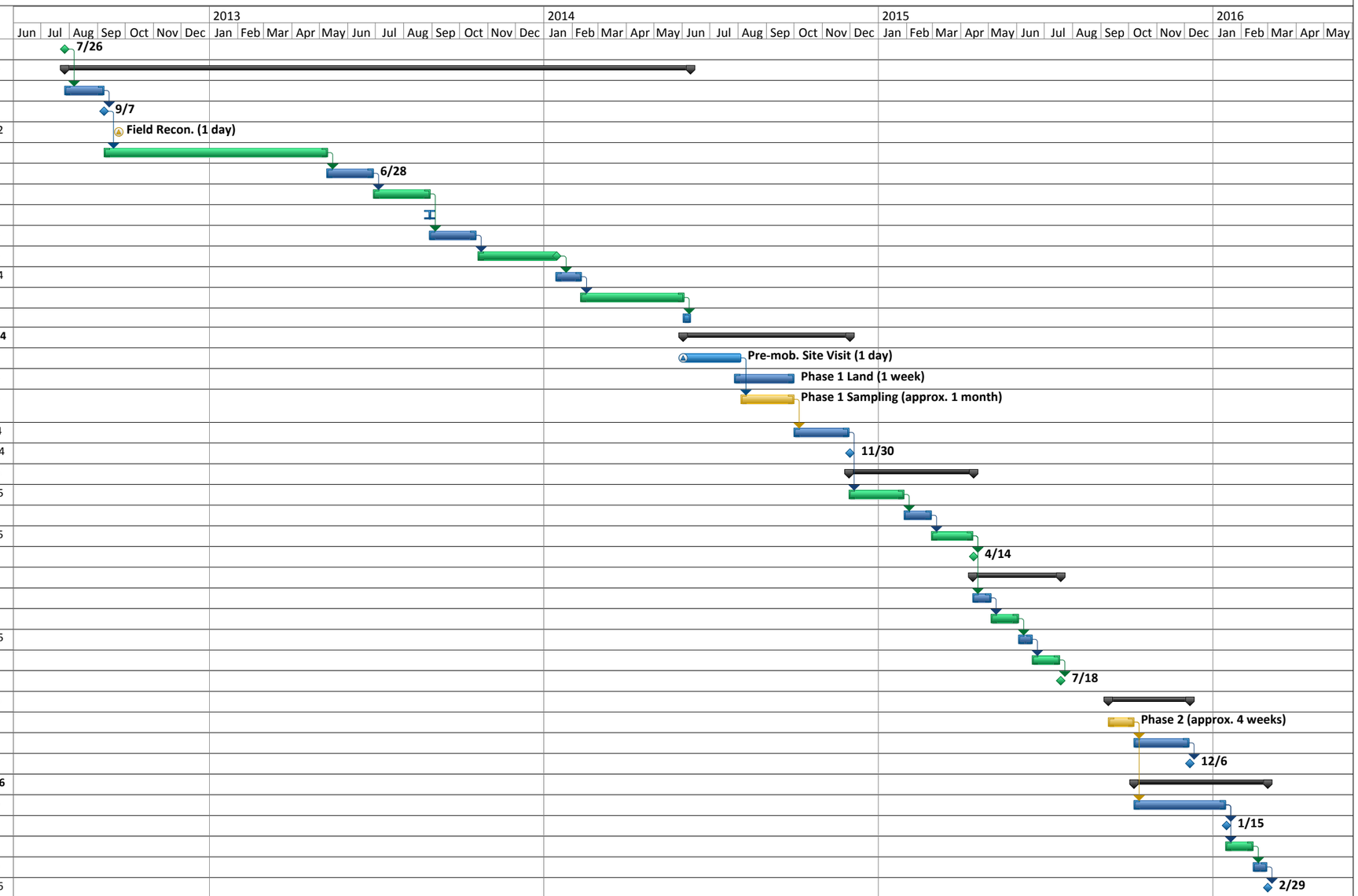
F-GB-I-188-Rev.01 (20Dec2010) Walkley Black Analytical Benchsheet
Green Bay Laboratory

Attachment 5
Project Schedule

Project Schedule
EE/CA Investigation - Area 7 Pesticide Area, AUS OU
Crab Orchard National Wildlife Refuge

Title: QAPP - EE/CA for Pesticides at Area 7 AUS OU
Revision: 4 Status: Final
Date: June 2014

ID	Task Name	Duration	Start	Finish
1	Effective Date	1 day	Thu 7/26/12	Thu 7/26/12
2	**Phase 1 Planning Documents**	**683 days**	**Fri 7/27/12**	**Mon 6/9/14**
3	Draft HASP and SAP	43 days	Fri 7/27/12	Fri 9/7/12
4	Submit HASP and SAP	1 day	Fri 9/7/12	Fri 9/7/12
5	Phase 1 Field Reconnaissance Visit	1 day	Mon 9/24/12	Mon 9/24/12
6	Agency Review of HASP and SAP	244 days	Sat 9/8/12	Thu 5/9/13
7	Revise HASP and SAP	51 days	Thu 5/9/13	Fri 6/28/13
8	Agency Review of Final HASP and SAP	62 days	Sat 6/29/13	Thu 8/29/13
9	SAP Approved as Modified by FWS on August 29, 2013	1 day	Thu 8/29/13	Thu 8/29/13
10	Revise HASP and SAP	51 days	Thu 8/29/13	Fri 10/18/13
11	Agency Review HASP and Final SAP	86 days	Mon 10/21/13	Tue 1/14/14
12	Revise HASP and Issue Final SAP by February 10, 2014	28 days	Tue 1/14/14	Mon 2/10/14
13	Agency Review of HASP	113 days	Mon 2/10/14	Mon 6/2/14
14	Issue Final HASP and Final SAP by June 9, 2014	8 days	Mon 6/2/14	Mon 6/9/14
15	**Phase 1**	**182 days**	**Mon 6/2/14**	**Sun 11/30/14**
16	Pre-mobilization Site Visit	1 day	Mon 6/2/14	Sun 8/3/14
17	Phase 1 Land-based (well install & bldg. survey)*	5 days	Mon 7/28/14	Tue 9/30/14
18	Phase 1 Fieldwork (Available Dates based on Fishing)** (8/4/14 - 9/30/14)	30 days	Mon 8/4/14	Tue 9/30/14
19	Evaluate and Process Data	60 days	Wed 10/1/14	Sat 11/29/14
20	Submit Phase 1 Data to Agency	1 day	Sun 11/30/14	Sun 11/30/14
21	**Risk Assessment**	**136 days**	**Sun 11/30/14**	**Tue 4/14/15**
22	Agency Completes Risk Assessment	60 days	Sun 11/30/14	Wed 1/28/15
23	Review Risk Assessment	30 days	Thu 1/29/15	Fri 2/27/15
24	Agency Revises Risk Assessment	45 days	Sat 2/28/15	Mon 4/13/15
25	Final Risk Assessment Issued	1 day	Tue 4/14/15	Tue 4/14/15
26	**Phase 2 Planning Documents**	**96 days**	**Tue 4/14/15**	**Sat 7/18/15**
27	Draft Addendum to HASP and SAP	20 days	Tue 4/14/15	Sun 5/3/15
28	Agency Review Addendums to HASP and SAP	30 days	Mon 5/4/15	Tue 6/2/15
29	Revise Addendums to HASP and SAP	15 days	Wed 6/3/15	Wed 6/17/15
30	Agency Review of Final Addendums	30 days	Thu 6/18/15	Fri 7/17/15
31	Agency Approval of Final Addendums	1 day	Sat 7/18/15	Sat 7/18/15
32	**Phase 2**	**89 days**	**Wed 9/9/15**	**Sun 12/6/15**
33	Phase 2 Fieldwork	28 days	Wed 9/9/15	Tue 10/6/15
34	Evaluate and Process Phase 2 Data	60 days	Wed 10/7/15	Sat 12/5/15
35	Submit Phase 2 Data to Agency	1 day	Sun 12/6/15	Sun 12/6/15
36	**EE/CA Reporting**	**146 days**	**Wed 10/7/15**	**Mon 2/29/16**
37	Draft EE/CA Report	100 days	Wed 10/7/15	Thu 1/14/16
38	Submit Draft EE/CA Report	1 day	Fri 1/15/16	Fri 1/15/16
39	Agency Review of EE/CA Report	30 days	Fri 1/15/16	Sat 2/13/16
40	Revise EE/CA Report	15 days	Sun 2/14/16	Sun 2/28/16
41	Submit Final EE/CA Report	1 day	Mon 2/29/16	Mon 2/29/16
42				
43	* Land-based activities may be conducted prior to fish, SW, and sediment sampling. Schedule to be determined based on field conditions and contractor availability.			
44	** Dates of fieldwork may need to be adjusted to reflect seasonal conditions of fish spawning.			



Agency Action Item | Agency Milestone | Respondent Task | Respondent Milestone | Fieldwork

Notes:
1. Respondent deadlines meet requirements of the AOC, and Agency Review periods are assumed.
2. Schedule to be updated as project progresses to reflect actual dates of submittal and completion of work.

\\ntapb-madison\msn-vol6\-\WPMSN\PJT2\194355\0001\000004\Crab Orchard Schedule_06-06-14.mpp
Project: Area 7 Pesticide Crab Orchard
Date: 06-06-2014