EPA Region 5 Records Ctr.
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ROY F. WESTON, INC.

REMOVAL PROGRAM QUALITY ASSURANCE
SITE SPECIFIC- SAMPLING AND ANALYSIS PLAN

PHASE II
DOWNER'S GROVE GROUNDWATER INVESTIGATION
DOWNERS GROVE, ILLINOIS

MARCH 2002

WESTON

REMOVAL PROGRAM QUALITY ASSURANCE
SITE SPECIFIC- SAMPLING AND ANALYSIS PLAN

PHASE II
DOWNER'S GROVE GROUNDWATER INVESTIGATION
DOWNERS GROVE, ILLINOIS

MARCH 2002

Prepared For:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Emergency and Enforcement Response Branch
77 West Jackson Boulevard
Chicago, Illinois 60604

TDD No. 0111-010
Document Control No. 195-2F-ABOM

Approvals:

		3/29/02	
Steve Faryan	**Date**	**Om Patel**	**Date**
On-Scene Coordinator		**START Project Manager**	

GENERAL SITE INFORMATION:

SITE NAME: Downer's Grove Groundwater Investigation TDD#: 01-11-010
SAMPLERS: Ben Maradkel, Geologist, Subcontractors NO. OF SAMPLES: approx. 228
LAB: Accutest DATE OF SAMPLING: 4/8/02-5/17/02
495 Technology Center West DATE SHIPPED: DAILY
Building One
Marlborough, MA 01752

Site Description:

The Site Assessment will focus on Rexnord, Arrow Gear, Scott, Ames and St. Joseph Creek of the Ellsworth Industrial Park, which are located in Downer's Grove, Illinois.

Climatic Limits on Sampling: Snow thaw or heavy rain.

ANALYTICAL INFORMATION:

____ QA Level I (Field Screening)
__X__ QA Level II (Laboratory Analysis, Appendix A)
____ QA Level III (Analyte Specific Laboratory Analysis)

TYPE OF LABORATORY: ____ Commercial ____ CLP ____ Other

TURNAROUND TIME: (fax) 10 days (committed by Lab. However, Work Plan indicates 14 days)
(Hardcopy w/data package) 10 days (committed by Lab. However, Work Plan indicates 14 days)

PURPOSE OF SAMPLING:

(Check all applicable)

__X__ Site Characterization
__X__ Extent of Contamination
____ Confirm Presence of Suspected Contaminant/Characterize Unknown Contaminant
____ Disposal/Treatment of Materials
____ Confirm Efficiency of Existing Treatment Systems
__X__ Other: Assist U.S. EPA in determining the source of the contamination.

MATRIX	NO. OF SAMPLES
Soil	100
Sludge	
Drum/Tanks/Vats/Containers	
Wipe	
Surface Water	
Groundwater	50
Air	
Waste	
Sediment	16

TYPE OF SAMPLING:

X Biased (non-random, judgmental) ___ Unbiased (random, systematic grid)

ATTACHMENTS:

1 Sample Location Maps
2 Chain-of-Custody
3 Sampling Form
4 Sample Tracking Log
5 Laboratory SOPs
6 Investigation-Derived Wastes Sampling SOP

SAMPLING METHODS (SOPs):

(Check all applicable)

X	Soil	(Appendix B)
X	Sediment	(Appendix B)
	Drum/Tank/Sludge/Waste	
	Wipe	
	Surface Water	
X	Groundwater	(Appendix B)
	Air	
	Other:	

DECONTAMINATION PROCEDURES (SOPs):

	Personnel	
X	Equipment	(Appendix C)
X	Instrument	(Appendix C)
	Radiation	

DECONTAMINATION MATERIALS AND INVESTIGATIVE DERIVED WASTE:

All used PPE materials will be properly contained, bagged, and left on site to be disposed of at the discretion of the U.S. EPA.

ANALYTICAL DECISION CRITERIA

Groundwater sample results will be compared to Illinois Minimum Contamination Limits (MCLs) and TACO Section 742.TABLE E: Tier 1 Groundwater Remediation Objectives for the Groundwater Component. Soil and Sediment sample results will be compared to Region IX RBCs, U.S. EPA III Emergency Removal Guidelines and 40 CFR Part 261.24-toxicity characteristics. Criteria specific to industrial and residential areas will be used to evaluate data from on-site and off-site areas, respectively. In case where more than one set of criteria apply to a data point, the most conservative criteria level will be used. (Appendix D)

REFERENCE SITES ON THE INTERNET:

Environmental Response Team (ERT)
www.ert.org
www.ert.org/respns_resres/sops.asp

ATSDR
www.atsdr.cdc.gov/atsdrhome.html

U.S. EPA SW846 Analytical Test Methods
www.epa.gov/epaoswer/hazwaste/test/main.html

U.S. EPA AMTIC Air Toxic Methods
www.epa.gov/ttnamti1/airtox.html

Environmental Test Methods/Guidelines
www.epa.gov/cpahome/standards.html

MSDS
www.msdsonline.com
msms.pdc.cornell.edu/issearch/msdssrch.html
hazard.com/msds/index.html

NIOSH Pocket Guide
www.cdc.gov/niosh/npg/npgdname.html

NIOSH Manual of Analytical Methods
www.cdc.gov/niosh/nmam/nmammenu.html

NAERG
hazmat.dot.gov/gydebook.html

SURFACE WATER / GROUNDWATER / POTABLE WATER SAMPLES

No. of Surface Samples 0 No. of Well Samples 0
No. of Groundwater Samples 50 No. of Trip Blanks 1 per sample cooler
Detection Limit 1 ppb
No. of Duplicates & Equipment Blanks 1 per 10 project samples per parameter

ANALYSIS	NO. OF SAMPLES INCLUDE DUPL. & BLANKS	NO. OF CONTAINERS PER SAMPLE	TOTAL NO. OF CONTAINERS		PRESERVATIVES REQUIRED	LABORATORY METHOD
Semivolatile Organics	0	x 2		80 oz. amber	Ice	
PCB/Pesticides	0	x 2		80 oz. amber	Ice	
Volatile Organics	75 (GW) 120 (Soil) 18 (Sediment)	x 2 x 2 x 2	150 240 36	40 ml. glass 4 oz. glass 4 oz. glass	Ice, 1 ml Hcl Ice Ice	SW-846-8260
Dioxin	0	x 2		80 oz. amber	Ice	
Metals	0	x 1		1 liter HDPE	Ice, 5 ml HNO_3	
Cyanide	0	x 1		1 liter HDPE	Ice, 5 ml HNO_3	

TOTAL NUMBER OF CONTAINERS REQUIRED

	80 oz. amber
150	40 ml. glass
	1 liter HDPE
276	4 oz. glass
	Other:

Attachment 1

Sample Location Map

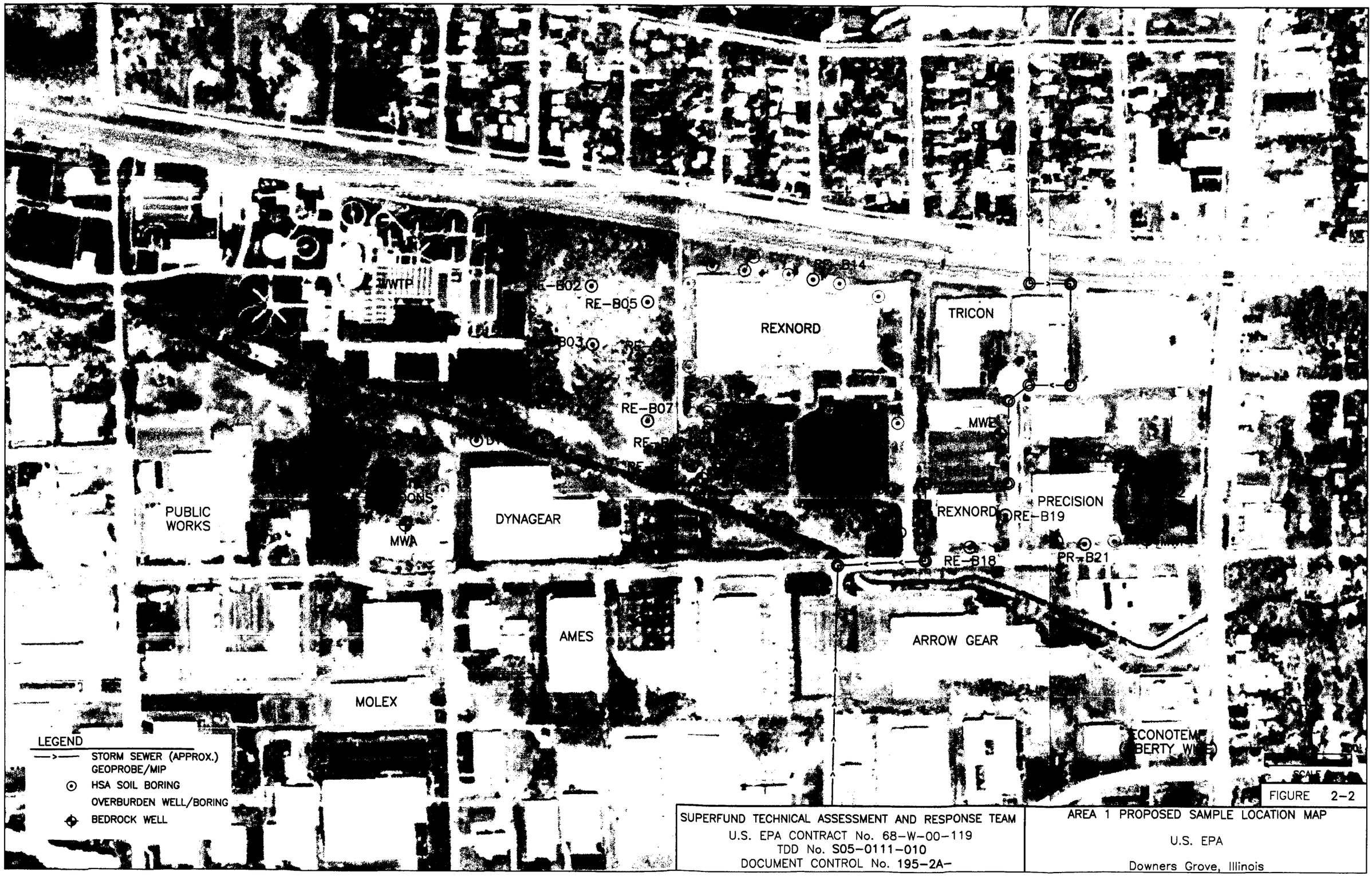

FIGURE 2-2

SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM
U.S. EPA CONTRACT No. 68-W-00-119
TDD No. S05-0111-010
DOCUMENT CONTROL No. 195-2A-

AREA 1 PROPOSED SAMPLE LOCATION MAP

U.S. EPA

Downers Grove, Illinois

C:\DGN\ 000-07202.dwg, 03/29/02 11:54:16 AM

FIGURE 2-3

SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM
U.S. EPA CONTRACT No. 68-W-00-119
TDD No. S05-0111-010
DOCUMENT CONTROL No. 195-2A-

AREA 2 PROPOSED SAMPLE LOCATION MAP
U.S. EPA
Downers Grove, Illinois

Attachment 2

Chain of Custody

ACCUTEST®

CHAIN OF CUSTODY

495 TECHNOLOGY CENTER WEST • BUILDING ONE
MARLBOROUGH, MA 01752
TEL: 508-481-6200 • FAX: 508-481-7753

ACCUTEST #:

ACCUTEST QUOTE #:

CLIENT INFORMATION

NAME

ADDRESS

CITY, STATE ZIP

SEND REPORT TO:
PHONE #

FACILITY INFORMATION

PROJECT NAME

LOCATION

PROJECT NO.

FAX #

ANALYTICAL INFORMATION

MATRIX CODES

DW - DRINKING WATER
GW - GROUND WATER
WW - WASTE WATER
SO - SOIL
SL - SLUDGE
OI - OIL
LIQ - OTHER LIQUID
SOL - OTHER SOLID

ACCUTEST SAMPLE #	FIELD ID / POINT OF COLLECTION	COLLECTION DATE	COLLECTION TIME	SAMPLED BY:	MATRIX	# OF BOTTLES	PRESERVATION HCl	NaOH	HNO3	H2SO4	NONE													LAB USE ONLY

DATA TURNAROUND INFORMATION

- ☐ 14 DAYS STANDARD
- ☐ 7 DAYS *RUSH*
- ☐ 48 HOUR EMERGENCY
- ☐ OTHER

APPROVED BY:

14 DAY TURNAROUND HARDCOPY. EMERGENCY OR RUSH IS FAX DATA UNLESS PREVIOUSLY APPROVED

DATA DELIVERABLE INFORMATION

- ☐ STANDARD
- ☐ COMMERCIAL "B"
- ☐ DISK DELIVERABLE
- ☐ STATE FORMS
- ☐ OTHER (SPECIFY)

COMMENTS/REMARKS

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESION, INCLUDING COURIER DELIVERY

RELINQUISHED BY SAMPLER:	DATE TIME:	RECEIVED BY:	RELINQUISHED BY:	DATE TIME:	RECEIVED BY:
1.		1.	2.		2.
RELINQUISHED BY:	DATE TIME:	RECEIVED BY:	RELINQUISHED BY:	DATE TIME:	RECEIVED BY:
3.		3.	4.		4.
RELINQUISHED BY:	DATE TIME:	RECEIVED BY:	SEAL #	PRESERVE WHERE APPLICABLE ☐	ON ICE ☐ TEMPERATURE ____ C
5.		5.			

Attachment 3

Sampling Form

Sampling Form

Downer's Grove Groundwater Investigation

WO#: 12634-001-001-0195-00
Location: _____ Date: _____
Samplers: _____
Comments (weather, temp, etc.): _____

Sample ID	Time	Description of area sampled	Sample Appearance

Sample Location Sketch

Jan-02

Attachment 4

Sample Tracking Log

ACCUTEST LABRATORY
495 Technology Center West (Building one)
Marlborough, MA 01752
Phone (508) 481-6200
FAX (508) 481-7753

Downers Grove Groundwater Investigation

Date Samples Sent	Designation of samples	Lab	Analysis	Date Results Due	Date Results Received	Other Info.

Attachment 5

Laboratory SOPs

ACCUTEST.

ACCUTEST LABORATORIES
STANDARD OPERATING PROCEDURE

FN: MMS105-03
Pub Date: 01/06/98
Rev Date: 03/12/00

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Lab Manager: Doug Yargeau DRY

QA Manager: Mark Warren

TITLE: DETERMINATION OF VOLATILE ORGANICS USING GC/MS SYSTEM

REFERENCES: SW846 8260B

1.0 SCOPE & APPLICATION

1.1 The following method describes the analytical procedures which are utilized by Accutest to aquire samples for the analysis of volatile organic compounds.

1.2 This analytical method is designed for nearly all types of samples, regardless of water content, including groundwater, aqueous sludges, oily waste, sediments, and soils.

1.3 The purgeable organics can be quantitated by Gas Chromatograph/Mass Spectrometer (GC/MS) following purge and trap utilizing the internal standard technique.

1.4 The Reporting (RL) is based on the lowest calibration standard. RL'S may vary depending on matrix difficulties and sample volumes or weight and percent moisture. Additionally, RL's will vary between some compounds.

2.0 SUMMARY

2.1 This method is performed in accordance with EPA methodologies 8260B and 5030B (purge and trap), from SW-846, 3rd edition.

2.2 An inert gas is bubbled through a 5 ml sample contained in a specifically designed purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with the inert gas to desorb the purgeables onto a gas chromatographic (GC) column.

2.3 The volatile compounds are separated by the temperature programmed GC column and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information.

2.4 The peaks detected are qualitated by comparison to characteristic ions and retention times specific to the known target list of compounds.

2.5 Once identified the compound is quantitated by internal standard technique with an average response factor generated from a calibration curve containing a minimum of five points. . Additional points may be added to meet client requirements.

2.6 Additional unknown peaks with a response > 10 % of the closest internal standard may be processed through a library search with comparison to a data base of approximately 70,000 spectra. An estimated concentration is quantitated by assuming a response factor of 1.

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3.0 METHOD DETECTION LIMIT

3.1 The Method Detection Limit (MDL) represents the lowest reportable concentration of an individual analyte that meets the method qualitative identification criteria.

3.2 Method Detection limits (MDLs) are experimentally determined using the procedures described in 40 CFR, Part 136, Appendix B. Actual reported MDLs incorporate the sample volume analyzed and sample dilutions if needed, which may cause MDL variations from sample to sample.

3.3 In general, MDLs are determined through the analysis of at least 7 replicate blank spikes (using the same procedures for sample analysis). The MDL is calculated by multiplying the standard deviation of the replicate concentrations by the appropriate Student's t value (3.143 for 7 replicates). MDLs are determined initially (prior to analysis) and on an annual basis. Refer to the most recent study for current MDLs.

4.0 DEFINITIONS

4.1 ALIQUOT - a measured portion of a sample, or solution, taken for sample preparation and/or analysis.

4.2 BATCH – a group of samples prepared at the same time in the same location using the same method.

4.3 CALIBRATION – the establishment of an analytical curve based on the absorbance, emission intensity, or other measured characteristic of known standards. The calibration standards must be prepared using the same type of acid or concentration of acids as used in the sample preparation.

4.4 CALIBRATION STANDARDS – a series of known solutions used by the analyst for calibration of the instrument (i.e., preparation of the analytical curve).

4.5 CONTINUING CALIBRATION – analytical standard run every 12 hours to verify the initial calibration of the analytical system.

4.6 DRY WEIGHT – the weight of a sample based on percent solids. The weight after drying in an oven.

4.7 CONTAMINATION - a component of a sample or an extract that is not representative of the environmental source of the sample. Contamination may stem from other samples, sampling equipment, while in transit, from laboratory reagents, laboratory environment, or analytical instruments.

4.8 FIELD SAMPLE - a portion of material to be analyzed that is contained in single or multiple containers and identified by a unique sample number.

4.9 FIELD BLANK – this is any sample that is submitted from the field and is identified as a blank. This includes trip blanks, rinsates, equipment blanks, etc.

4.10 HOLDING TIME – the elapsed time expressed in days from the date of sampling until the date of its analysis.

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4.11 INTERFERENTS – substances which affect the analysis for the analyte of interest.

4.12 GAS CHROMATOGRAPH (GC) - the instrument used to separate analytes on a stationary phase within a chromatographic column. The analytes are volatized directly from the sample (VOA water and low-soil) volatized from the sample extract (VOA medium soil), or injected as extracts (SVOA and PEST). In VOA and SVOA analysis, the compounds are detected by a Mass Spectrometer (MS). In PEST analysis, the compounds are detected by an Electron Capture (EC) detector. In the screening procedure (all fractions), the Flame Ionization Detector (FID) is used as the detector.

4.13 INITIAL CALIBRATION - analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the mass spectrometer or electron capture detector to the target compounds.

4.14 INTEGRATION TIME RANGE - the retention time at the beginning of the area of integration to the retention time at the end of the area of integration.

4.15 INSUFFICIENT QUANTITY - when there is not enough volume (water sample) or weight (soil/sediment) to perform any of the required operations: sample analysis or extraction, percent moisture, MS/MSD, etc.

4.16 MATRIX - the predominant material of which the sample to be analyzed is composed. For the purpose of this SOP, a sample matrix is either water or soil/sediment. Matrix is <u>not</u> synonymous with phase (liquid or solid).

4.17 MATRIX EFFECT - in general, the effect of a particular matrix (water or soil/sediment) on the constituents with which it contacts. This is particularly pronounced for clay particles which may adsorb chemicals and catalyze reactions. Matrix effects may prevent extraction of target analytes, and may affect surrogate recoveries. In addition, non-target analytes may be extracted from the matrix causing interferences.

4.18 MATRIX SPIKE - aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

4.19 MATRIX SPIKE DUPLICATE - a second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

4.20 METHOD BLANK - an analytical control consisting of all reagents, internal standards, and surrogate standards (or SMCs for VOA), that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background, and reagent contamination.

4.21 PERCENT DIFFERENCE (%D) - As used in this SOW and elsewhere to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference.)

4.22 PERCENT MOISTURE - an approximation of the amount of water in a soil/sediment sample made by drying an aliquot of the sample at 105 °C. The percent moisture determined in this manner also includes contributions from all compounds that may volatilize at or below 105 °C, including water. Percent moisture may be determined from decanted samples and from samples that are not decanted.

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4.23 PURGE AND TRAP (DEVICE) - analytical technique (device) used to isolate volatile (purgeable) organics by stripping the compounds from water or soil by a stream of inert gas, trapping the compounds on an adsorbent such as a porous polymer trap, and thermally desorbing the trapped compounds onto the gas chromatographic column.

4.24 PURGEABLES - volatile compounds.

4.25 REAGENT WATER - water in which an interferant is not observed at or above the minimum quantitation limit of the parameters of interest. Accutest uses deionized water (municipal water which passes through Accutest's DI treatment system).

4.26 RELATIVE PERCENT DIFFERENCE (RPD) - As used in this SOP to compare two values, the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. In contrast, see percent difference.

4.27 RELATIVE RESPONSE FACTOR (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples. RRF is determined by the following equation:

$$RRF = \frac{A_x}{A_{is}} x \frac{C_{is}}{C_x}$$

Where,

A = area of the characteristic ion measured
C = concentration, or amount (mass)
is = internal standard
x = analyte of interest

4.28 RELATIVE RETENTION TIME (RRT) - the ratio of the retention time of a compound to that of a standard (such as an internal standard).

$$RRT = \frac{RT_c}{RT_{is}}$$

Where,

RT_c = Retention time for the volatile target or surrogate compound in continuing calibration.
RT_{is} = Retention time for the internal standard in calibration standard or in a sample.

4.29 RESPONSE - or Instrumental Response: a measurement of the output of the GC detector (MS, EC, or FID) in which the intensity of the signal is proportionate to the amount (or concentration) detected. Measured by peak area or peak height.

4.30 SOIL - used herein synonymously with soil/sediment and sediment.

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4.31 SURROGATES (Surrogate Standard) – for volatiles, semivolatiles and pesticides/Aroclors, compounds added to every blank, sample, matrix spike, matrix spike duplicate, and standard; used to evaluate analytical efficiency by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labeled compounds not expected to be detected in environmental media.

4.32 TWELVE-HOUR TIME PERIOD - The twelve (12) hour time period for GC/MS system instrument performance check, standards calibration (initial or continuing calibration), and method blank analysis begins at the moment of injection of the DFTPP or BFB analysis that the laboratory submits as documentation of instrument performance. The time period ends after 12 hours have elapsed according to the system clock. For pesticide/Aroclor analyses performed by GC/EC, the twelve hour time period in the analytical sequence begins at the moment of injection of the instrument blank that precedes sample analyses, and ends after twelve hours have elapsed according to the system clock.

4.33 VOLATILE COMPOUNDS - compounds amenable to analysis by the purge and trap technique. Used synonymously with purgeable compounds.

4.34 RETENTION TIME (RT) - the time a target analyte is retained on a GC column before elution. The identification of a target analyte is dependent on a target compound's retention time falling within the specified retention time window established for that compound. Retention time is dependent on the nature of the column's stationary phase, column diameter, temperature, flow rate, and other parameters.

4.35 DEIONOZED WATER (DI water) - water that has passed through Accutest's deionization system. Used as reagent water (water that an interferant is not observed at or above the minimum quantitation limit of the parameters of interest).

4.36 SPIKE BLANK OR LABORATORY CONTROL SAMPLE (LCS) – A blank spiked with a known concentration of analyte (from a second source from the calibration standard) or an external quality control standard with a known concentration of analyte used to determine accuracy of the method.

5.0 HEALTH & SAFETY

5.1 All safety practices must be followed as outlined in the Accutest Laboratories Chemical Hygiene Plan. Safety glasses, gloves, and lab coats must be worn. All samples, solutions, and extracts must be treated as unknown and potentially hazardous.

6.0 COLLECTION, PRESERVATION, AND HOLDING TIMES

6.1 Collection and Preservation

6.1.1 Soil/Sediment: Refer to SOP MSM207 (Collection and Preservation of Solid Samples for Volatile Organics Analysis by SW846 5035 Methodology).

6.1.2 Aqueous: Samples are collected in certified pre-cleaned 40 ml VOA vials equipped with a teflon-lined silicone septum cap. Samples must be preserved with 1: 1 HCL to a pH of < 2.

Note: The pH of aqueous volatile samples must be checked AFTER analysis. If sample is not properly preserved, this information must be communicated to the client.

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6.1.3 Volatile samples must be protected from light and stored segregated from samples for other analyses at a temperature of 4°C ± 2°C from the time of receipt to analysis.

6.2 Holding Time: Samples must be analyzed within 14 days of sampling.

7.0 APPARATUS & MATERIALS

7.1 SYRINGE

7.1.1 10, 25, 50, 100, 500 and 5000 ul graduated syringes, manually held (Hamilton or equiv.).

7.1.2 5 ml glass gas tight syringes with Luerlok end, if applicable to the purging device.

7.2 BALANCE

7.2.1 Analytical balance capable of weighing 0.0001 gram.

7.2.2 Top-loading balance capable of weighing 0.1 g.

7.3 PURGE AND TRAP DEVICES

7.3.1 Tekmar LSC2000 , ALS2016 and O.I. Analytical 4552, 4560, and 4551-a are used for purging, trapping and desorbing the sample into GC column.

7.3.2 The sample purge vessel must be designed to accept 5 ml samples with a water column at least 3 cm deep.

7.3.3 The trap must be at least 25 cm long and have an inside diameter of at least 0.105 inch. The trap must be packed to contain the following absorbents (3-ring):

7.3.3.1 2,6-Diphenylene oxide polymer.
7.3.3.2 Silica gel.
7.3.3.3 Charcoal packing.
7.3.3.4 Or equivalent

7.3.4 The trap should be conditioned according to manufacturer specifications by back flushing with a Helium gas flow of at least 20 ml/min prior to use.

7.3.5 The desorber should be capable of rapidly heating the trap to 180 C fordesorption.

7.3.6 O.I. 4552 is equipped with sample heater for analyzing low-level soils.

7.4 GAS CHROMATOGRAPH/MASS SPECTROMETER SYSTEM

7.4.1 Gas Chromatograph.

7.4.1.1 An alytical system complete with a temperature programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases.

7.4.2 Column.

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7.4.2.1 For 5890: 75 m x 0.53 mm I.D., 3 um film DB-624; J&W Scientific. Or equivalent. For 6890: 60 m x 0.25 mm I.D., 1.4 um film DB-VRX; J&W Scientific. Or equivalent.

7.4.3 Mass Spectrometer.

7.4.3.1 Capable of scanning from 35-260 amu every second or less utilizing a 70 volt (nominal) electron energy in the electron impact ionization mode.

7.4.3.2 Capable of producing a mass spectrum which meets all the criteria in Table 2 when injecting 50 ng of Bromofluorobenzene(BFB).

7.5 DATA SYSTEM

7.5.1 A computer system is interfaced to the mass spectrometer which allows the continuous acquisition and storage on machine readable media (disc) of all mass spectra obtained throughout the duration of the chromatographic program.

7.5.2 The computer utilizes software which allows searching any GC/MS data file for target analytes which display specific fragmentation patterns.

7.5.3 The Enviroquant data system is capable of quantitation using multipoint calibration and multipoint internal standards.

7.5.4 The recent version of the EPA/NIH mass spectral library (70,000 compounds) is being used for non target peak tentative identification.

7.5.5 Data can be archived to magnetic tape for long term storage.

8.0 STANDARDS & REAGENTS

Note: All applicable standard/reagent preparation information, including vendor, lot number, date of preparation, date of expiration, calculations, and initials must be entered in the appropriate standard/reagent preparation logbook. Vendors typically used by Accutest include Fisher Scientific, VWR, Accustandard, Supelco, Chemservices, Ultra, and ERA. Additional vendors may be utilized as necessary.

8.1 Solvent

8.1.1 Methanol: Purge and trap B&J Brand quality or equivalent. Store apart from other solvents.

8.2 Reagent water

8.2.1 Reagent water is defined as water in which an interferant is not observed at the method detection limit of the parameters of interest.

8.2.1.1 Reagent water is generated by either passing tap water through a bed of approximately one pound of activated carbon or by using the water purification system at Accutest which is a series of deionizers and carbon cartridges.

8.3 Stock standard solutions

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8.3.1 Commercially prepared standards used:

Accustandard M-502-AR-10X; 2.0 mg/ml in methanol

Accustandard M-502B-10X; 2.0 mg/ml in methanol

Accustandard M8260-Add-10X; 2.0 mg/ml in methanol

Accustandard Acrolein/Acrylonitrile (10000 ug/ml)

Accustandard S-5054 custom mix; 2.0 mg/ml in methanol

Accustandard S-8232 Custom Oxygenate Standard; 2.0 Mg/ml in methanol

Or equivalent standards.

8.3.2 Stock standard solutions (except gases) must be replaced after 6 months or according to manufacturers expiration date if comparison with quality control check samples indicates a problem.

8.3.2.1 The purgeable gases standard should be replaced weekly or sooner if comparison to quality control samples indicates a problem.

8.3.2.2. Stock standard solutions should be stored according to manufacturers specifications. Opened ampules should be stored at -10°C except for Acrolein/Acrylonitrile (solution in water) DAV 10/8/01

8.4 Internal Standard and Surrogate Solution.

8.4.1 Four internal standards (see Table 3) are used that exhibit similar analytical behavior to the compounds of interest:

Internal Std: Ultra, Internal Standard Mixture # STM-341N ; 2.0 mg/ml in methanol or equivalent.

Surrogate: Ultra, Surrogate Standard Mixture # STM-330N; 2.0 mg/ml in methanol or equivalent.

8.5 Working standards

8.5.1 A 50 ug/ml working standard is utilized as the calibration, blank spike, and matrix spike solution for the Instruments using the Tekmar LSC-II and 2016 . A 200 ug/ml working standard is used for the O.I. 4552 and 4551a autosamplers. A 1:10 dilution of these standards are also prepared to use in the 3 lowest calibration levels.

8.5.1.1 The blank spike and matrix spike solutions are prepared independently from the calibration standards using a different vendor or lot number.

8.5.2 See Table 10 for preparation of working standard.

8.5.3 Bromofluorobenzene (BFB)

8.5.3.1 The BFB is prepared at 25 ug/ml by measuring 25 ul of Ultra 4-Bromofluorobenzene Solution, (#STS-110N, 2000 ug/ml in methanol) into 1975 uls of methanol.

8.5.4 Working standard solutions should be stored at -10°C. DAV 6/8/01

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9.0 INTERFERENCES

9.1 The data from all blanks, samples, and spikes must be evaluated for interferences.

9.2 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-TFE tubing, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.

9.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. A field blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

9.4 Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for cross contamination.

10.0 PROCEDURE

10.1 CALIBRATION (See Section 10.6.4 before proceeding)

10.1.1 The calibration range covered by the standards is 1, 2, 5, 50, 100, 200, 400 ug/l. (A) The Analyte Reporting Limit can not be lower than the lowest calibration level utilized.

10.1.2 The linear range covered by this calibration is 110 % of highest concentration standard (up to 440 ug/L).

10.1.3 Add 5 ul of internal standard and surrogate solution (see section 8.4) to each standard with a 10 ul syringe. This results in a concentration of 50 ug/L for each internal and surrogate standard. For the O.I. 4552 and 4551-a autosamplers internal and surrogate standards are added from a reservoir containing both at a concentration of 250 ug/ml. 1 ul is added to the standard, sample or blank prior to analyses.

10.1.4 Each analyte is quantitatively determined by internal standard technique using the closest eluting internal standard and the corresponding area of the major ion. See Table 7.

10.1.5 The Response Factor (RF) is defined in section 10.4.1.

10.1.6 Initial calibration

The following criteria must be met for the initial calibration to be valid.

10.1.6.1 The percent relative standard deviation (% RSD) (see section 10.4.2) of calibration check compound (CCC) (see Table 5) must be less than 30 %. The % RSD should be less than 15% for the rest of the compounds for quantitation versus an average response factor to take place. For compounds with % RSD > 15, linear regression or quadratic curve may be used provided the linear coefficient is greater than or equal to 0.990 . A minimum of five calibration levels must be used for a Linear regression and a minimum of six levels must be used for a Quadratic curve.

(A) the ICAL analyzed for Army Corps samples must have a low standard no lower than 5 ppb. Refer to specific Army Corps QAPp for additional guidance for the ICAL analysis. project

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10.1.6.2 The minimum average response factor (RF) of the system performance check compound (SPCC) (see Table 5) is 0.300 (>0.10 for Bromoform and 0.10 for chloromethane and 1,1-Dichloroethane).

10.1.6.3 Evaluation of retention times. The relative retention time of each target analyte in each calibration standard should agree within 0.06 relative retention time units.

10.1.7 Continuing calibration (CBCHK)

10.1.7.1 A continuing calibration check standard at mid-level concentration (100 ug/ml) must be acquired every 12 hrs. *

10.1.7.2 The RF's generated for each parameter must be compared to the average RF in the Initial calibration for each analyte to determine the percent difference (% D) (see section 10.4.3).

10.1.7.3 The minimum RF of check standard for SPCC compound is 0.300 >0.10 for Bromoform, 0.10 for chloromethane and 1,1-Dichloromethane

10.1.7.4 The % D for CCC must be less than 20.

10.1.7.5 If both of the above specified criteria are met, the continuing calibration is considered valid.

10.1.7.6 If either of the criteria fail, corrective action must be performed. Standard data is evaluated to determine if an analytical system problem exists. If there is problem which does not require making major changes to the system, then those changes are made and the continuing calibration is re-analyzed. If a major problem exists or major changes need to be performed, then the Supervisor is notified for further instruction.

10.1.7.7 If any of the internal standard areas change by a factor of two (- 50% to + 100%) from the last mid-point initial calibration standard, the analytical system must be inspected for malfunctions and corrections will be made, as appropriate.

10.1.7.8 If the retention time for the Internal Standards change by more than 30 seconds from the most recent mid-point initial calibration standard, the system must be inspected for malfunctions. When corrections are made the sample must be reanalyzed.

10.2 ANALYSIS

10.2.1 Instrument conditions

10.2.1.1 Recommended instrument conditions are listed in Table 1 Modifications are allowed as long as criteria of calibration are met.

10.2.2 Purge and Trap Conditions.

10.2.2.1 Recommended instrument conditions are listed in Table 1.

10.2.3 Daily GC/MS performance check.

* All continuing and initial calibration standards are prepared in volumetric flasks and transferred to 40 ml vials.

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10.1.6.2 The minimum average response factor (RF) of the system performance check compound (SPCC) (see Table 5) is 0.300 (>0.10 for Bromoform and 0.10 for chloromethane and 1,1-Dichloroethane).

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10.1.7.2 The RF's generated for each parameter must be compared to the average RF in the Initial calibration for each analyte to determine the percent difference (% D) (see section 10.4.3).

10.1.7.3 The minimum RF of check standard for SPCC compound is 0.300 >0.10 for Bromoform, 0.10 for chloromethane and 1,1-Dichloromethane

10.1.7.4 The % D for CCC must be less than 20.

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10.1.7.8 If the retention time for the Internal Standards change by more than 30 seconds from the most recent mid-point initial calibration standard, the system must be inspected for malfunctions. When corrections are made the sample must be reanalyzed.

10.2 ANALYSIS

10.2.1 Instrument conditions.

10.2.1.1 Recommended instrument conditions are listed in Table 1 Modifications are allowed as long as criteria of calibration are met.

10.2.2 Purge and Trap Conditions.

10.2.2.1 Recommended instrument conditions are listed in Table 1.

10.2.3 Daily GC/MS performance check.

* All continuing and initial calibration standards are prepared in volumetric flasks and transferred to 40 ml vials.

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10.2.3.1 Every 12 hours, inject 2 ul (50 ng) of BFB solution directly on column.

10.2.3.2 The GC/MS system must be checked to verify acceptable performance criteria are achieved (see Table 2)

10.2.3.3 This performance test must be passed before any samples, blanks or standards are analyzed.

10.2.3.4 If all the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are met.

10.2.3.5 The injection time of the acceptable tune analysis, is considered the start of the 12 hour clock.

10.2.4 Daily calibration check

10.2.4.1 See section 10.1.7

10.2.5 Method blank (reagent water)

10.2.5.1 An acceptable method blank must be analyzed for every 12 hour time period.

10.2.5.2 Load 5 ml D.I. water with the 5 ml Luerlok syringe and add 5 ul of 50 ug/ml of internal standard and surrogate mixture to the syringe as a method blank. For O.I. 4551 and 4552 autosamplers, fill a clean 40 ml voa vial with deionized water. Replace teflon lined cap being sure not to leave any air bubbles in vial. Analyze as per 10.2.

10.2.5.3 No compound can be present above the RL (Reporting Limits). The exception to this is Methylene Chloride, 2-Butanone, and Acetone which must be less than 5 x the RL. See Table 8 for RLs.

10.2.5.4 Surrogates must meet ~~Table 4 criteria~~ or in-house acceptance limits. 11-5-01

10.2.5.5 If the method blank does not meet internal standard, surrogate recovery or contamination criteria, the method blank must be re-analyzed and evaluated before sample analysis can begin. If target compounds are detected in the method blank above the reporting limit, and sample results are non-detected these results may be reported. 11-5-01

10.2.6 Sample analysis

10.2.6.1 Rinse 5 ml syringes at least three times with organic-free water (reagent water).

10.2.6.2 Establish dilution of sample in order to fall within calibration range (Refer to the Dilution SOP for guidelines in determining need for dilutions and preparation of dilutions).

10.2.6.2.1 from acquired sample data.
10.2.6.2.2 from history program.
10.2.6.2.3 sample characteristics (appearance, sheen, etc.)

10.2.6.3 Water sample

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10.2.6.3.1 pour the sample into the syringe until just overflowing.
10.2.6.3.2 replace the syringe plunger and adjust the sample volume to 5 ml.
10.2.6.3.3 care must be taken to prevent air into the syringe.
10.2.6.3.4 For O.I. 4552 and 4551a autosamplers, place entire 40 ml vial into appropriate position on autosampler.
10.2.6.3.5 Record pH using 0-14 pH paper and record in logbook. (For OI autosamplers, the pH is checked after analysis is complete). (For Tekmar autosamplers, the pH is checked after sample is loaded into purge tube). 10.2.6.4.1

10.2.6.4 Sediment/ soil sample

Low-level soil method (Requires separate initial and continuing calibrations) *

10.2.6.4.1 Low level soils are collected in the field preserved in sodium bisulfate. If sample is not preserved – the analyst adds 5 mls of DI water to 5 g of sample (and a stir bar) in a 40 ml voa vial. Soil samples are generally purged on O.I. 4552 instrumentation. Surrogates and IS are loaded onto the instrument (in vials) and automatically injected into the sample. The samples are heated, stirred, and purged onto the trap.
10.2.6.4.2 Alternately, accurately weigh approximately 5 g (or less) sample into clean 40 ml voa vial.
10.2.6.4.3 Add 5 ml reagent water and 1 stir bar to voa vial.
10.2.6.4.4 Place vial into O.I. 4552 autosampler.

Medium-level soil method (Requires separate initial and continuing calibrations) ** DAT 12/26/01

The sample should be extracted in methanol if sample contains analytes above working calibration range or exhibits severe matrix interference.

10.2.6.4.5 weigh 10 g sample into VOA vial containing 10 ml methanol and seal with Teflon lined septum.
10.2.6.4.6 Add 12.5 uls Ultra Surrogate Standard Mixture (2000 ug/ml).
10.2.6.4.7 mix by hand shaking vigorously for 1 minute.
10.2.6.4.8 let settle.
10.2.6.4.9 aliquot proper amount of extract by using gas tight microsyringe.
10.2.6.4.10 add aliquoted sample (extract) to a syringe containing 5 ml reagent water.

10.2.6.5 For medium-level soil analyses, add 5 ul of 50 ug/ml internal standard (I.S.) to syringe containing sample. The concentration of each I.S. should be 50 ug/l without any dilution factors.

10.2.6.6 Attach the syringe to the valve on the TEKMAR ALS and inject into purge vial.

10.2.6.7 For analysis of low-level soils soils, heat the sample vial to 40°C while purging and stirring the sample for 11 minutes with Helium. Water samples are not heated. Sample dry purge time is 2 minutes for both matrices.

10.2.6.8 Desorb the sample for 4 minutes by rapidly heating the trap to 180°C while backflushing with Helium.

* Low level initial and continuing calibration standards are prepared in sodium bisulfate solution.

** Medium level initial and continuing calibration standards are prepared in water containing methanol equivalent to a 1:50 dilution. DAT 12/26/01

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10.2.6.9 Bake the trap for 12 minutes at 225°C or at the manufacturers specifications to remove any residual purgeable compounds.

10.2.6.10 If the quantitation value for any analyte exceeds the working range of the GC/MS system, dilute the sample and re-analyze.

10.3 DATA INTERPRETATION

10.3.1 Qualitative identification.

10.3.1.1 The targeted compounds shall be identified by analyst with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria required for a positive identification are:

10.3.1.2 The sample component must elute at the same relative retention time (RRT) as the daily standard. Criteria is the RRT of sample component must be within ± 0.06 RRT units of the standard.

10.3.1.3 All ions present in the standard mass spectra at a relative intensity greater than 10% (major abundant ion in the spectrum equals 100%) must be present in the sample spectrum.

10.3.1.4 The relative intensities of these ion must agree within ± 30% between the daily standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%).

10.3.2 Quantitative analysis.

10.3.2.1 When a target compound has been identified, concentration (see section 10.4) will be based on the integrated area of the quantitation ion, normally the base peak (see Table 7).

10.3.2.2 If the sample produces an interference for the primary ion, use a secondary ion to quantitate (see Table 7). This is characterized by an excessive background signal of the same ion which distorts the peak shape beyond a definitive integration. Also an interference could severely inhibit the response of the internal standard ion.This secondary ion must also be used to generate new calibration response factors.

10.3.3 Library search for tentatively identified compounds.

10.3.3.1 If a library search is requested, the analyst should perform a forward library search of NBS mass spectral library to tentatively identify 15 non-reported compounds.

10.3.3.2 Guidelines for making tentative identification are:

10.3.3.2.1 These compounds should have a response greater than 10% of the nearest internal standard. The response is obtained from the integration for peak area of the Total Ion Chromatogram (TIC).

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10.3.3.2.2 The search is to include a spectral printout of the 3 best library matches for a particular substance. The results are to be interpreted by analyst.

10.3.3.2.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

10.3.3.2.4 Relative intensities of major ions in the reference spectrum (ions > 10% of the most abundant ion) should be present in the sample spectrum.

10.3.3.2.5 The relative intensities the major ions should agree within ± 20%.

10.3.3.2.6 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

10.3.3.2.7 Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible background subtraction from the sample spectrum because of background contamination or coeluting peaks.

10.3.3.2.8 Quantitation of the tentatively identified compounds is obtained from the total ion chromatogram based on a response factor of 1 and is to be tabulated on the library search summary data sheet.

10.3.3.2.9 Quantitation will be performed by using the nearest internal standard.

10.3.3.2.10 Report result as estimated.

10.4 CALCULATION

10.4.1 Response Factor (RF)

$$RF = \frac{As \times Cis}{Ais \times Cs}$$

where: As = Area of the characteristic ion for the compound being measured.
Ais = Area of the characteristic ion for the specific internal standard.
Cs = Concentration of the compound being measured (ug/l).
Cis = Concentration of the specific internal standard (ug/l).

10.4.2 Percent Relative Standard Deviation (% RSD)

$$\%RSD = \frac{SD}{RFav} \times 100$$

where: SD = Standard Deviation
RFav = Average response factor from initial calibration.

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10.4.3 Percent Difference (% D)

$$\%D = \frac{|RFav - RFc|}{RFav} \times 100$$

where: RFc = RF from continuing calibration (CBCHK)

10.4.4 Concentration (Conc.)

For water:

$$Conc.\ (ug/l) = \frac{Ac \times Cis \times Vp}{Ais \times RFav \times Vi}$$

For soil/sediment (on a dry weight basis):

$$Conc.\ (ug/kg) = \frac{Ac \times Cis \times Vp}{Ais \times RFav \times Ws \times M}$$

Where: Ac = Area of characteristic ion for compound being measured.
Vp = 5 ml (Total Purge Volume)
Vi = Initial volume of water purged (ml).
Ws = Weight of sample extracted (g).
M = (100 - % moisture in sample) / 100 or % solids / 100

10.4.5 Percent Recovery (% R)

$$\%R = \frac{Concentration\ Found}{Concentration\ Spiked} \times 100$$

10.4.6 Relative Percent Difference (RPD)

$$RPD = \frac{|MSC - MSDC|}{(\frac{1}{2})(MSC + MSDC)} \times 100$$

Where: MSC = Matrix Spike Concentration
MSDC = Matrix Spike Duplicate Concentration

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11.0 QUALITY ASSURANCE

11.1 QC Requirements Summary

BFB	Every 12 hrs.
Calibration Check std.	Every 12 hrs.
Method blank	Every 12 hrs. and/or every batch
Matrix Spike	one per 20 samples.*
Matrix Spike Duplicate	one per 20 samples.*
Blank Spike	one per batch.*
Surrogate	every sample and standard.
Internal Standard	every sample and standard.

* The maximum number of samples per analytical batch is twenty.

11.2 Daily GC/MS performance check - refer to section 10.2.3

11.3 Daily calibration check - refer to section 10.1.7

11.4 Method blank (reagent water) - refer to section 10.2.5

11.5 Matrix Spike(MS)/Matrix Spike Duplicate(MSD).

11.5.1 One sample is selected at random from each analytical batch of similar matrix types and spiked in duplicate with select compounds to check precision and reproducibility.

11.5.2 Matrix spikes are prepared by spiking an actual sample at a concentration of 50 ug/l or 50 ug/kg based on 5 g dry weight. This is analyzed as outlined in 10.2.

11.5.3 Percent recoveries (% R) (see section 10.4.5) are compared to ~~the acceptance criteria listed in Table 6, or~~ against in-house control limits. 11.5.4 11-5-1

11.5.4 A relative percent deviation (RPD) (see section 10.4.6) is calculated and compared to RPD levels presented in Table 6, or against in-house limits (when established).

11.5.5 If matrix spikes do not meet criteria and the QC check sample (blank spike) passed acceptance criteria (see Table 9 or in-house limits), a matrix interference is to be assumed and the data is reportable and must be footnoted.

11.6 Blank Spike.

11.6.1 Reagent water is used for the Blank Spike.

11.6.2 Blank Spikes are prepared by adding 5uls of blank Spike solution (prepared independently and from a second source as the calibration standards) to 5mls reagent water. For O.I. 4552 and 4551a , 10 uls are added to 40 mls. reagent water. See Table 10 for standard preparation.

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11.6.3 Percent recoveries are compared to criteria listed in table 6 or against in-house acceptance limits (when established).

11.6.4 Blank spike values are used to verify results when Matrix spike/matrix spike duplicate results indicate a potential problem due to sample matrix.

11.6.5 If blank spike recoveries are biased high, and sample results are non-detected, these results may be reported. If blank spike recoveries are biased low, the sample(s) (and blank spike) must be re-analyzed. 11.5.6

11.7 Surrogate

11.7.1 All blanks, samples, and standards contain surrogate compounds which are used to monitor method performance.

11.7.2 If the recovery of any surrogate compound does not meet the control limits specified ~~in Table 4,~~ or in-house acceptance limits (when established) the calculation must be checked.

11.7.3 The sample must be reanalyzed if the recovery of any one surrogate is out of control limit.

11.7.4 Above conditions (section 11.7.3) are not required for samples having severe matrix interference problems.

11.7.5 If surrogate recoveries are acceptable upon reanalysis, the data from the reanalysis is reported. If the reanalysis date did not meet the hold time, then both sets of data have to submitted with the reanalysis reported.

11.7.6 If surrogates are still outside control limits upon reanalysis, then both sets of data should be submitted with the first analysis reported.

11.8 Internal Standard.

11.8.1 Retention time for all internal standard must be within ± 30 seconds of the corresponding internal standard in the latest continuing calibration or 100 ug/l standard of initial calibration if samples are analyzed directly following an initial calibration.

11.8.2 The area (Extracted Ion Current Profile) of the internal standard in all analyses must be within 50 to 200% of the corresponding area in the latest calibration standard (12 hr. time period).

11.8.3 If area of internal standard does not meet control limits, the calculations must be checked. If a problem is not discovered, the sample must be reanalyzed.

11.8.4 If areas are acceptable upon reanalysis, the reanalysis data is reported.

11.8.5 If areas are unacceptable upon reanalysis, then both set of data are submitted with the original analysis reported.

11.9 A Precision and accuracy (P&A) study is performed as an initial determination of capability, on an annual basis (continued demonstration of capability – a successful PT result may be used in place of a P&A for continued DOC), and if any significant changes have been made to the instrument. In general, 4 replicates or blank spikes are analyzed using the same procedures and conditions for sample analysis. The percent recovery are compared to ~~Table 9 until~~ in-house control limits are established. If percent recovery criteria are not met, corrective action must be taken to bring the system back into control.

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12.0 DOCUMENTATION

12.1 The analytical logbook is a record of the analysis sequence; the logbook must be completed daily. Each instrument will have a separate logbook.

12.2 If samples require reanalysis, a brief explanation of the reason should be documented in this log.

12.3 The standard preparation logbook must be completed for all standard preparations. All information requested must be completed; the page must be signed and dated by the respective person.

12.4 The Accutest lot number must be cross-referenced on the standard vial.

12.5 The instrument Maintenance logbook must be completed when any type of maintenance is performed on the instrument. Each instrument will have a separate log.

12.6 All laboratory logbooks must be reviewed and initialed or signed by the lab manager.

12.7 Any corrections to laboratory data must be done using a single line through the error. The initials of the person and date of correction must appear next to the correction.

13.0 DATA REVIEW

13.1 The analyst conducts the primary review of all data. This review begins with a check of all instrument and method quality control and progresses through sample quality control concluding with a check to assure that the client's requirements have been executed. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter of non-conformance.

13.2 A secondary review is performed by department managers, and it includes review of the data produced by their department. All manual calculations, QC criteria, and a comparison of the data package to client specified requirements are checked. The department manager may reject data, initiate reanalysis, take additional corrective action, or reprocess data.

13.3 The laboratory director performs a full tertiary review of the data package following its assembly. This review includes an evaluation of QC data against acceptance criteria and a check of the data package contents to assure that all analytical requirements and specifications were executed.

13.4 Spot-check reviews are performed by the Quality Assurance Officer focusing on all elements of the deliverable including the client's specifications and requirements, analytical quality control, sample custody documentation and sample identification.

14.0 DATA REPORTING

14.1 A results page including positive results and/or RLs, units, methodology, surrogate recoveries, analysis dates, and data qualifiers are reported. Additional quality control data including calibration summaries, MS/MSD (or duplicate) percent recoveries and RPDs, blank spike recoveries, and method blank results may be reported upon request of the client. Raw data may be reported to the client on request.

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14.2 Data may be submitted to the client in a specified electronic format (EDD).
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14.2 Data may be submitted to the client in a specified electronic format (EDD).

14.3 Once the data is approved by the laboratory manager, it may be accessed by clients via LabLink™.

15.0 POLLUTION PREVENTION & WAST MANAGEMENT

15.1 Pollution Prevention. Users of this method must perform all procedural steps that controls the creation and/or escape of wastes of hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids, or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 15.2

15.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the Sample and Waste Disposal SOP. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

15.2.1 Non-hazardous aqueous wastes
15.2.2 Hazardous aqueous wastes
15.2.3 Chlorinated organic solvents
15.2.4 Non-chlorinated organic solvents
15.2.5 Hazardous solid wastes
15.2.6 Non-hazardous solid wastes

16.0 REFERENCES

16.1 SW846 5030B

16.2 SW846 5035

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Table 1

RECOMMENDED OPERATING CONDITION

Gas Chromatograph/ Mass Spectrometer	5890/5970MSD	6890/5973
Carrier Gas(linear velocity)	Helium at 30 cm/sec	1.2 ml/min
Mass range	35 - 260 amu	"
Electron Energy	70 volts (nominal)	"
Scan time	not to exceed 7 sec. per scan	"
Injection port temperature	250degC	"
Source temperature	200 – 250degC	"
Transfer line temperature	250 – 300degC	"
Analyzer temperature	220 – 260degC	"
Initial temperature	36degC	42
Time 1	3 minutes	2 minutes
Column temperature rate	8deg/min.	10deg/min to 80degC 14deg/min to 210degC 16deg/min to 240degC
Final temperature	200degC. 3 min. hold	80degC 2.9min hold
Total run time	30 minutes	20 minutes

Purge and Trap Unit

Water Samples

Purge flow	40 mls/ min.
Purge time	11 min.
Dry Purge	2 min
Desorb preheat	175degC
Desorb	4 min. at 180 degC
Bake	8-12 min. at 225degC
Transfer line	100 – 110degC
Valve temperature	approx. transfer line temp.

Purge and Trap Unit

Soil Samples

Purge flow	40 mls/ min.
Purge time	11 min.
Dry Purge	2 min
Desorb preheat	175degC
Desorb	4 min. at 180degC
Bake	8-12 min. at 225degC
Transfer line	100 – 110degC
Valve temperature	approx. transfer line temp.
Preheat	40degC
Preheat time	3 min.

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Table 2

BFB KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15 - 40 of mass 95
75	30 - 60 of mass 95
95	Base peak, 100% relative abundance
96	5 - 9% of mass 95
173	<2% of mass 174
174	>50% of mass 198
175	5 - 9% of mass 174
176	>95% and <101% of mass 95
177	5 - 9% of mass 176

Table 3

INTERNAL STANDARD

Internal Standard	Prim./Sec. Ions
Pentafluorobenzene	168
Chlorobenzene-d5	117 / 82, 119
1,4-Difluorobenzene	114 / 63, 88
1,4-Dichlorobenzene-d4	152, 115, 150

Table 4

SURROGATES

Compound	(Prim./Sec. ions)	Control Limit (%)	
		Water	Soil
Dibromofluoromethane	(113)	86 - 118	80 - 120
Toluene-d8	(92 / 91,65)	88 - 110	81 - 117
4-Bromofluorobenzene	(95 / 174,176)	86 - 115	74 - 121

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Table 5

Criteria for CCC and SPCC

Initial Calibration: Maximum % RSD for CCC is 30%

Continuing Calibration: Maximum % D for CCC is 20%

Minimum acceptable average relative response factor (RRF) is 0.300 for SPCC (>0.10 for Bromoform, chloromethane & 1,1 Dichloroethane).

Calibration check compounds (CCC)

Volatile
Vinyl Chloride
1,1-Dichloroethene
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

System Performance Check Compounds (SPCC)

Volatile
Chloromethane
1,1-Dichloroethane
Bromoform
1,1,2,2-Tetrachloroethane
Chlorobenzene

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Table 6

MATRIX SPIKE RECOVERY and RSD LIMITS*

Matrix Spike Compound	RPD *		% Recovery limit *	
	Water	Soil	Water	Soil
1,1-Dichloroethene	14	22	61 - 145	59 - 172
Trichloroethene	14	24	71 - 120	62 - 137
Benzene	11	21	76 - 127	66 - 142
Toluene	13	21	76 - 125	59 - 139
Chlorobenzene	13	21	75 - 130	60 - 133

*Advisory Limits only

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Table 7
Volatile Internal Standards with Corresponding Analytes Assigned for Quantitation

Pentafluorobenzene	ions	Chlorobenzene-d5	ions
Acetone	(43/58)	1,1,2-Trichloroethane	(97,99,61)
Acrylonitrile	(53/52,51)	Chlorobenzene	(112/114,77)
Acrolein	(56/55,58)	Ethylbenzene	(106/91)
Bromochloromethane	(128,49,130)	1,3-Dichloropropane	(76,78)
Bromomethane	(94/96,79)	*Ethyl methacrylate	(69/41,99)
Carbon disulfide	(76/78)	2-Hexanone	(43/58,57)
Chloroethane	(64/66,49)	Styrene	(104/78,103)
Chloroform	(83/85,47)	Tetrachloroethene	(164/129,131)
Chloromethane	(50/52,49)	Toluene-d8	(surr.)
Dichlorodifluoromethane	(85/87,50)	Xylenes	(106/91)
1,1-Dichloroethane	(63/65,83)	Chlorodibromomethane	(129/208,206)
2,2-Dichloropropane	(77,97)	1,1,1,2-Tetrachloroethane	(131,133,206)
1,2-Dichloroethane	(surr.)	Bromoform	(173/171,175,252)
1,1-Dichloroethene	(96/61,98)		
Iodomethane	(142/127,141)		
Methylene chloride	(84/49,51)		
Vinyl chloride	(62/64,61)		
trans-1,2-Dichloroethene	(96/61,98)		
Trichlorofluoromethane	(101/103,66)		
Tertiary butyl alcohol	(59/41)		
Vinyl Acetate	(43,86)		
cis-1,2-Dichloroethene	(96,61,98)		
Tetrahydrofuran	(42/71/72)		
1,4-Difluorobenzene	**ions**	**1,4-Dichlorobenzene-D4**	**ions**
Benzene	(78/52,77)	Isopropylbenzene	(105,120)
Bromodichloromethane	(83/85,129)	Bromobenzene	(156,77,158)
2-Butanone	(72/57,43)	1,2,3-Trichloropropane	(75/110,77,61)
Carbon tetrachloride	(117/119,121)	n-Propylbenzene	(91,120)
2-Chloroethyl vinyl ether	(63/65,106)	1,1,2,2 Tetrachloroethane	(83/85,131,133)
Dibromomethane	(93/174,95)	2-chlorotoluene	(91,126)
1,4-Dichloro-2-butene	(75/53,89)	4-chlorotoluene	(91,126)
1,2-Dichloropropane	(63/62,41)	1,3,5-Trimethylbenzene	(105,120)
cis-1,3-Dichloropropene	(75/77,390	t-Butlybenzene	(119,91,134)
trans-1,3-Dichloropropene	(75/77,39)	sec-Butlybenzene	(105,134)
1,1,1-Trichloroethane	(97/99,117)	1,3-Dichlorobenzene	(146/148,111)
Trichloroethene	(130/95,97,132)	1,3-Dichlorobenzene	(146/148,111)
Vinyl acetate	(43/86)	1,2-Dichlorobenzene	(146/148,111)
Methyl tert butyl ether	(73/57)	p-Isopropyltoluene	(119,134,91)
1,4-Dioxane	(88/58)	n-Butylbenzene	(91,92,134)
Ethyl acetate	(43/45,61)	1,2-Dibromo-3-chloropropane	(75,155,157)
Bromofluorobenzene	(surr.)	1,2,4-Trichlorobenzene	(180,182,145)
1,1-Dichloropropane	(75,110,77)	Naphthalene	(128)
1,2-Dichloroethane	(62,64,98)	Hexachlorobutadiene	(225,223,227)

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Toluene	(91/92,65)	1,2,3-Trichlorobenzene	(180,182,145)
4-methyl-2-pentanone	(43/58,100)		
1,2-Dibromoethane			

* non routine target compound

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Table 8

REPORTING LIMITS (RL)

COMPOUND	CAS #	WATER (ug/l)	RL SOIL (ug/kg)
ACETONE	67-64-1	5.0	5.0
ACROLEIN	107-02-08	25	25
ACRYLONITRILE	107-13-1	25	25
BENZENE	71-43-2	1.0	2.0
BROMOBENZENE	108-86-1	5.0	5.0
BROMOCHLOROMETHANE	74-97-5	5.0	5.0
BROMODICHLOROMETHANE	75-27-4	2.0	2.0
BROMOFORM	75-25-2	2.0	2.0
BROMOMETHANE	74-83-9	2.0	2.0
2-BUTANONE	78-93-3	5.0	5.0
n-BUTLYBENZENE	104-51-8	5.0	5.0
sec-BUTYLBENZENE	135-98-8	5.0	5.0
tert-BUTYLBENZENE	98-06-6	5.0	5.0
CARBON DISULFIDE	75-15-0	5.0	5.0
CARBON TETRACHLORIDE	56-23-5	2.0	2.0
CHLOROBENZENE	108-90-7	2.0	2.0
CHLOROETHANE	75-00-3	5.0	5.0
CHLOROFORM	67-66-3	2.0	2.0
CHLOROMETHANE	74-87-3	5.0	5.0
2-CHLOROETHYL VINYL ETHER	110-75-8	5.0	5.0
2-CHLOROTOLUENE	95-49-8	5.0	5.0
4-CHLOROTOLUENE	106-43-4	5.0	5.0
DIBROMOCHLOROMETHANE	124-48-1	2.0	2.0
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	5.0	5.0
1,2-DIBROMOETHANE	106-93-4	2.0	2.0
DIBROMOMETHANE	74-95-3	5.0	2.0
1,2-DICHLOROBENZENE	95-50-1	2.0	2.0
1,3-DICHLOROBENZENE	540-73-1	2.0	2.0
1,4-DICHLOROBENZENE	106-46-7	2.0	2.0
DICHLORODIFLUOROMETHANE	75-71-8	2.0	2.0
1,1-DICHLOROETHANE	75-34-3	2.0	2.0
1,2-DICHLOROETHANE	107-06-02	2.0	2.0
1,1-DICHLOROETHYLENE	75-35-4	1.0	2.0
cis-1,2-DICHLOROETHYLENE	156-59-2	2.0	2.0
trans-1,2-DICHLOROETHYLENE	156-60-5	2.0	2.0
1,2-DICHLOROPROPANE	78-87-5	2.0	2.0
1,3-DICHLOROPROPANE	142-28-9	5.0	5.0
2,2-DICHLOROPROPANE	594-20-7	5.0	5.0

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Table 8 (cont.)

REPORTING LIMITS (RL)

COMPOUND	CAS #	RL WATER (ug/l)	RL SOIL (ug/kg)
1,1-DICHLOROPROPENE	563-58-6	5.0	5.0
cis-1,3-DICHLOROPROPENE	10061-01-5	0.5	2.0
trans-1,3-DICHLOROPROPENE	10061-02-6	0.5	2.0
ETHYLBENZENE	100-41-4	1.0	2.0
HEXACHLOROBUTADIENE	87-68-3	5.0	5.0
2-HEXANONE	591-78-6	5.0	5.0
IODOMETHANE	74-88-4	5.0	5.0
ISOPROPYLBENZENE	98-82-8	5.0	5.0
p-ISOPROPYLTOLUENE	99-87-6	5.0	5.0
METHYLENE CHLORIDE	75-09-2	2.0	2.0
4-METHYL-2-PENTANONE	108-10-1	5.0	5.0
NAPHTHALENE	99-20-3	5.0	5.0
n-PROPYLBENZENE	103-65-1	5.0	5.0
[illegible]	[illegible]	5.0	5.0
TETRAHYDROFURAN	109-99-9	50.0	50.0
TOLUENE	108-88-3	1.0	2.0
1,2,3-TRICHLOROBENZENE	87-61-6	5.0	5.0
1,2,4-TRICHLOROBENZENE	120-82-1	5.0	5.0
1,1,1-TRICHLOROETHANE	71-55-6	2.0	2.0
1,1,2-TRICHLOROETHANE	79-00-5	2.0	2.0
TRICHLOROETHYLENE	79-01-6	2.0	2.0
TRICHLOROFLUOROMETHANE	75-69-4	2.0	2.0
1,2,3-TRICHLOROPROPANE	96-18-4	5.0	5.0
1,2,4-TRIMETHYLBENZENE	95-63-6	5.0	5.0
1,3,5-TRIMETHYLBENZENE	108-67-8	5.0	5.0
VINYL ACETATE	108-05-4	5.0	5.0
VINLY CHLORIDE	75-01-4	2.0	2.0
m-XYLENE	108-38-3	1.0	2.0
p-XYLENE	106-42-3	1.0	2.0
o-XYLENE	95-47-6	1.0	2.0

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Table 9
SINGLE LABORATORY ACCURACY AND PRECISION DATA FOR VOLATILE *ORGANIC COMPOUNDS IN WATER DETERMINED WITH A WIDE-BORE CAPILLARY COLUMN* *

COMPOUND	CONC. RANGE (UG/L)	RECOVERY (%)	STANDARD DEVIATION OF REC.	PERCENT RSD
ACETONE	ND **	ND	ND	ND
ACROLEIN	ND	ND	ND	ND
ACRYLONITRILE	ND	ND	ND	ND
BENZENE	0.1-10	97	6.5	5.7
BROMOBENZENE	0.1-10	100	5.5	5.5
BROMOCHLOROMETHANE	0.5-10	90	5.7	6.4
BROMODICHLOROMETHANE	0.1-10	95	5.7	6.1
BROMOFORM	0.5-10	101	6.4	6.3
BROMOMETHANE	0.5-10	95	7.8	8.2
2-BUTANONE	ND	ND	ND	ND
n-BUTLYBENZENE	0.5-10	100	7.6	7.6
sec-BUTYLBENZENE	0.5-10	100	7.6	7.6
tert-BUTYLBENZENE	0.5-10	102	7.4	7.3
CARBON DISULFIDE	ND	ND	ND	ND
CARBON TETRACHLORIDE	0.5-10	84	7.4	8.8
CHLOROBENZENE	0.1-10	98	5.8	5.9
CHLOROETHANE	0.5-10	89	8.0	9.0
CHLOROFORM	0.5-10	90	5.5	6.1
CHLOROMETHANE	0.5-10	93	8.3	8.9
2-CHLOROETHYL VINYL ETHER	ND	ND	ND	ND
2-CHLOROTOLUENE	0.1-10	90	5.6	6.2
4-CHLOROTOLUENE	0.1-10	99	8.2	8.3
DIBROMOCHLOROMETHANE	0.1-10	92	6.5	7.0
1,2-DIBROMO-3-CHLOROPROPANE	0.5-10	83	16.6	19.9
1,2-DIBROMOETHANE	0.5-10	102	4.0	3.9
DIBROMOMETHANE	0.5-10	100	5.6	5.6
1,2-DICHLOROBENZENE	0.1-10	93	5.8	6.2
1,3-DICHLOROBENZENE	0.5-10	99	6.8	6.9
1,4-DICHLOROBENZENE	0.2-20	103	6.6	6.4
DICHLORODIFLUOROMETHANE	0.5-10	90	6.9	7.7
1,1-DICHLOROETHANE	ND	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND
1,1-DICHLOROETHYLENE	ND	ND	ND	ND

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Table 9 (cont.)

COMPOUND	CONC. RANGE (UG/L)	RECOVERY (%)	STANDARD DEVIATION OF REC.	PERCENT RSD
trans-1,3-DICHLOROPROPENE	ND	ND	ND	ND
ETHYLBENZENE	0.1-10	99	8.4	8.6
HEXACHLOROBUTADIENE	0.5-10	100	6.8	6.8
2-HEXANONE	ND	ND	ND	ND
IODOMETHANE	ND	ND	ND	ND
ISOPROPYLBENZENE	0.6-10	101	7.7	7.6
p-ISOPROPYLBENZENE	0.1-10	99	6.7	6.7
METHYLENE CHLORIDE	0.1-10	95	5.0	5.3
4-METHYL-2-PENTANONE	ND	ND	ND	ND
NAPHTHALENE	0.1-100	104	8.6	8.2
n-PROPYLBENZENE	0.1-10	100	5.8	5.8
STYRENE	0.1-100	102	7.3	7.2
1,1,1,2 TETRACHLOROETHENE	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	0.1-10	91	5.7	6.3
TETRACHLOROTOLUENE	ND	ND	ND	ND
TOLUENE	0.5-10	102	8.1	8.0
1,2,3-TRICHLOROBENZENE	0.5-10	109	9.4	8.6
1,2,4-TRICHLOROBENZENE	0.5-10	108	9.0	8.3
1,1,1-TRICHLOROETHANE	0.5-10	98	7.9	8.1
1,1,2-TRICHLOROETHANE	0.5-10	104	7.6	7.3
TRICHLOROETHYLENE	0.5-10	90	6.5	7.3
TRICHLOROFLUOROMETHANE	0.5-10	90	7.2	8.1
1,2,3-TRICHLOROPROPANE	0.5-10	100	15.0	14.4
1,2,4-TRIMETHYLBENZENE	0.5-10	99	8.0	8.1
1,3,5-TRIMETHYLBENZENE	0.5-10	92	6.8	7.4
VINYL ACETATE	ND	ND	ND	ND
VINLY CHLORIDE	0.5-10	96	6.5	6.7
m-XYLENE	0.1-10	97	6.3	6.5
p-XYLENE	0.5-10	104	8.0	7.7
o-XYLENE	0.1-31	103	7.4	7.2

* Criteria from SW846 method 8260B
** ND: not determined

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Table 10

WORKING STANDARD PREPARATION

Internal standard and Surrogate mixture	LSC-2000 (50ug/ml)	O.I. 4552/4551a (250 ug/ml)
Internal Standard (2000 ug/ml)	50 ul	250 ul
Surrogates (2000 ug/ml)	50 ul	250 ul
Methanol	1900 ul	1500 ul
Final volume	2000 ul	2000 ul

Calibration mixture	LSC-2000 (50 ug/ml)	O.I. 4552/4551a (200 ug/ml)
Accustandard M502-AR-10X (2000ug/ml)	50 ul	200 ul
Accustandard M502-B 10x (2000ug.ml)	50 ul	200 ul
Accustandard S-5054 (2000ug/ml)	50 ul	200 ul
Accustandard M-603-10x (10000ug/ml)	50 ul	200 ul
Accustandard S-8232 (2000ug/ml)	50 ul	200 ul
Methanol	1750 ul	1000 ul
Final volume	2000 ul	2000 ul

Blank Spike/ Matrix Spike (2nd source)	LSC-2000 (50 ug/ml)	O.I. 4552/4551a (200ug/ml)
Restek 502.2 Calibration Mix 1 (2000ug/ml)	25ul	100 ul
Restek 502.2 Cal 2000 Megamix (2000ug/ml)	25ul	100 ul
Methanol	950ul	800 ul
Final volume	1000ul	1000 ul

Attachment 6

Investigation-Derived Wastes Sampling SOP

SUPERFUND TECHNICAL ASSESSMENT RESPONSE TEAM
STANDARD OPERATING PROCEDURE

SOP 406
INVESTIGATION-DERIVED WASTES SAMPLING

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) provides Roy F. Weston, Inc. (WESTON®), Superfund Technical Assessment Response Team (START) field personnel with general investigation-derived waste sampling guidelines and strategies.

Sampling guidelines and strategies may vary depending upon site specific conditions, equipment and procedural limitations.

2.0 MATERIALS REQUIRED

The following materials are required for investigation derived waste sampling:

- Sampling jars/bottles (check with lab for necessary volume)
- Proper personal protective equipment (PPE)
- Disposable sampling scoops
- Proper level of respiratory protection
- Scissors

3.0 SAFETY PRECAUTIONS

Investigation derived wastes represent a significant threat for personal exposure. When sampling investigation-derived wastes, consult PPE requirements outlined in the site health and safety plan (HASP) regarding the waste source. Sampling activities performed in Level B PPE will effectively minimize exposure risks. For further guidance, consult Material Safety Data Sheets (MSDS), Occupational Safety and Health Association (OSHA) regulations, and corporate health and safety procedures.

4.0 SAMPLING PROCEDURES

To accurately characterize the investigative derived waste, collect a representative sample of the waste. Representative sampling maximizes resources and cost-effectiveness. *Note: If previous sampling analyses accurately characterize the waste, investigation-derived waste sampling may be unnecessary.*

4.1 Personal Protective Equipment

Procedure:

1. Dress in proper PPE as per the site HASP.
2. Select the sample container(s) based on waste, needed volume, and lab specifications.
3. Cut approximately 5-inch x 5-inch squares of each representative PPE piece (i.e. Tyvek®, booties, Saranex®, gloves, etc.).
4. Place the representative pieces of PPE in the proper sample container(s).
5. Label the sample container(s) with the appropriate markings.
6. Repeat steps 1-5 for non-disposable sampling equipment (i.e. drum thieves).

4.2 Decontamination Water/Purged Well Water

Procedure:

1. Dress in proper PPE as per the site HASP.
2. Select the sample container(s) based on waste, needed volume, and lab specifications.
3. Check analysis requirements and lab specifications for preservative information.
4. Submerge the sample container(s) and collect the specified volume.
5. Label the sample container(s) with appropriate markings.

5.0 REFERENCE

EPA. 1991. *Compendium of Emergency Response Team (ERT) Chip, Wipe and Sweep Sampling and Drum Sampling Procedures*. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/P-91/008.

Appendix A

QA Level II

-%Relative standard deviation (%RSD) of response factors for aldrin, endrin, DBC, DDT, DCB.
-Analytical sequence.

- Method Blank(s): -Detection limit.
  -Amount detected in blank.
  -Calibration blank.

- Surrogate Recoveries: -% recovery.
  -Control limits.
  -List compound(s) used as surrogate.

4. Copies of Raw Data for all Analytical Results:
   -Sample chromatograms and ion spectra for GC.
   -Enhanced or background subtracted chromatograms and ion spectra for GC.
   -Standard chromatograms and ion spectra for GC.

5. Compound Quantitation Calculations: -Dilutions.
   -Concentrations.
   -Dry weights.
   -Etc.

6. Chain-of Custody: Photocopy of COC form.

C. Organics by GC/MS

1. Case Narrative: -Observations and/or Problems.
   -Methods used.

2. Sample Holding Times: -Extraction dates.
   -Analysis dates.

3. Analytical Results for:
   - Samples: -Relative retention times.
     -Mass Spectra.
     -Ion chromatograms.

   - *GC/MS Tuning: BFB/DFTPP ion abundances.*

   - Initial Calibration: -Retention times (RT).
     -Response factors (RF and RRF).
     -% relative standard deviation (%RSD).

   - Continuing Calibrations: % difference from initial standard.

   - Method Blank(s): -Detection limits.
     -Amount detected in blank.

   - Surrogate Recoveries: -% recoveries.

   - Tentatively Identified Compounds, if applicable: Ion relative intensities.

4. Copies of Raw Data for all Analytical Results:
   -Sample spectra.
   -Enhanced or background subtracted spectra.

QA LEVEL II
Laboratory Data Package Deliverable Requirements

A. Metals

1. Case Narrative: -Observations and/or Problems.
   -Methods used.

2. Sample Holding Times: -Analysis dates.

3. Analytical Results for:
   - Samples.
   - Standards: -Number of standards.
     -Concentration of standards.
   - Initial Calibration: % Recoveries (%R) of true value.
   - Continuing Calibrations: % Recoveries (%R) of true value.
   - Calibration Blanks.
   - *Method Blank(s)*: -Detection limit.
     -Amount detected in blank.
   - Matrix Spike/Matrix Spike Duplicate, if applicable: -% Recoveries (%R)
     -% Difference (%D)
   - Laboratory Control Samples.
   - ICP Interference Check Samples, if applicable.
   - ICP Serial Dilutions, if applicable.
   - Standard Additions, if applicable.

4. Copies of Raw Data for all Analytical Results: Peak areas for all items in No. 3.

5. Compound Quantitation Calculations: -Dilutions.
   -Concentrations.
   -Dry weights.
   -Etc.

6. Chain-of-Custody (COC): Photocopy of COC form.

B. Pesticides by Gas Chromatograph (GC)

1. Case Narrative: -Observations and/or Problems.

2. Sample Holding Times: -Extraction dates.
   -Analysis dates.

3. Analytical Results for:
   - Samples: Verification of positive hits by GC/MS or dissimilar column.

   - Initial Calibration: -Pesticide standard retention time windows and standard Rts.
     -Response factors (RF).
     -% relative standard deviation (%RSD) of response factors for aldrin, endrin, DBC, DDT, DCB.
     -% Breakdown for endrin and 4,4-DDT in Evaluation Standard Mix B.
     -Surrogate compound retention times.

   - Continuing Calibrations: -Retention times (RT).
     -Response factors (RF).

2. Sample Holding Times: -Extraction dates.
-Analysis dates.

3. Analytical Results for:
   - Samples.
   - Calibration or Standardization.
   - Duplicates.
   - Reagent Blank Results.
   - Spike Recoveries.

4. Copies of Raw Data for all Analytical Results.

5. Compound Quantitation Calculations: -Dilutions.
-Concentrations.
-Dry weights.
-Etc.

6. Chain-of-Custody: Photocopy of COC form.

F. QA/QC Analytical Methods Reference

Analytical Parameter	Analytical Method
VOCs	**SW846 1311/8260**
SVOCs	**SW846 1311/8270**
PCBs	**SW846 8082**
Pesticides	**SW846 8081**
Metals (total) **Metals (TCLP)** **Mercury**	**SW846 6010 or 6020** **SW846 1311** **SW846 7470 or 7471**
Asbestos (PLM, TEM)	**SW846 9010**
Flash point	**SW846 1010 (closed cup)**
pH	**SW846 9045c**
Dioxin	**SW846 8290**
TPH **(DRO,GRO, Oil&Grease)**	**SW846 8015**

-Standard spectra. (For tentative identified compounds. provide a reference mass spectra from the spectral library.)

5. Compound Quantitation Calculations: -Dilutions.
   -Concentrations.
   -Dry weights.
   -Etc.

6. Chain-of Custody: Photocopy of COC form.

D. Polychlorinated Biphenyls (PCBs) by GC.

1. Case Narrative: -Observations and/or Problems.
   -Methods used.

2. Sample Holding Times: -Extraction dates.
   -Analysis dates.

3. Analytical Results for:
   - Samples: -Retention time windows.
   - Initial Calibration: -3-point calibration for each aroclor of interest.
     -Response factors (RF).
     -% relative standard deviation (%RSD).
   - Continuing Calibrations: % difference from initial standard.
   - Method Blank(s): -Detection limits.
     -Amount detected in blank.
   - Matrix Spike/Matrix Spike Duplicate, if applicable: % recovery.
   - Surrogate Recoveries: -% recovery.
     -Control limits.
     -List compound(s) used as surrogate.

4. Copies of Raw Data for all Analytical Results:
   -Sample chromatograms.
   -Enhanced or background subtracted chromatograms.
   -Standard chromatograms.

5. Compound Quantitation Calculations: -Dilutions.
   -Concentrations.
   -Dry weights.
   -Etc.

6. Chain-of Custody: Photocopy of COC form.

E. Miscellaneous Analysis

1. Case Narrative: -Observations and/or Problems.
   -Methods used.

Appendix B

Sampling SOPs

SUPERFUND TECHNICAL ASSESSMENT RESPONSE TEAM
STANDARD OPERATING PROCEDURES

SOP 303
SEDIMENT SAMPLING

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may determine whether concentrations of specific contaminants exceed established threshold action levels, or if the concentrations present a risk to public health, welfare, or the environment.

The methodologies discussed in this procedure are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by the sampling area. However, if modifications occur, they should be documented in the site logbook or report summarizing field activities.

For the purposes off this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, or other impoundments or flowing, as in rivers and streams.

2.0 METHOD SUMMARY

Sediment samples may be recovered using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface versus subsurface), the type of sample required (disturbed versus undisturbed) and the sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand-held device such as a shovel, trowel, or auger, or indirectly using a remotely activated device such as an Ekman or Ponar dredge. Following collection, the sediment is placed into a container constructed of inert material, homogenized, and transferred to the appropriate sample containers. The homogenization procedure should not be used if sample analysis includes volatile organics.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

- Chemical preservation of solids is generally not recommended. Cooling is usually the best approach, supplemented by the appropriate holding time.

- Wide-mouth glass containers with Teflon-lined caps are utilized for sediment

samples. The sample volume is a function of the analytical requirements and will be specified in the work plan.

- Transfer sediment from the sample collection device to an appropriate sample container using a stainless steel or plastic lab spoon or equivalent. If composite samples are collected, place the sediment sample in a stainless steel, plastic or other appropriate composition (e.g., Teflon) bucket, and mix thoroughly to obtain a homogeneous sample representative of the entire sampling interval. Then place the sediment sample into labeled containers.

- Samples for volatile organic analysis must be collected directly from the bucket, before mixing the sample, to minimize loss due to volatilization of contaminants.

- All sampling devices should be decontaminated, then wrapped in aluminum foil. The sampler should remain in this wrapping until it is needed. Each sampler should be used for only one sample. Dedicated samplers for sediment samples may be impractical due to the large number of sediment samples which may be required and the cost of the sampler. In this case, samplers should be cleaned in the field using the decontamination procedure described in SOP No. 301, Decontamination Procedures.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Substrate particle size and organic content are directly related to water velocity and flow characteristics of a body of water. Contaminants are more likely to be concentrated in sediments typified by the fine particle size and a high organic content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic content do not typically concentrate pollutants and are found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results.

5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of sediment samples includes:

- maps/plot plan
- safety equipment
- compass
- tape measure
- survey stakes, flags, or buoys and anchors
- camera and film
- stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart, wide-mouth jars w/Teflon-lined lids
- Ziploc plastic bags
- logbook
- sample jar labels
- chain of custody forms, field data sheets
- cooler(s)

- ice
- decontamination supplies/equipment
- spade or shovel
- spatula
- scoop
- trowel
- bucket auger
- thin-walled auger
- extension rods
- T-handle
- sampling trier
- sediment coring device (tubes, points, drive head, drop hammer, "eggshell" check valve devices, acetate cores)
- Ponar dredge
- Ekman dredge
- nylon rope

6.0 REAGENTS

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in SOP #301, Sampling Equipment Decontamination.

7.0 PROCEDURES

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

6. Use stake, flags, or buoys to identify and mark all sampling locations. Specific site characteristics, including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, and extent and nature of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the medium to be sampled.

7.2.1 Sampling Surface Sediments with a Trowel or Scoop From Beneath a Shallow Aqueous Layer

Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth; then a stainless steel or plastic scoop should be used to collect the sample.

This method can be used to collect consolidated sediments but is limited somewhat by the depth of the aqueous layer. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A stainless steel or plastic scoop or lab spoon will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden trowels.

Follow these procedures to collect sediment samples with a scoop or trowel:

1. Using a precleaned stainless steel scoop or trowel, remove the desired thickness of sediment from the sampling area.

2. Transfer the sample into an appropriate sample or homogenization container.

7.2.2 Sampling Surface Sediments with a Thin-Wall Tube Auger From Beneath a Shallow Aqueous Layer

This system consists of an auger, a series of extension rods, and a "T" handle (see Figure 4, Attachment 1). The auger is driven into the sediment and used to extract a core. A sample of the core is taken from the appropriate depth.

Use the following procedure to collect sediment samples with a thin-walled auger:

1. Insert the auger into the material to be sampled at a 0° to 45° angle from vertical. This orientation minimizes spillage of the sample from the sampler. Extraction of samples may require tilting of the sampler.

2. Rotate the auger once or twice to cut a core of material.

3. Slowly withdraw the auger, making sure that the slot is facing upward.

4. An acetate core may be inserted into the auger prior to sampling, if characteristics of the sediments or body of water warrant. By using this technique, an intact core can be extracted.

5. Transfer the sample into an appropriate sample or homogenizaton container.

7.2.3 Sampling Deep Sediments with Augers and Thin-Wall Tube Samplers From Beneath a Shallow Aqueous Layer

This system uses an auger, a series of extension rods, a "T" handle, and a thin-wall tube sampler (Figure 4, Attachment 1). The auger bores a hole to a desired sampling depth and then is withdrawn. The auger tip is then replaced with a tube core sampler, lowered down the borehole, and driven into the sediment at the completion depth. The core is then withdrawn and the sample collected. This method can be used to collect consolidated sediments, but is somewhat limited by the depth of the aqueous layer.

Several augers are available which include bucket and posthole augers. Bucket augers are better for direct sample recovery, are fast, and provide a large volume of sample. Posthole augers have limited utility for sample collection as they are designed more for their ability to cut through fibrous, rooted, swampy areas.

Follow these procedures to collect sediment samples with a hand auger:

1. Attach the auger bit into a drill extension rod, then attach the "T" handle to the drill extension rod.

2. Clear the area to be sampled of any surface debris.

3. Begin augering, periodically removing any accumulated sediment from the auger bucket.

4. After reaching the desired depth, slowly and carefully remove the auger from boring. (When sampling directly from the auger, collect sample after the auger is removed from boring and proceed to Step 10).

5. Remove the auger tip from the drill rods and replace it with a precleaned thin-wall tube sampler. Install the proper cutting tip.

6. Carefully lower the tube sampler down borehole. Gradually force the tube sampler into sediment. Care should be taken to avoid scraping the borehole

sides. Also, avoid hammering of the drill rods to facilitate coring, since the vibrations may cause the boring walls to collapse.

7. Remove the tube sampler and unscrew the drill rods.

8. Remove the cutting tip and remove the core from the device.

9. Discard the top of the core (approximately 1 inch), as this represents material collected by the tube sampler before penetration of the layer of concern.

10. Transfer the sample into an appropriate sample or homogenization container.

7.2.4 Sampling Surface Sediments From Beneath a Deep Aqueous Layer with an Ekman or Ponar Dredge

This technique consists of lowering a sampling device to the sediment by use of a rope, cable, or extended handle. The mechanism is triggered, and the device entraps sediment in spring-loaded jaws, or within lever-operated jaws.

Follow these procedures for collecting sediment with an Ekman dredge (Figure 5, Attachment 1):

1. Thread a sturdy nylon or stainless steel cable through the bracket, or secure the extended handle to the bracket with machine bolts.

2. Attach springs to both sides. Arrange the Ekman dredge sampler so that the jaws are in the open position and trip cables are positioned over the release studs.

3. Lower the sampler to a point just above the sediment surface.

4. Drop the sampler sharply onto the sediment.

5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extended handle.

6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Be careful to retain fine sediments.

7. Open the dredge and transfer the sediment into a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has

been secured. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

8. Samples for volatile analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

Follow these procedures for collecting sediment with a Ponar dredge (Figure 6, Attachment 1):

1. Attach a sturdy nylon or steel cable to the hook provided on top of the dredge.

2. Arrange the Ponar dredge sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.

3. Slowly lower the sampler to a point just above the sediment.

4. Drop the sampler sharply into the sediment, then pull sharply up on the line, thus releasing the trip bar and closing the dredge.

5. Raise the sampler to the surface and slowly decant any free liquid through the screens on top of the dredge. Be careful to retain fine sediments.

6. Open the dredge and transfer the sediment to a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been gained. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

7. Samples for volatile organic analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

7.2.5 Sampling Subsurface Sediments From Beneath a Deep Aqueous Layer with a Sample Coring Device

Follow these procedures when using a sample coring device (Figure 7, Attachment 1) to collect subsurface sediments. It consists of a coring device, handle, and acetate core utilized in the following procedure:

1. Assemble the coring device by inserting the acetate core into the sampling tube.

2. Insert the "eggshell" check valve mechanisms into the tip of the sampling tube with the convex surface positioned inside the acetate core.

3. Screw the coring point onto the tip of the sampling tube.

4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.

5. Place the sampler in a perpendicular position on the material to be sampled.

6. This sampler may be used with either a drive hammer for firm consolidated sediments, or a "T" handle for soft sediments. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. Rotate the sampler to shear off the core of the bottom, retrieve the device and proceed to Step 15.

7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.

8. With left hand holding the tube, drive the sampler into the material to the desired depth. Do not drive the tube further than the tip of the hammer's guide.

9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.

10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

11. Rotate the sampler at least two revolutions to shear off the sample at the bottom.

12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.

13. Withdraw the sampler by pulling the handle (hammer) upwards and dislodging the hammer from the sampler.

14. Unscrew the coring point and remove the "eggshell" check valve.

15. Slide the acetate core out of the sampler tube. The acetate core may be capped at both ends. The sample may be used in this fashion, or the contents transferred to a stainless steel or plastic bucket and mixed thoroughly to obtain a homogeneous sample representative of the entire sampling interval.

16. Samples for volatile organic analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.1 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following QA/QC procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials follow U.S. EPA, OSHA and specific health and safety procedures.

More specifically, when sampling sediment from bodies of water containing known or suspected hazardous substances, adequate precautions must be taken to ensure the sampler's safety. The team member collecting the sample should not get too close to the edge of the water, where bank failure may cause him or her to lose their balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is necessary, implement appropriate protective measures.

12.0 REFERENCES

EPA. 1991. Compendium of ERT Surface Water and Sediment Sampling Procedures. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/P-91/008.

Attchments: (2)

ATTACHMENT 1

FIGURES

Figure 1: Kemmerer Bottle

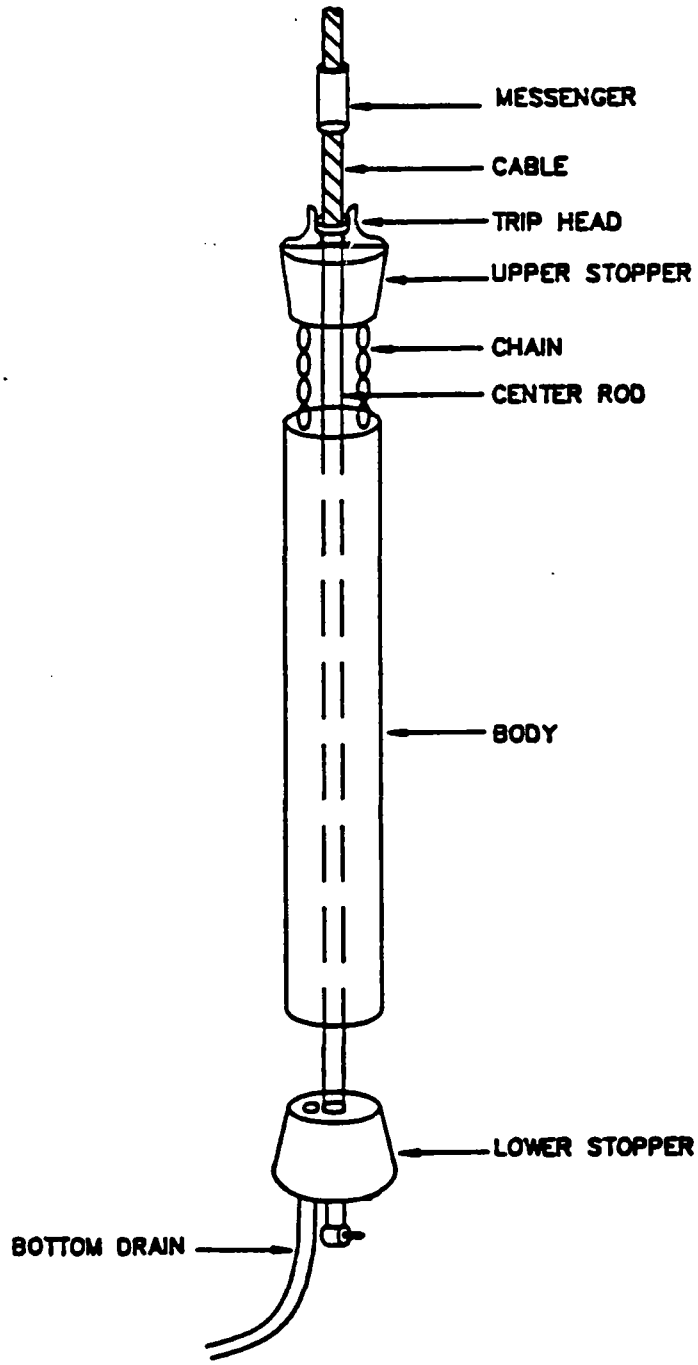


Figure 2: Bacon Bomb Sampler

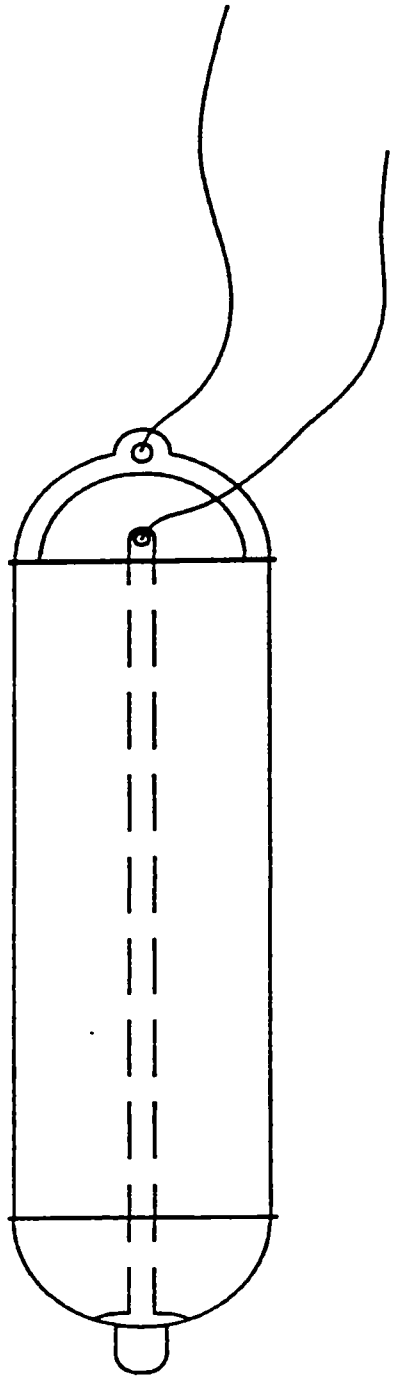


Figure 3: Dip Sampler

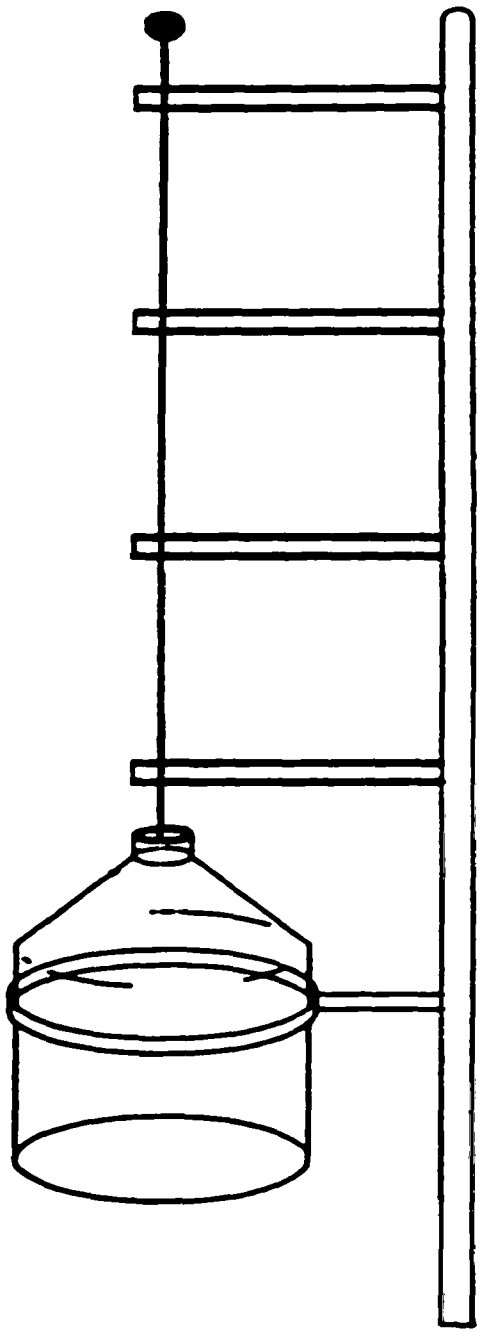


Figure 4: **Sampling Auger**

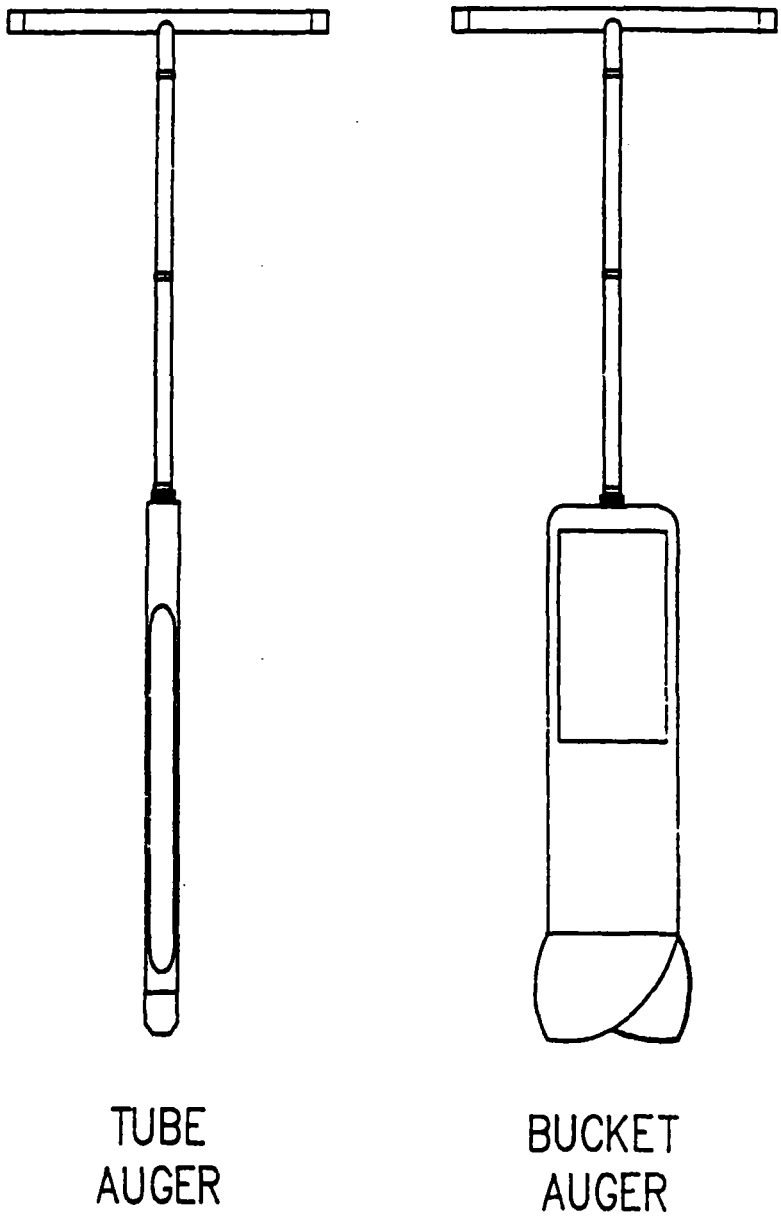


Figure 5: Ekman Dredge

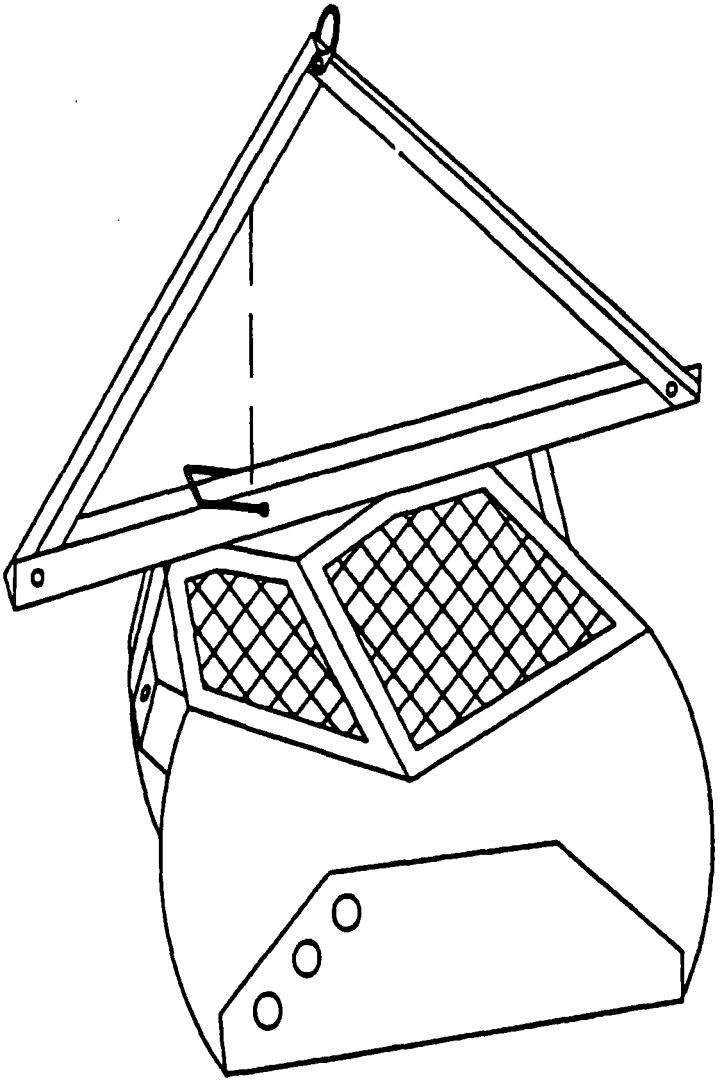


Figure 6: Ponar Dredge

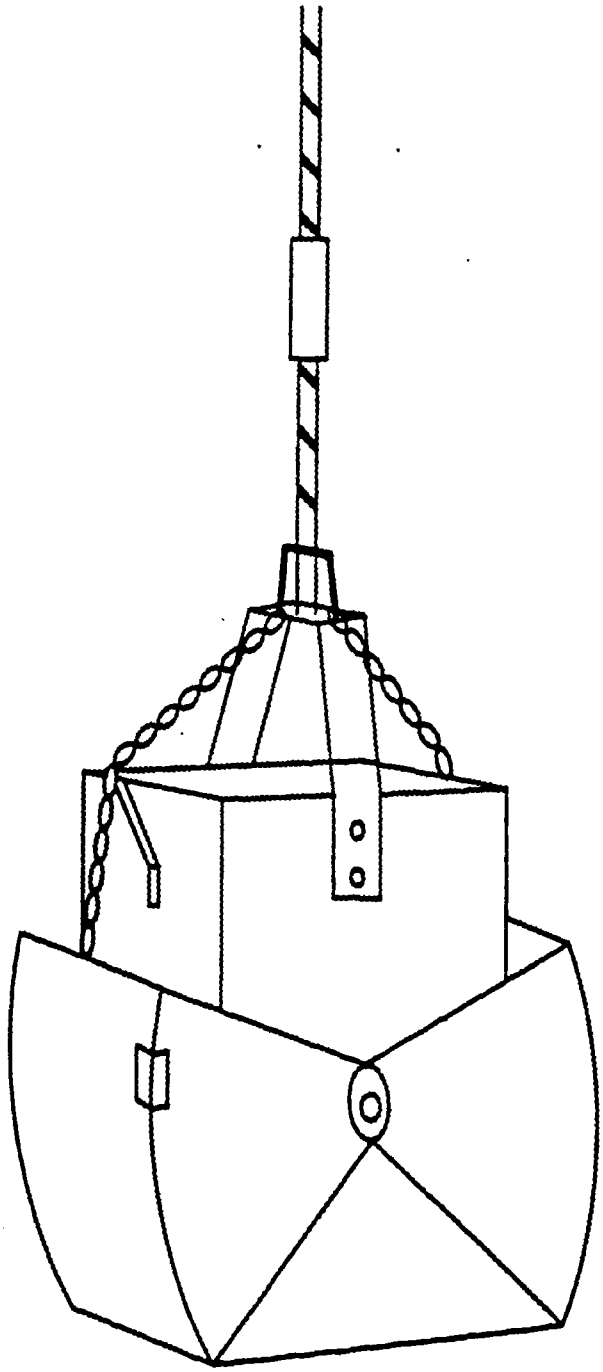
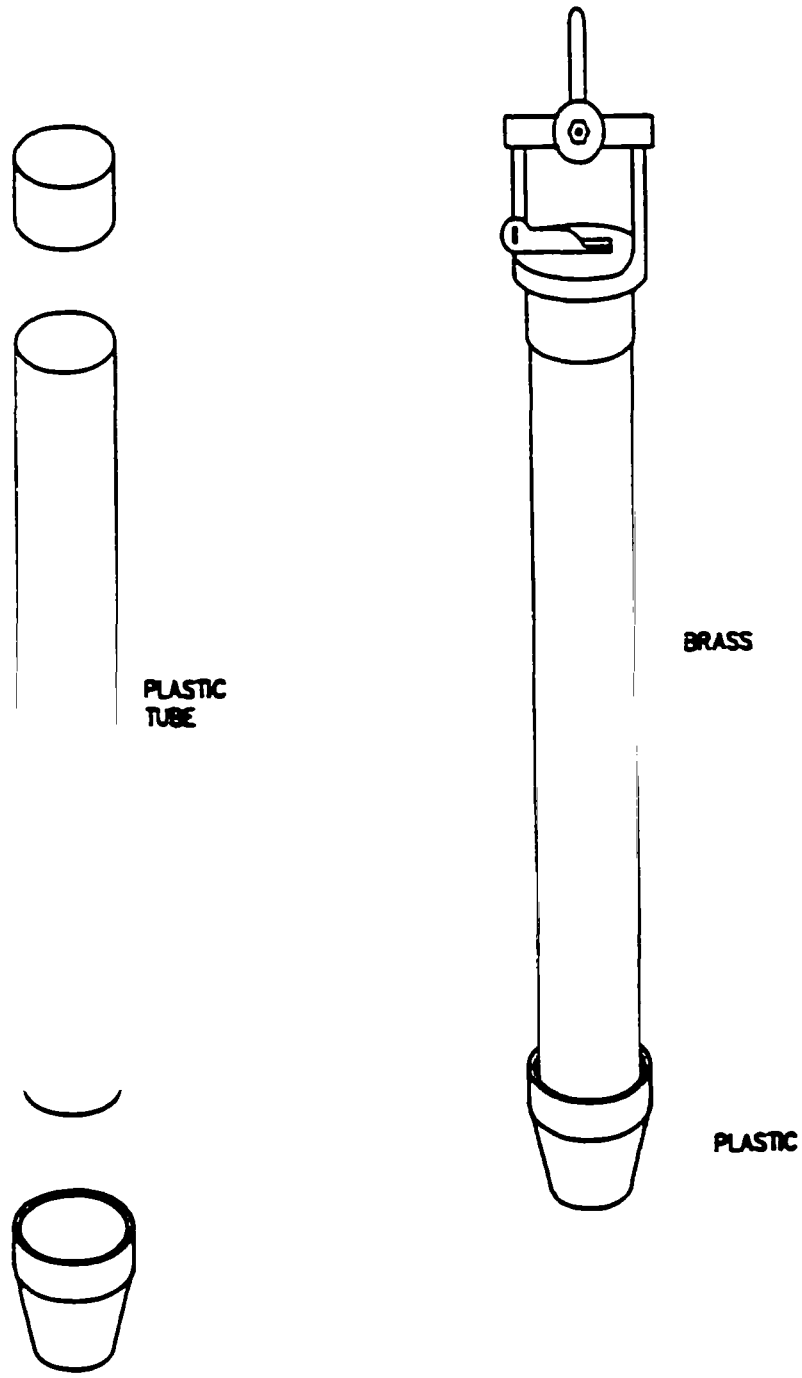


Figure 7: Sample Coring Device



Attachment 2

Chain of Custody

Sample Number(s): _____
Date: _____
Time: _____

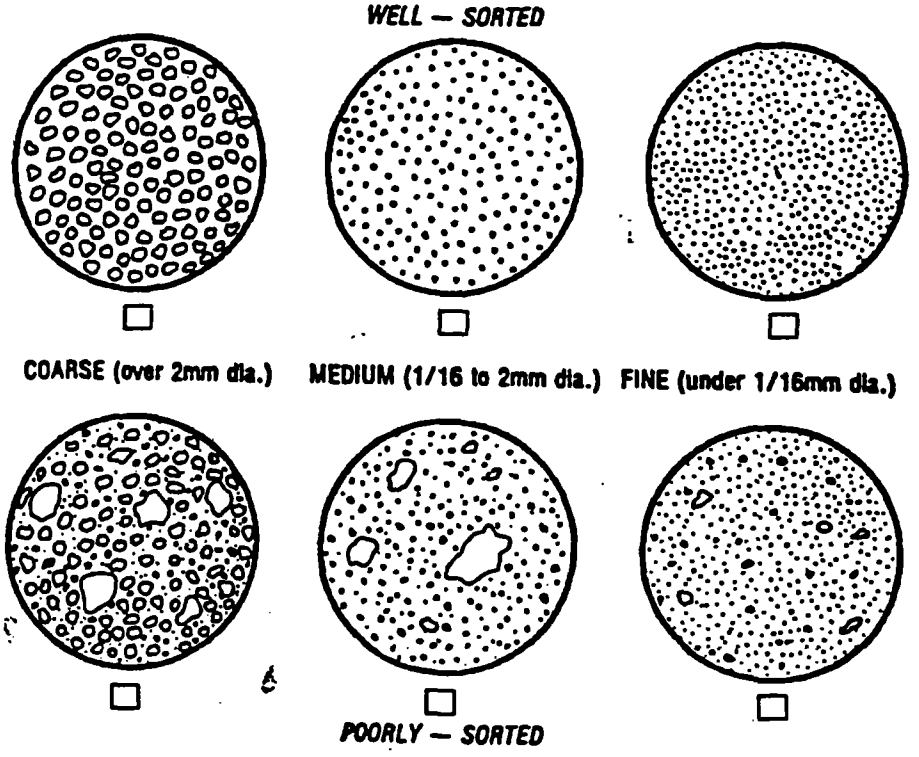
Soil Sampling Data Sheet

Site Name: _____ **Sampler:** _____
Sample Depth: ____ Surface (0-0.5 ft) _____ Shallow (0.5-5.0 ft)
Sample Method(Circle One):_____Scoop (2,3,4,5,6,7,8,A,C,+) ____ Hand Auger(2,3,4,5,6,7,B,+,-)
_____Slide-Hammer (1,2,3,4,5,6,7,8,A,B,+,-) ____ Open Tube (A,+,-)
_____Split/Solid Tube (1,2,3,4,5,6,7,8,A,B,-) ____ Thin-Wall Tube(8,A,-)

Preferred Methods

1 - Volatiles	5 - PCBs	A - Grab	+ - Surface
2 - Semi-Volatiles	6 - TPH	B - Composite (Vertical)	- - Shallow
3 - Primary Metals	7 - Rad	C - composite (Areal)	
4 - Pesticides	8 - Geotechnical		

Soil Description (Munsell): Chart _____ Value _____ Hue _____
Grain Size and Distribution:



SUPERFUND TECHNICAL ASSESSMENT RESPONSE TEAM
STANDARD OPERATING PROCEDURE

SOP 304
SUBSURFACE SOIL SAMPLING

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to provide Roy F. Weston, Inc. (WESTON®), Superfund Technical Assessment Response Team (START) members with a step-by-step guide for collecting representative subsurface soil samples.

2.0 MATERIALS REQUIRED

Equipment requests should be completed and issued to the equipment room at least one week in advance of site operations. *Pre-assemble all sampling equipment that requires assembly prior to departure* (especially split-spoon apparatus).

Equipment for subsurface sampling is as follows:

- Personal protective equipment (as specified in the Health and Safety Plan)
- Sampling plan
- Maps/sketches
- Compass
- Tape measure (up to 300 ft)
- Survey stakes/flags
- Aluminum homogenization trays
- Sample jars
- Logbook
- Sample labels/tags
- Chain of custody forms and custody seals
- Field data sheets
- Coolers
- Ice
- Decontamination supplies (brushes, baskets, garden sprayer, phosphate-free soap, de-ionized water, etc.)
- Ziploc® bags
- Plastic sheeting
- Paper towels
- Ball-point pen
- Permanent marker
- Grease pencil
- Camera with film
- Plastic sample scoops
- Stainless steel trowels
- Plastic garbage bags
- Scissors

- Methanol/hexane/nitric acid
- Screw auger
- Bucket auger
- Post-hole auger
- T-handle
- Extension rods
- Split spoon halves (2 sets) with shoes (2)
- Plastic sample baskets
- Adapter
- Drive head
- Bit(s)
- Extension (optional)
- Slam bar (manual sampling only)
- Slam hammer (manual sampling only)
- Extraction head
- Gas can
- Generator oil
- Generator
- Jackhammer (rental)
- Heavy duty lift-jack
- Wheel barrow
- Ground fault interrupter (GFI)
- 24-inch pipe wrenches (2)
- Manual sledge hammer
- Rubber mallet
- Spray-lubricant (ingredients must not interfere with analysis parameters)
- Shovel/spade
- Roofing nails
- Tool box (vice grips, adjustable wrenches, pliers, channel locks, etc.)
- Back support belt(s)

3.0 SAFETY PRECAUTIONS

Due to unknown constituents of the soil media, the exposure potential for personnel exists and must be of primary concern. Before any soil sampling is performed, a Health and Safety Plan (HASP) must be approved by the Regional Safety Officer.

1. Follow the HASP safety schedule.
2. Determine the appropriate levels of protection to be worn by personnel.
3. Conduct air monitoring in the breathing zones and screen the sample location holes once they are selected.
4. Ensure that equipment is properly decontaminated and is in working condition prior to mobilization to the site.
5. Coordinate efforts and staffing with the client or agency with which you are working.

4.0 SAMPLING PROCEDURES

4.1 Sampling Preparation

1. Perform a general site reconnaissance to verify actual site conditions consistent with the HASP.
2. Identify and mark all sampling locations using sample flags or stakes as specified in the sampling plan. *All sample locations should be measured, documented, and mapped in reference to a permanent marker, i.e. specified utility pole, benchmark, property marker, etc.* Note: It is often convenient (for residential properties, etc.) to hammer roofing nails into wooden stakes which can be driven below the surface; therefore, a hand-held metal detector can be used to find exact sample locations.
3. Make sure all sampling equipment is properly decontaminated prior to sampling.
4. Notify utility companies to check sampling areas for underground utilities prior to digging, boring, or coring operations. Most states require 7-day notice, and have a toil-free number to arrange a single, all-inclusive, free inspection.

4.2 Auger Sampling

1. Wear appropriate personal protective equipment (PPE), as defined by the site Health and Safety Plan (HASP). *Remember that a clean pair of sample gloves must be worn for each sample collected.*
2. Assemble the auger unit, if required.
3. Clear the area to be sampled of any surface debris.
4. Spread plastic sheeting near the sample location to allow for easy accessibility and to prevent equipment contamination.
5. Remove surface soil to expose the desired depth of soil to be sampled using a screw auger, bucket auger, post-hole auger, power auger, shovel, or backhoe. The sampling device (auger, split-spoon, etc.) can be marked with a grease pencil.
6. Stage removed soil on plastic sheeting near the hole. *Special care should be taken to avoid allowing surface soil to cross-contaminate soil at the desired sampling depth.*
7. Use auger extension rods to sample to depths up to approximately 9 feet.
8. Use a *decontaminated* auger to collect sample(s) after digging or boring to the desired sample depth. The best way to retrieve desired soil, while avoiding cross-contamination, is with a bucket auger. Each 6-inch bucket auger will hold approximately 3-4 inches of augered ("fluffed") soil.
9. Decontaminate the augers after each sample-depth is collected. Note: Discarding the top inch of soil from the retrieved sample also reduces cross-contamination.
10. Transfer a portion of the sample directly into an appropriate, labeled sample container(s) with a stainless steel trowel if volatile organic analysis is to be performed.

11. Deposit sample into a homogenization tray for analysis other than volatile organics and thoroughly mix the soils to obtain a homogenous, representative sample.
12. Place homogenized sample into an appropriate, labeled sample container with a plastic scoop or stainless steel trowel, depending on the requested analysis.
13. Record all field notes on field data sheets and in the site logbook as specified in the sampling plan. The sample location should reference a permanent marker, and should be mapped and described in the field notes.
14. Photograph sample locations with landmarks in view. Keep in mind that sample locations may need to be referenced in the future, often years after your sampling event.
15. Abandon the sample hole(s) in accordance with state regulations. Generally, holes can be backfilled with removed soil materials.
16. Decontaminate all sampling equipment in accordance with SOP No. 301 Decontamination Procedures.

4.3 Split Spoon Sampling

1. Wear appropriate personal protective equipment (PPE), as defined by the site HASP. *Remember that a clean pair of sample gloves must be worn for each sample collected.*
2. Assemble cleaned spoon halves by aligning threads, inserting a clean sample basket, and screwing on the shoe.
3. Screw on the appropriate adapter for a slam bar or jackhammer apparatus. For manual sample collection, attach the slam bar to the adapter. For jackhammer-driven sample collection, attach the drive head to the adapter.
4. Clear the area to be sampled of any surface debris.
5. Spread plastic sheeting near the sample location.
6. Remove surface soil to expose the desired depth of soil to be sampled using a screw auger, bucket auger, post-hole auger, power auger, shovel, or backhoe.
7. Stage removed soil on plastic sheeting near the hole. *Special care should be taken to avoid allowing surface soil to cross-contaminate soil at desired sampling depth.*
8. Use a *decontaminated* split-spoon to collect the sample(s) after digging or boring to desired sample depth.
9. For the manual collection of a sample, slide the slam hammer over the slam bar. Slam the hammer repeatedly until the core is driven to desired depth.
10. For jackhammer-facilitated sampling, attach and lock the bit to the jackhammer. Carefully lift the jackhammer, slide the bit into the adapter, and drive the core to the desired depth. One person should support the spoon halves and the adapter during coring operations to insure that the apparatus remains vertical and that individual parts do not come unscrewed.
11. Attach the appropriate extraction head to the in-ground split spoon apparatus.
12. Using a heavy-duty lift-jack, carefully retrieve the sample core. This step usually requires two people: one to hold the jack in a vertical position while the other operates the jack.
13. Lay the core on clean plastic sheeting after the core is retrieved and carefully

unscrew the extraction head and the adapter.

14. Unscrew the shoe, but *make sure the split spoon core does not open.* Often, pipe wrenches are required to unscrew the shoe.
15. Lay out *labeled* homogenization trays alongside the sample core.
16. Open the split spoon and take care not to spill or disturb the sample core.
17. Measure the desired soil depths.
18. Use clean gloves and a clean polyethylene scoop to retrieve each sample. *Do not slide the soil down the spoon to retrieve it.* Instead, use the scoop to carefully lift the sample into a homogenization tray.
19. Transfer a portion of the sample directly into an appropriately labeled sample container(s) with a stainless steel trowel if volatile organic analysis is to be performed.
20. Deposit the sample into a homogenization tray for analysis other than volatile organics, and thoroughly mix the soils to obtain a homogenous, representative sample.
21. Place the homogenized sample into an appropriate, labeled sample container using a plastic scoop or stainless steel trowel, depending on the requested analysis.
22. Record all field notes on field data sheets and the site logbook, as specified in the sampling plan. The sample location should reference a permanent marker, and should be mapped and described in the field notes.
23. Photograph sample locations with landmarks in view. Keep in mind that sample locations may need to be referenced in the future, often years after your sampling event.
24. Abandon the sample hole(s) in accordance with state regulations. Generally, holes can be back filled with removed soil materials.
25. Decontaminate all sampling equipment in accordance with ERT SOP No. 2006
26. Sampling Equipment Decontamination.

5.0 REFERENCES

EPA. 1991. *Compendium of Emergency Response Team (ERT) Waste Sampling Procedures.* Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/P-91/008.

EPA 1991. *Removal Program Representative Sampling Guidance.* Volume 1 - Soil. Office of Solid Waste and Emergency Response, Washington, DC. 9630.4-10 P892-963408.

WESTON® (Roy F. Weston, Inc.) 1993. *Standard Practices Manuel for Soil Sampling With a Spade, Scoop and Stainless Surface Soil Sampler Auger and Tube Sampler.* West Chester, PA.

Attachment: 1

ATTACHMENT 1

SOIL SAMPLING DATA SHEET

Sample Number(s): _____
Date: _____
Time: _____

Soil Sampling Data Sheet

Site Name: _____ **Sampler:** _____
Sample Depth: ____ Surface (0-0.5 ft) _____ Shallow (0.5-5.0 ft)
Sample Method(Circle One):_____Scoop (2,3,4,5,6,7,8,A,C,+) ____ Hand Auger(2,3,4,5,6,7,B,+,-)
_____Slide-Hammer (1,2,3,4,5,6,7,8,A,B,+,-) ____ Open Tube (A,+,-)
_____Split/Solid Tube (1,2,3,4,5,6,7,8,A,B,-) ____ Thin-Wall Tube(8,A,-)

Preferred Methods

1 - Volatiles	5 - PCBs	A - Grab	+ - Surface
2 - Semi-Volatiles	6 - TPH	B - Composite (Vertical)	- - Shallow
3 - Primary Metals	7 - Rad	C - composite (Areal)	
4 - Pesticides	8 - Geotechnical		

Soil Description (Munsell): Chart _____ Value _____ Hue _____
Grain Size and Distribution:

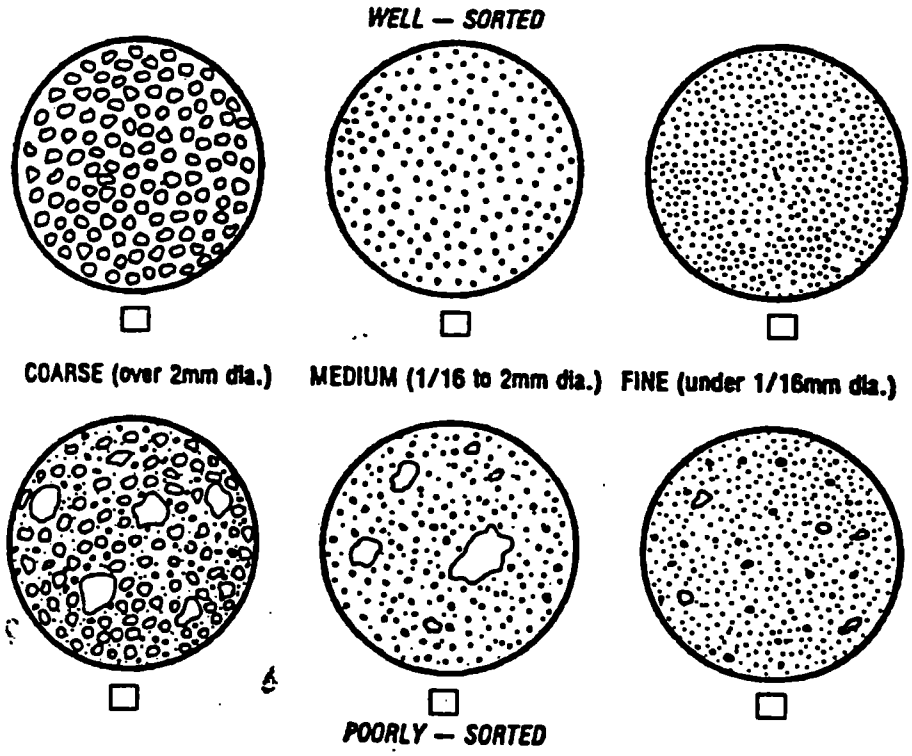


Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _____ **Site** _____ **Well No.** _____ **Date** _____
Well Depth _____ **Screen Length** _____ **Well Diameter** _____ **Casing Type** _____
Sampling Device _____ **Tubing type** _____ **Water Level** _____
Measuring Point _____ **Other Infor** _____

Sampling Personnel _____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Figure 2. Ground Water Sampling Log

Project _____ Site _____ Well No. _____ Date _____

Well Depth _____ Screen Length _____ Well Diameter _____ Casing Type _____

Sampling Device _____ Tubing type _____ Water Level _____

Measuring Point _____ Other infor _____

Sampling Personnel _____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: Vol_{cyl} = $\pi r^2 h$, Vol_{sphere} = $4/3\pi r^3$

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the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give *consistent* results and *minimal* disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. *In this sense, the* pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U.S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over any other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g., pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques, and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (*i.e.*, ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

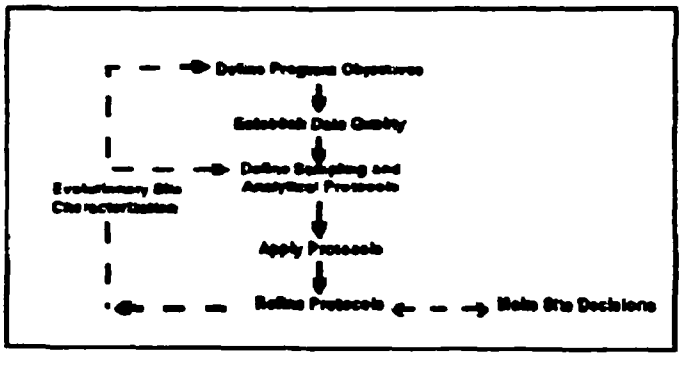

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (*e.g.*, use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

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EPA Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic units. With time it became apparent that conventional water supply generalizations of homogeneity did not adequately represent field data regarding pollution of these subsurface resources. The important role of heterogeneity became increasingly clear not only in geologic terms, but also in terms of complex physical,

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Appendix C

Decontamination SOPs

SUPERFUND TECHNICAL ASSESSMENT RESPONSE TEAM
STANDARD OPERATING PROCEDURES

SOP 301
DECONTAMINATION PROCEDURES

1.0 PURPOSE

To provide guidance for the decontamination of equipment used to sample, and install sample, and install sample points (monitor wells, soil borings and test pits), and make field measurements. This operating practice is not intended to be site specific or equipment specific, but to provide guidance in place of non-existent state or federal guidelines.

2.0 DISCUSSION

2.1 Introduction

The objective of decontamination procedures is to provide clean equipment for the retrieval of representative environmental samples. Decontamination procedures differ depending on the nature of the equipment used. The three categories of decontamination procedures are discussed below:

- Intrusive equipment used to install sample points including drilling (tools, augers, rods, etc.) and excavation equipment (backhoes, excavators, etc.).

- Equipment used to measure the characteristics of the media to be sampled including water level, pH, specific conductivity, and temperature probes. This category also includes pumps to purge water.

- Equipment that has contact with the sample to be submitted for laboratory analysis including bailer, split-spoons, hand auger, stainless steel bowls and scoops.

Because items from the first two categories do not contact the sample media that is sent to a laboratory for analysis, the decontamination procedures are less stringent. Dedicated and disposable equipment will be used whenever feasible to limit decontamination and the possibility of cross-contamination. This includes rope, tubing, filterware and, in some cases, soil scoops and bailers.

3.0 PROCEDURES

3.1 Intrusive Equipment

Drilling tools, including augers, rods, drill bits, hand tools, etc. will be steam cleaned prior to use and after each location. Split spoons will also be steam cleaned if not used for sample collection. Backhoe buckets and arms will also be steam cleaned prior to use and between each sample location.

3.2 Field Measurement Equipment

Water level probes will be cleaned using the following procedures:

- Wipe the probe with a paper towel.
- Alconox and potable water wash.
- Deionized water rinse.

Other measurement equipment should be rinsed with deionized water between readings.

Pumps used for well purging shall be decontaminated using the following procedures:

- Alconox and potable water scrub and pump through.
- Potable water rinse and pump through.

Rope and tubing used with the pump will be made of polyethylene and be dedicated (and disposable) to one sample location.

3.3 Sampling Equipment

Equipment used for sample collection include but are not limited to:

- Teflon bailers
- Stainless steel scoops and bowls
- Hand augers
- Split spoons

This equipment will be cleaned using the following procedures:

- Alconox and potable water scrub.

- Thorough potable water rinse.
- Deionized water rinse.
- 10% nitric acid rinse* (1% solution if used on low carbon steel split spoons).
- Deionized water rinse*.
- Acetone (pesticide grade) rinse**.
- Total air dry**.
- Deionized water rinse**.

* Only if sample is to be analyzed for metals.

** Only if sample is to be analyzed for organics.

Sampling instruments should be wrapped in aluminum foil after decontamination to keep clean before sampling.

4.0 DOCUMENTATION

Decontamination efforts should be documented in the field logbook. Decontamination fluids should be disposed of properly. Depending on site conditions, it may be appropriate to contain spent decontamination fluids. In that case, the appropriate vessel (i.e., drum) should be used depending on the ultimate disposition of the material.

5.0 INTERPRETATION

If there are questions on the interpretation or applicability of items in this operating practice, the Project Manager or Technical Manager should be consulted. In the absence of either of those, contact a Section Manager.

6.0 REFERENCES

New Jersey Department of Environmental Protection and energy Field Sampling Procedures Manual, May 1992.

"Standard Practice for Decontamination of Field Equipment Used at Non-radioactive Waste Sites", ASTM Designation D5088-90.

Appendix D

Analytical Decision Criteria

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION												CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils		CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
8.7E-03	i	4.0E-03	i	8.7E-03	i	4.0E-03	r	0			30560-19-1	Acephate	5.6E+01	ca**	2.8E+02	ca*	7.7E-01	ca*	7.7E+00	ca*		
				7.7E-03	i	2.6E-03	i	1			75-07-0	Acetaldehyde	1.1E+01	ca**	2.3E+01	ca**	8.7E-01	ca*	1.7E+00	ca		
		2.0E-02	i			2.0E-02	r	0		0.1	34256-82-1	Acetochlor	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i			1.0E-01	r	1			67-64-1	Acetone	1.6E+03	nc	6.2E+03	nc	3.7E+02	nc	6.1E+02	nc	1.6E+01	8.0E-01
		8.0E-04	h			8.0E-04	r	0		0.1	75-86-5	Acetone cyanohydrin	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		
		6.0E-03	x			1.7E-02	r	1			75-05-8	Acetonitrile	2.7E+02	nc	1.7E+03	nc	6.2E+01	nc	7.9E+01	nc		
		1.0E-01	i			5.7E-06	x	1			98-86-2	Acetophenone	4.9E-01	nc	1.6E+00	nc	2.1E-02	nc	4.2E-02	nc		
1.1E-01	o	1.3E-02	i	1.1E-01	i	1.3E-02	r	0		0.1	50594-66-6	Acifluorfen	4.4E+00	ca	2.2E+01	ca	6.1E-02	ca	6.1E-01	ca		
		2.0E-02	h			5.7E-06	r	1			107-02-8	Acrolein	1.0E-01	nc	3.4E-01	nc	2.1E-02	nc	4.2E-02	nc		
4.5E+00	i	2.0E-04	i	4.6E+00	i	2.0E-04	r	0		0.1	79-06-1	Acrylamide	1.1E-01	ca	5.4E-01	ca	1.5E-03	ca	1.5E-02	ca		
		5.0E-01	i			2.9E-04	r	0		0.1	79-10-7	Acrylic acid	2.9E+04	nc	1.0E+05	max	1.0E+00	nc	1.8E+04	nc		
5.4E-01	i	1.0E-03	h	2.4E-01	i	5.7E-04	r	1			107-13-1	Acrylonitrile	2.1E-01	ca*	5.1E-01	ca*	2.8E-02	ca*	3.9E-02	ca*		
8.1E-02	h	1.0E-02	i	8.0E-02	i	1.0E-02	r	0		0.1	15972-60-8	Alachlor	6.0E+00	ca	3.1E+01	ca	8.4E-02	ca	8.4E-01	ca		
		1.5E-01	i			1.5E-01	r	0		0.1	1596-84-5	Alar	9.2E+03	nc	1.0E+05	max	5.5E+02	nc	5.5E+03	nc		
		1.0E-03	i			1.0E-03	r	0		0.1	116-06-3	Aldicarb	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E-03	i			1.0E-03	r	0		0.1	1646-88-4	Aldicarb sulfone	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
1.7E+01	i	3.0E-05	i	1.7E+01	i	3.0E-05	r	0		0.1	309-00-2	Aldrin	2.9E-02	ca*	1.5E-01	ca	3.9E-04	ca	4.0E-03	ca	5.0E-01	2.0E-02
		2.5E-01	i			2.5E-01	r	0		0.1	5585-64-8	Ally	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		5.0E-03	i			5.0E-03	r	0		0.1	107-18-6	Allyl alcohol	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		5.0E-02	x			2.9E-04	r	0		0.1	107-05-1	Allyl chloride	3.0E+03	nc	4.3E+04	nc	1.0E+00	nc	1.8E+03	nc		
		1.0E+00	n			1.4E-03	n	0			7429-90-5	Aluminum	7.6E+04	nc	1.0E+05	max	5.1E+00	nc	3.6E+04	nc		
		4.0E-04	i					0			20859-73-8	Aluminum phosphide	3.1E+01	nc	8.2E+02	nc			1.5E+0[illegible]	nc		
		3.0E-04	i			3.0E-04	r	0		0.1	67485-29-4	Amdro	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+0[illegible]	nc		
		9.0E-03	i			9.0E-03	r	0		0.1	834-12-8	Ametryn	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+0[illegible]	nc		
		7.0E-02	h			7.0E-02	r	0		0.1	591-27-5	m-Aminophenol	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+0[illegible]	nc		
		2.0E-05	h			2.0E-05	r	0		0.1	504-24-5	4-Aminopyridine	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-0[illegible]	nc		
		2.5E-03	i			2.5E-03	r	0		0.1	33089-61-1	Amitraz	1.5E+02	nc	2.2E+03	nc	9.1E+00	nc	9.1E+0[illegible]	nc		
						2.9E-02	i				7664-41-7	Ammonia					1.0E+02	nc				
		2.0E-01	i					0		0.1	7773-06-0	Ammonium sulfamate	1.2E+04	nc	1.0E+05	max			7.3E+03	nc		
5.7E-03	i	7.0E-03	n	5.7E-03	i	2.9E-04	i	0		0.1	62-53-3	Aniline	8.5E+01	ca**	4.3E+02	ca*	1.0E+00	nc	1.2E+01	ca*		
		4.0E-04	i					0			7440-36-0	Antimony and compounds	3.1E+01	nc	8.2E+02	nc			1.5E+01	nc	5.0E+00	3.0E-01
		5.0E-04	h					0			1314-60-9	Antimony pentoxide	3.9E+01	nc	1.0E+03	nc			1.8E+01	nc		
		9.0E-04	h					0			28300-74-5	Antimony potassium tartrate	7.0E+01	nc	1.8E+03	nc			3.3E+01	nc		
		4.0E-04	h					0			1332-81-6	Antimony tetroxide	3.1E+01	nc	8.2E+02	nc			1.5E+01	nc		
		4.0E-04	h			5.7E-05	i	0			1309-64-4	Antimony trioxide	3.1E+01	nc	8.2E+02	nc	2.1E-01	nc	1.5E+01	nc		
		1.3E-02	i			1.3E-02	r	0		0.1	74115-24-5	Apollo	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
2.5E-02	i	5.0E-02	h	2.5E-02	i	5.0E-02	r	0		0.1	140-57-8	Aramite	1.9E+01	ca	9.9E+01	ca	2.7E-01	ca	2.7E+00	ca		
		3.0E-04	i					0		0.03	7440-38-2	Arsenic (noncancer endpoint)	2.2E+01	nc	4.4E+02	nc						
1.5E+00	i	3.0E-04	i	1.5E+01	i			0		0.03	7440-38-2	Arsenic (cancer endpoint)	3.9E-01	ca*	2.7E+00	ca	4.5E-04	ca	4.5E-02	ca	2.9E+01	1.0E+00
						1.4E-05	i	0			7784-42-1	Arsine (see arsenic for cancer endpoint)					5.2E-02	nc				
		9.0E-03	i			9.0E-03	r			0.1	76578-12-6	Assure	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc		
		5.0E-02	i			5.0E-02	r	0		0.1	3337-71-1	Asulam	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
2.2E-01	h	3.5E-02	h	2.2E-01	i	3.5E-02	r	0		0.1	1912-24-9	Atrazine	2.2E+00	ca	1.1E+01	ca	3.1E-02	ca	3.0E-01	ca		
		4.0E-04	i			4.0E-04	r	0		0.1	71751-41-2	Avermectin B1	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
1.1E-01	i			1.1E-01	i			0		0.1	103-33-3	Azobenzene	4.4E+00	ca	2.2E+01	ca	6.2E-02	ca	6.1E-01	ca		
		7.0E-02	i			1.4E-04	h	0			7440-39-3	Barium and compounds	5.4E+03	nc	1.0E+05	max	5.2E-01	nc	2.6E+03	nc	1.6E+03	8.2E+01
		4.0E-03	i			4.0E-03	r	0		0.1	114-26-1	Baygon	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		3.0E-02	i			3.0E-02	r	0		0.1	43121-43-3	Bayleton	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0		0.1	68359-37-5	Baythroid	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		3.0E-01	i			3.0E-01	r	0		0.1	1861-40-1	Benefin	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		5.0E-02	i			5.0E-02	r	0		0.1	17804-35-2	Benomyl	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		3.0E-02	i			3.0E-02	r	0		0.1	25057-89-0	Bentazon	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		1.0E-01	i			1.0E-01	r	0		0.1	100-52-7	Benzaldehyde	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
5.5E-02	i	3.0E-03	n	2.7E-02	i	1.7E-03	n	1			71-43-2	**Benzene**	6.5E-01	ca*	1.5E+00	ca*	2.5E-01	ca*	3.5E-01	ca*	3.0E-02	2.0E-03

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION									CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
2.3E+02	i	3.0E-03	i	2.3E+02	i	3.0E-03	r	0	0.1	92-87-5	Benzidine	2.1E-03	ca	1.1E-02	ca	2.9E-05	ca	2.9E-04	ca		
		4.0E+00	i			4.0E+00	r	0	0.1	65-85-0	Benzoic acid	1.0E+05	max	1.0E+05	max	1.5E+04	nc	1.5E+05	nc	4.0E+02	2.0E+01
1.3E+01	i			1.3E+01	r			0	0.1	98-07-7	Benzotrichloride	3.7E-02	ca	1.9E-01	ca	5.2E-04	ca	5.2E-03	ca		
		3.0E-01	h			3.0E-01	r	0	0.1	100-51-6	Benzyl alcohol	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
1.7E-01	i			1.7E-01	i			1		100-44-7	Benzyl chloride	8.9E-01	ca	2.3E+00	ca	4.0E-02	ca	6.6E-02	ca		
		2.0E-03	i	8.4E+00	i	5.7E-06	i	0		7440-41-7	Beryllium and compounds	1.5E+02	nc	2.2E+03	ca**	8.0E-04	ca*	7.3E+01	nc	6.3E+01	3.0E+00
		1.0E-04	i			1.0E-04	r	0	0.1	141-66-2	Bidrin	6.1E+00	nc	8.8E+01	nc	3.7E-01	nc	3.6E+00	nc		
		1.5E-02	i			1.5E-02	r	0	0.1	82657-04-3	Biphenthrin (Talstar)	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		5.0E-02	i			5.0E-02	r	1		92-52-4	1,1-Biphenyl	3.5E+02	sat	3.5E+02	sat	1.8E+02	nc	3.0E+02	nc		
1.1E+00	i			1.2E+00	i			1		111-44-4	Bis(2-chloroethyl)ether	2.1E-01	ca	6.2E-01	ca	5.8E-03	ca	9.8E-03	ca	4.0E-04	2.0E-05
7.0E-02	h	4.0E-02	i	3.5E-02	h	4.0E-02	r	1		108-60-1	Bis(2-chloroisopropyl)ether	2.9E+00	ca	8.1E+00	ca	1.9E-01	ca	2.7E-01	ca		
2.2E+02	i			2.2E+02	i			1		542-88-1	Bis(chloromethyl)ether	1.9E-04	ca	4.4E-04	ca	3.1E-05	ca	5.2E-05	ca		
7.0E-02	h	4.0E-02	i	3.5E-02	h	4.0E-02	r	1		108-60-1	Bis(2-chloro-1-methylethyl)ether	2.9E+00	ca	8.1E+00	ca	1.9E-01	ca	2.7E-01	ca		
1.4E-02	i	2.0E-02	i	1.4E-02	r	2.2E-02	r	0	0.1	117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	3.5E+01	ca*	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		5.0E-02	i			5.0E-02	r	0	0.1	80-05-7	Bisphenol A	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		9.0E-02	i			5.7E-03	h	0	0.1	7440-42-8	Boron	5.5E+03	nc	7.9E+04	nc	2.1E+01	nc	3.3E+03	nc		
						2.0E-04	h	0	0.1	7637-07-2	Boron trifluoride					7.3E-01	nc				
		2.0E-02	n			2.9E-03	n	1		108-86-1	Bromobenzene	2.8E+01	nc	9.2E+01	nc	1.0E+01	nc	2.0E+01	nc		
6.2E-02	i	2.0E-02	i	6.2E-02	i	2.0E-02	r	1		75-27-4	Bromodichloromethane	1.0E+00	ca	2.4E+00	ca	1.1E-01	ca	1.8E-01	ca	6.0E-01	3.0E-02
7.9E-03	i	2.0E-02	i	3.9E-03	i	2.0E-02	r	0	0.1	75-25-2	Bromoform (tribromomethane)	6.2E+01	ca*	3.1E+02	ca*	1.7E+00	ca*	8.5E+00	ca*	8.0E-01	4.0E-02
		1.4E-03	i			1.4E-03	i	1		74-83-9	Bromomethane (Methyl bromide)	3.9E+00	nc	1.3E+01	nc	5.2E+00	nc	8.7E+00	nc	2.0E-01	1.0E-02
								0	0.1	101-55-3	4-Bromophenyl phenyl ether										
		5.0E-03	h			5.0E-03	r	0	0.1	2104-96-3	Bromophos	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	1689-84-5	Bromoxynil	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	1689-99-2	Bromoxynil octanoate	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
1.8E+00	r			1.8E+00	i			1		106-99-0	1,3-Butadiene	3.5E-03	ca	7.6E-03	ca	3.7E-03	ca	6.2E-03	ca		
		1.0E-01	i			1.0E-01	r	0	0.1	71-36-3	1-Butanol	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	1.7E+01	9.0E-01
		5.0E-02	i			5.0E-02	r	0	0.1	2008-41-5	Butylate	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		1.0E-02	n			1.0E-02	r	1		104-51-8	n-Butylbenzene	1.4E+02	nc	2.4E+02	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	n			1.0E-02	r	1		135-98-8	sec-Butylbenzene	1.1E+02	nc	2.2E+02	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	n			1.0E-02	r	1		98-06-6	tert-Butylbenzene	1.3E+02	nc	3.9E+02	sat	3.7E+01	nc	6.1E+01	nc		
		2.0E-01	i			2.0E-01	r	0	0.1	85-68-7	Butyl benzyl phthalate	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc	9.3E+02	8.1E+02
		1.0E+00	i			1.0E+00	r	0	0.1	85-70-1	Butylphthalyl butylglycolate	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		3.0E-03	h			3.0E-03	r	0	0.1	75-60-5	Cacodylic acid	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		5.0E-04	i	6.3E+00	i			0	0.001	7440-43-9	Cadmium and compounds	3.7E+01	nc	8.1E+02	nc	1.1E-03	ca	1.8E+01	nc	8.0E+00	4.0E-01
											"CAL-Modified PRG" (PEA, 1994)	9.0E+00									
		5.0E-01	i			5.0E-01	r	0	0.1	105-60-2	Caprolactam	3.1E+04	nc	1.0E+05	max	1.8E+03	nc	1.8E+04	nc		
8.6E-03	h	2.0E-03	i	8.6E-03	r	2.0E-03	r	0	0.1	2425-06-1	Captafol	5.7E+01	ca**	2.9E+02	ca**	7.8E-01	ca**	7.8E+00	ca**		
3.5E-03	h	1.3E-01	i	3.5E-03	r	1.3E-01	r	0	0.1	133-06-2	Captan	1.4E+02	ca*	7.0E+02	ca	1.9E+00	ca	1.9E+01	ca		
		1.0E-01	i			1.1E-01	r	0	0.1	63-25-2	Carbaryl	6.1E+03	nc	8.8E+04	nc	4.0E+02	nc	3.6E+03	nc		
2.0E-02	h			2.0E-02	r			0	0.1	86-74-8	Carbazole	2.4E+01	ca	1.2E+02	ca	3.4E-01	ca	3.4E+00	ca	6.0E-01	3.0E-02
		5.0E-03	i			5.0E-03	r	0	0.1	1563-66-2	Carbofuran	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		1.0E-01	i			2.0E-01	i	1		75-15-0	Carbon disulfide	3.6E+02	nc	7.2E+02	sat	7.3E+02	nc	1.0E+03	nc	3.2E+01	2.0E+00
1.3E-01	i	7.0E-04	i	5.3E-02	i	7.0E-04	r	1		56-23-5	Carbon tetrachloride	2.4E-01	ca**	5.3E-01	ca*	1.3E-01	ca*	1.7E-01	ca*	7.0E-02	3.0E-03
		1.0E-02	i			1.0E-02	r	0	0.1	55285-14-8	Carbosulfan	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		1.0E-01	i			1.0E-01	r	0	0.1	5234-68-4	Carboxin	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		1.5E-02	i			1.5E-02	r	0	0.1	133-90-4	Chloramben	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
4.0E-01	h			4.0E-01	r			0	0.1	118-75-2	Chloranil	1.2E+00	ca	6.1E+00	ca	1.7E-02	ca	1.7E-01	ca		
3.5E-01	i	5.0E-04	i	3.5E-01	i	2.0E-04	i	0	0.04	12789-03-6	Chlordane	1.6E+00	ca*	1.1E+01	ca*	1.9E-02	ca*	1.9E-01	ca*	1.0E+01	5.0E-01
		2.0E-02	i			2.0E-02	r	0	0.1	90982-32-4	Chlorimuron-ethyl	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i			5.7E-05	n			7782-50-5	Chlorine					2.1E-01	nc				
						5.7E-05	i			10049-04-4	Chlorine dioxide					2.1E-01	nc				
								1		107-20-0	Chloroacetaldehyde										
		2.0E-03	h			2.0E-03	r	0	0.1	79-11-8	Chloroacetic acid	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		

Key: i=IRIS, h=HEAST, n=NCEA, w=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *where nc > 100X ca, **where nc > 10X ca

FOR PLANNING PURPOSES

TOXICITY INFORMATION											CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		8.6E-06	r			8.6E-06	r	1		532-27-4	2-Chloroacetophenone	3.3E-02	nc	1.1E-01	nc	3.1E-02	nc	5.2E-02	nc		
		4.0E-03	i			4.0E-03	r	0	0.1	106-47-8	4-Chloroaniline	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc	7.0E-01	3.0E-02
		2.0E-02	i			1.7E-02	n	1		108-90-7	Chlorobenzene	1.5E+02	nc	5.4E+02	nc	6.2E+01	nc	1.1E+02	nc	1.0E+00	7.0E-02
2.7E-01	h	2.0E-02	i	2.7E-01	h	2.0E-02	r	0	0.1	510-15-6	Chlorobenzilate	1.8E+00	ca	9.1E+00	ca	2.5E-02	ca	2.5E-01	ca		
		2.0E-01	h			2.0E-01	r	0	0.1	74-11-3	p-Chlorobenzoic acid	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		2.0E-02	h			2.0E-02	r	0	0.1	98-56-6	4-Chlorobenzotrifluoride	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-02	h			2.0E-03	h	1		126-99-8	2-Chloro-1,3-butadiene	3.6E+00	nc	1.2E+01	nc	7.3E+00	nc	1.4E+01	nc		
		4.0E-01	h			4.0E-01	r	1		109-69-3	1-Chlorobutane	4.8E+02	sat	4.8E+02	sat	1.5E+03	nc	2.4E+01	nc		
		1.4E+01	r			1.4E+01	i	1		75-68-3	1-Chloro-1,1-difluoroethane (HCFC-142b)	3.4E+02	sat	3.4E+02	sat	5.2E+04	nc	8.7E+04	nc		
		1.4E+01	r			1.4E+01	i	1		75-45-6	Chlorodifluoromethane	3.4E+02	sat	3.4E+02	sat	5.1E+04	nc	8.5E+04	nc		
2.9E-03	n	4.0E-01	n	2.9E-03	r	2.9E+00	i	1		75-00-3	Chloroethane	3.0E+00	ca	6.5E+00	ca	2.3E+00	ca	4.6E+00	ca		
								1		110-75-8	2-Chloroethyl vinyl ether										
6.1E-03	i	1.0E-02	i	8.1E-02	i	8.6E-05	n	1		67-66-3	Chloroform	2.4E-01	ca**	5.2E-01	ca**	8.4E-02	ca**	1.6E-01	ca**	6.0E-01	3.0E-02
1.3E-02	h			6.3E-03	h	8.6E-02	n	1		74-87-3	Chloromethane	1.2E+00	ca	2.7E+00	ca	1.1E+00	ca	1.5E+00	ca		
5.8E-01	h			5.8E-01	r			0	0.1	95-69-2	4-Chloro-2-methylaniline	8.4E-01	ca	4.3E+00	ca	1.2E-02	ca	1.2E-01	ca		
4.6E-01	h			4.6E-01	r			0	0.1	3165-93-3	4-Chloro-2-methylaniline hydrochloride	1.1E+00	ca	5.4E+00	ca	1.5E-02	ca	1.5E-01	ca		
		8.0E-02	i			8.0E-02	r	1		91-58-7	beta-Chloronaphthalene	3.9E+03	nc	2.7E+04	nc	2.9E+02	nc	4.9E+02	nc		
2.5E-02	h			2.5E-02	r		r	1		88-73-3	o-Chloronitrobenzene	8.1E+00	ca	2.3E+01	ca	2.7E-01	ca	4.5E-01	ca		
1.8E-02	h			1.8E-02	r		r	1		100-00-5	p-Chloronitrobenzene	1.1E+01	ca	3.2E+01	ca	3.7E-01	ca	6.2E-01	ca		
		5.0E-03	i			5.0E-03	r	1		95-57-8	2-Chlorophenol	6.3E+01	nc	2.4E+02	nc	1.8E+01	nc	3.0E+01	nc	4.0E+00	2.0E-01
		2.9E-02	r			2.9E-02	h	1		75-29-6	2-Chloropropane	1.7E+02	nc	5.9E+02	nc	1.0E+02	nc	1.7E+02	nc		
1.1E-02	h	1.5E-02	i	1.1E-02	r	1.5E-02	r	0	0.1	1897-45-6	Chlorothalonil	4.4E+01	ca*	2.2E+02	ca*	6.1E-01	ca*	6.1E+00	ca*		
		2.0E-02	i			2.0E-02	r	1		95-49-8	o-Chlorotoluene	1.6E+02	nc	5.7E+02	nc	7.3E+01	nc	1.2E+02	nc		
		2.0E-01	i			2.0E-01	i	0	0.1	101-21-3	Chlorpropham	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		3.0E-03	i			3.0E-03	i	0	0.1	2921-88-2	Chlorpyrifos	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		1.0E-02	h			1.0E-02	r	0	0.1	5598-13-0	Chlorpyrifos-methyl	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		5.0E-02	i			5.0E-02	r	0	0.1	64902-72-3	Chlorsulfuron	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		8.0E-04	h			8.0E-04	r	0	0.1	60238-56-4	Chlorthiophos	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		
				4.2E+01	i			0			Total Chromium (1.6 ratio Cr VI:Cr III)	2.1E+02	ca	4.5E+02	ca	1.6E-04	ca			3.8E+01	2.0E+00
		1.5E+00	i							16065-83-1	Chromium III	1.0E+05	max	1.0E+05	max	0.0E+00		5.5E+04	nc		
		3.0E-03	i	2.9E+02	i			0		18540-29-9	Chromium VI	3.0E+01	ca**	6.4E+01	ca	2.3E-05	ca	1.1E+02	nc	3.8E+01	2.0E+00
											"CAL-Modified PRG" (PEA, 1994)	2.0E-01						1.6E-01			
		6.0E-02	n							7440-48-4	Cobalt	4.7E+03	nc	1.0E+05	max			2.2E+03	nc		
				2.2E+00	i			0		8007-45-2	Coke Oven Emissions					3.1E-03	ca				
		3.7E-02	h					0		7440-50-8	Copper and compounds	2.9E+03	nc	7.6E+04	nc			1.4E+03	nc		
1.9E+00	h			1.9E+00	r			1		123-73-9	Crotonaldehyde	5.3E-03	ca	1.1E-02	ca	3.5E-03	ca	5.9E-03	ca		
		1.0E-01	i			1.1E-01	i	1		98-82-8	Cumene (isopropylbenzene)	1.6E+02	nc	5.2E+02	nc	4.0E+02	nc	6.6E+02	nc		
8.4E-01	h	2.0E-03	h	8.4E-01	i	2.0E-03	i	0	0.1	21725-46-2	Cyanazine	5.8E-01	ca	2.9E+00	ca	8.0E-03	ca	8.0E-02	ca		
		2.0E-02	i			8.6E-04	i	1		74-90-8	Cyanide and compounds	1.1E+01	nc	3.5E+01	nc	3.1E+00	nc	6.2E+00	nc		
		4.0E-02	i			4.0E-02	r	1		460-19-5	Cyanogen	1.3E+02	nc	4.3E+02	nc	1.5E+02	nc	2.4E+02	nc		
		9.0E-02	i			9.0E-02	r	1		506-68-3	Cyanogen bromide	2.9E+02	nc	9.7E+02	nc	3.3E+02	nc	5.5E+02	nc		
		5.0E-02	i			5.0E-02	r	1		506-77-4	Cyanogen chloride	1.6E+02	nc	5.4E+02	nc	1.8E+02	nc	3.0E+02	nc		
		5.7E+00	r			5.7E+00	n	1		110-82-7	Cyclohexane	1.4E+02	sat	1.4E+02	sat	2.1E+04	nc	3.5E+04	nc		
		5.0E+00	i			5.0E+00	r	0	0.1	108-94-1	Cyclohexanone	1.0E+05	max	1.0E+05	max	1.8E+04	nc	1.8E+05	nc		
		2.0E-01	i			2.0E-01	r	0	0.1	108-91-8	Cyclohexylamine	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		5.0E-03	i			5.0E-03	r	0	0.1	68085-85-8	Cyhalothrin/Karate	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	52315-07-8	Cypermethrin	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		7.5E-03	i			7.5E-03	r	0	0.1	66215-27-8	Cyromazine	4.6E+02	nc	6.6E+03	nc	2.7E+01	nc	2.7E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	1861-32-1	Dacthal	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		3.0E-02	i			3.0E-02	r	0	0.1	75-99-0	Dalapon	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0	0.1	39515-41-8	Danitol	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
2.4E-01	i			2.4E-01	r			0	0.03	72-54-8	DDD	2.4E+00	ca	1.7E+01	ca	2.8E-02	ca	2.8E-01	ca	1.6E+01	8.0E-01
3.4E-01	i			3.4E-01	r			0	0.03	72-55-9	DDE	1.7E+00	ca	1.2E+01	ca	2.0E-02	ca	2.0E-01	ca	5.4E+01	3.0E+00
3.4E-01	i	5.0E-04	i	3.4E-01	i	5.0E-04	r	0	0.03	50-29-3	DDT	1.7E+00	ca*	1.2E+01	ca*	2.0E-02	ca*	2.0E-01	ca*	3.2E+01	2.0E+00

Key: IRIS = i; HEAST = h; NCEA = n; WITHDRAWN = x; Other EPA DOCUMENTS = r; ROUTE EXTRAPOLATION = e; CANCER PRG = ca; NONCANCER PRG = nc; SAT = SOIL SATURATION = sat; CEILING LIMIT = max; *(where nc < 100X ca); **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																			Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.	Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
		1.0E-02	i			1.0E-02	r	0	0.1	1163-19-5	Decabromodiphenyl ether	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		4.0E-05	i			4.0E-05	r	0	0.1	8065-48-3	Demeton	2.4E+00	nc	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc		
6.1E-02	h			6.1E-02	r			0	0.1	2303-16-4	Diallate	8.0E+00	ca	4.0E+01	ca	1.1E-01	ca	1.1E+00	ca		
		9.0E-04	h			9.0E-04	r	0	0.1	333-41-5	Diazinon	5.5E+01	nc	7.9E+02	nc	3.3E+00	nc	3.3E+01	nc		
		4.0E-03	n			4.0E-03	r	1		132-64-9	Dibenzofuran	2.9E+02	nc	5.1E+03	nc	1.5E+01	nc	2.4E+01	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	106-37-6	1,4-Dibromobenzene	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
8.4E-02	i	2.0E-02	i	8.4E-02	r	2.0E-02	r	1		124-48-1	Dibromochloromethane	1.1E+00	ca	2.7E+00	ca	8.0E-02	ca	1.3E-01	ca	4.0E-01	2.0E-02
1.4E+00	h	5.7E-05	r	2.4E-03	h	5.7E-05	i	1		96-12-8	1,2-Dibromo-3-chloropropane	4.5E-01	ca**	4.0E+00	ca**	2.1E-01	nc	4.8E-02	ca**		
											"CAL-Modified PRG" (PEA, 1994)	6.0E-02				9.6E-04		4.7E-03			
8.5E+01	i	5.7E-05	r	7.7E-01	i	5.7E-05	h	1		106-93-4	1,2-Dibromoethane	6.9E-03	ca	4.8E-02	ca*	8.7E-03	ca*	7.6E-01	ca		
		1.0E-01	i			1.0E-01	r	0	0.1	84-74-2	Dibutyl phthalate	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	2.3E+03	2.7E+02
		3.0E-02	i			3.0E-02	r	0	0.1	1918-00-9	Dicamba		nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		9.0E-02	i			5.7E-02	h	1		95-50-1	1,2-Dichlorobenzene	3.7E+02	sat	3.7E+02	sat	2.1E+02	nc	3.7E+02	nc	1.7E+01	9.0E-01
		9.0E-04	n			9.0E-04	r	1		541-73-1	1,3-Dichlorobenzene	1.3E+01	nc	5.2E+01	nc	3.3E+00	nc	5.5E+00	nc		
2.4E-02	h	3.0E-02	n	2.2E-02	n	2.3E-01	i	1		106-46-7	1,4-Dichlorobenzene	3.4E+00	ca	8.1E+00	ca	3.1E-01	ca	5.0E-01	ca	2.0E+00	1.0E-01
4.5E-01	i			4.5E-01	r			0	0.1	91-94-1	3,3-Dichlorobenzidine	1.1E+00	ca	5.5E+00	ca	1.5E-02	ca	1.5E-01	ca	7.0E-03	3.0E-04
		3.0E-02	n			3.0E-02	r		0.1	90-98-2	**4,4'-Dichlorobenzophenone**	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
9.3E+00	r			9.3E+00	h			1		764-41-0	1,4-Dichloro-2-butene	7.9E-03	ca	1.8E-02	ca	7.2E-04	ca	1.2E-03	ca		
		2.0E-01	i			5.7E-02	h	1		75-71-8	Dichlorodifluoromethane	9.4E+01	nc	3.1E+02	nc	2.1E+02	nc	3.9E+02	nc		
		1.0E-01	h			1.4E-01	h	1		75-34-3	1,1-Dichloroethane	5.9E+02	nc	2.1E+03	nc	5.2E+02	nc	8.1E+02	nc	2.3E+01	1.0E+00
5.7E-03				5.7E-03				1			**"CAL-Modified PRG"**	3.3E+00	ca	7.1E+00	ca	1.2E+00	ca	2.0E+00	ca		
9.1E-02	i	3.0E-02	n	9.1E-02	i	1.4E-03	n	1		107-06-2	1,2-Dichloroethane (EDC)	3.5E-01	ca*	7.6E-01	ca*	7.4E-02	ca*	1.2E-01	ca*	2.0E-02	1.0E-03
6.0E-01	i	9.0E-03	i	1.8E-01	i	9.0E-03	r	1		75-35-4	1,1-Dichloroethylene	5.4E-02	ca	1.2E-01	ca	3.8E-02	ca	4.6E-02	ca	6.0E-02	3.0E-03
		1.0E-02	h			1.0E-02	r	1		156-59-2	1,2-Dichloroethylene (cis)	4.3E+01	nc	1.5E+02	nc	3.7E+01	nc	6.1E+01	nc	4.0E-01	2.0E-02
		2.0E-02	i			2.0E-02	r	1		156-60-5	1,2-Dichloroethylene (trans)	6.3E+01	nc	2.1E+02	nc	7.3E+01	nc	1.2E+02	nc	7.0E-01	3.0E-02
		3.0E-03	i			3.0E-03	r	0	0.1	120-83-2	2,4-Dichlorophenol	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc	1.0E+00	5.0E-02
		8.0E-03	i			8.0E-03	r	0	0.1	94-82-6	4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.05	94-75-7	2,4-Dichlorophenoxyacetic Acid (2,4-D)	6.9E+02	nc	1.2E+04	nc	3.7E+01	nc	3.6E+02	nc		
6.8E-02	h	1.1E-03	r	6.8E-02	r	1.1E-03	i	1		78-87-5	1,2-Dichloropropane	3.5E-01	ca*	7.7E-01	ca*	9.9E-02	ca*	1.6E-01	ca*	3.0E-02	1.0E-03
1.0E-01	i	3.0E-02	i	1.4E-02	i	5.7E-03	i	1		542-75-6	**1,3-Dichloropropene**	7.0E-01	ca	1.6E+00	ca	4.8E-01	ca	4.0E-01	ca	4.0E-03	2.0E-04
		3.0E-03	i			3.0E-03	r	0	0.1	616-23-9	2,3-Dichloropropanol	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
2.9E-01	i	5.0E-04	i	2.9E-01	r	1.4E-04	i	0	0.1	62-73-7	Dichlorvos	1.7E+00	ca*	8.5E+00	ca*	2.3E-02	ca*	2.3E-01	ca*		
4.4E-01	x			4.4E-01	r			0	0.1	115-32-2	Dicofol	1.1E+00	ca	5.6E+00	ca	1.5E-02	ca	1.5E-01	ca		
		3.0E-02	h			5.7E-05	h	1		77-73-6	Dicyclopentadiene	5.4E-01	nc	1.8E+00	nc	2.1E-01	nc	4.2E-01	nc		
1.6E+01	i	5.0E-05	i	1.6E+01	i	5.0E-05	r	0	0.1	60-57-1	Dieldrin	3.0E-02	ca	1.5E-01	ca	4.2E-04	ca	4.2E-03	ca	4.0E-03	2.0E-04
		5.7E-03	r			5.7E-03	h	0	0.1	112-34-5	Diethylene glycol, monobutyl ether	3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc		
		2.0E+00	h			2.0E+00	r	0	0.1	111-90-0	Diethylene glycol, monoethyl ether	1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc		
		1.1E-02	h			1.1E-02	r	0	0.1	617-84-5	Diethylformamide	6.7E+02	nc	9.7E+03	nc	4.0E+01	nc	4.0E+02	nc		
1.2E-03	i	6.0E-01	i	1.2E-03	r	6.0E-01	r	0	0.1	103-23-1	Di(2-ethylhexyl)adipate	4.1E+02	ca	2.1E+03	ca	5.6E+00	ca	5.6E+01	ca		
		8.0E-01	i			8.0E-01	r	0	0.1	84-66-2	Diethyl phthalate	4.9E+04	nc	1.0E+05	max	2.9E+03	nc	2.9E+04	nc		
4.7E+03	h			4.7E+03	r			0	0.1	56-53-1	Diethylstilbestrol	1.0E-04	ca	5.2E-04	ca	1.4E-06	ca	1.4E-05	ca		
		8.0E-02	i			8.0E-02	r	0	0.1	43222-48-6	Difenzoquat (Avenge)	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	35367-38-5	Diflubenzuron	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.1E+01	r			1.1E+01	i	1		75-37-6	1,1-Difluoroethane					4.2E+04	nc	6.9E+04	nc		
		2.0E-02	n			2.0E-02	r		0.1	28553-12-0	***Diisononyl phthalate***	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		8.0E-02	i			8.0E-02	r	0	0.1	1445-75-6	Diisopropyl methylphosphonate	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	55290-64-7	Dimethipin	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-04	i			2.0E-04	r	0	0.1	60-51-5	Dimethoate	1.2E+01	nc	1.8E+02	nc	7.3E-01	nc	7.3E+00	nc		
1.4E-02	h			1.4E-02	r			0	0.1	119-90-4	3,3'-Dimethoxybenzidine	3.5E+01	ca	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		5.7E-06	r			5.7E-06	x	1		124-40-3	Dimethylamine	6.7E-02	nc	2.5E-01	nc	2.1E-02	nc	3.5E-02	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	121-69-7	N-N-Dimethylaniline	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
7.5E-01	h			7.5E-01	r			0	0.1	95-68-1	2,4-Dimethylaniline	6.5E-01	ca	3.3E+00	ca	9.0E-03	ca	9.0E-02	ca		
5.8E-01	h			5.8E-01	r			0	0.1	21436-96-4	2,4-Dimethylaniline hydrochloride	8.4E-01	ca	4.3E+00	ca	1.2E-02	ca	1.2E-01	ca		
9.2E+00	h			9.2E+00	r			0	0.1	119-93-7	3,3'-Dimethylbenzidine	5.3E-02	ca	2.7E-01	ca	7.3E-04	ca	7.3E-03	ca		

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION								CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
2.6E+00	x			3.5E+00	x			0	0.1	57-14-7	1,1-Dimethylhydrazine	1.9E-01	ca	9.5E-01	ca	1.9E-03	ca	2.6E-02	ca		
3.7E+01	x			3.7E+01	x			0	0.1	540-73-8	1,2-Dimethylhydrazine	1.3E-02	ca	6.7E-02	ca	1.8E-04	ca	1.8E-03	ca		
		1.0E-01	h			8.6E-03	i	0	0.1	68-12-2	N,N-Dimethylformamide	6.1E+03	nc	8.8E+04	nc	3.1E+01	nc	3.6E+03	nc		
		1.0E-03	n			1.0E-03	r	0	0.1	122-09-8	Dimethylphenethylamine	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	105-67-9	2,4-Dimethylphenol	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc	9.0E+00	4.0E-01
		6.0E-04	i			6.0E-04	r	0	0.1	576-26-1	2,6-Dimethylphenol	3.7E+01	nc	5.3E+02	nc	2.2E+00	nc	2.2E+01	nc		
		1.0E-03	i			1.0E-03	r	0	0.1	95-65-8	3,4-Dimethylphenol	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E+01	x			1.0E+01	r	0	0.1	131-11-3	Dimethyl phthalate	1.0E+05	max	1.0E+05	max	3.7E+04	nc	3.6E+05	nc		
		1.0E-01	i			1.0E-01	i	0	0.1	120-61-6	Dimethyl terephthalate	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	131-89-5	4,6-Dinitro-o-cyclohexyl phenol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		4.0E-04	h			4.0E-04	r	0	0.1	528-29-0	1,2-Dinitrobenzene	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
		1.0E-04	i			1.0E-04	r	0	0.1	99-65-0	1,3-Dinitrobenzene	6.1E+00	nc	8.8E+01	nc	3.7E-01	nc	3.6E+00	nc		
		4.0E-04	h			4.0E-04	r	0	0.1	100-25-4	1,4-Dinitrobenzene	2.4E+01	nc	3.5E+02	nc	1.5E+00	nc	1.5E+01	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	51-28-5	2,4-Dinitrophenol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc	3.0E-01	1.0E-02
6.8E-01	i			6.8E-01	r			0	0.1	25321-14-6	Dinitrotoluene mixture	7.2E-01	ca	3.6E+00	ca	9.9E-03	ca	9.9E-02	ca	8.0E-04	4.0E-05
		2.0E-03	i			2.0E-03	r	0	0.1	121-14-2	2,4-Dinitrotoluene (see Dinitrotoluene mixture)	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc	8.0E-04	4.0E-05
		1.0E-03	h			1.0E-03	r	0	0.1	606-20-2	2,6-Dinitrotoluene (see Dinitrotoluene mixture)	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc	7.0E-04	3.0E-05
		1.0E-03	i			1.0E-03	r	0	0.1	88-85-7	Dinoseb	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.0E-02	h			2.0E-02	r	0	0.1	117-84-0	di-n-Octyl phthalate	1.2E+03	nc	1.0E+04	sat	7.3E+01	nc	7.3E+02	nc	1.0E+04	1.0E+04
1.1E-02	i			1.1E-02	i			0	0.1	123-91-1	1,4-Dioxane	4.4E+01	ca	2.2E+02	ca	6.1E-01	ca	6.1E+00	ca		
1.5E+05	h			1.5E+05	h			0	0.03	1746-01-6	Dioxin (2,3,7,8-TCDD)	3.9E-06	ca	2.7E-05	ca	4.5E-08	ca	4.5E-07	ca		
		3.0E-02	i			3.0E-02	r	0	0.1	957-51-7	Diphenamid	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0	0.1	122-39-4	Diphenylamine	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		3.0E-04	n			3.0E-04	r		0.1	74-31-7	**N,N-Diphenyl-1,4 benzenediamine (DPPD)**	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
8.0E-01	i			7.7E-01	i			0	0.1	122-66-7	1,2-Diphenylhydrazine	6.1E-01	ca	3.1E+00	ca	8.7E-03	ca	8.4E-02	ca		
		9.0E-03	n			9.0E-03	r	0	0.1	127-63-9	Diphenyl sulfone	5.5E+02	nc	7.9E+03	nc	3.3E+01	nc	3.3E+02	nc		
		2.2E-03	i			2.2E-03	r	0	0.1	85-00-7	Diquat	1.3E+02	nc	1.9E+03	nc	8.0E+00	nc	8.0E+01	nc		
8.6E+00	h			8.6E+00	r			0	0.1	1937-37-7	Direct black 38	5.7E-02	ca	2.9E-01	ca	7.8E-04	ca	7.8E-03	ca		
8.1E+00	h			8.1E+00	r			0	0.1	2602-46-2	Direct blue 6	6.0E-02	ca	3.0E-01	ca	8.3E-04	ca	8.3E-03	ca		
9.3E+00	h			9.3E+00	r			0	0.1	16071-86-6	Direct brown 95	5.2E-02	ca	2.7E-01	ca	7.2E-04	ca	7.2E-03	ca		
		4.0E-05	i			4.0E-05	r	0	0.1	298-04-4	Disulfoton	2.4E+00	nc	3.5E+01	nc	1.5E-01	nc	1.5E+00	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	505-29-3	1,4-Dithiane	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	330-54-1	Diuron	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		4.0E-03	i			4.0E-03	r	0	0.1	2439-10-3	Dodine	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		2.0E-01	n							7429-91-6	**Dysprosium**	1.6E+04	nc	1.0E+05	max			7.3E+03	nc		
		6.0E-03	i			6.0E-03	r	0	0.1	115-29-7	Endosulfan	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc	1.8E+01	9.0E-01
		2.0E-02	i			2.0E-02	r	0	0.1	145-73-3	Endothall	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		3.0E-04	i			3.0E-04	r	0	0.1	72-20-8	Endrin	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc	1.0E+00	5.0E-02
9.9E-03	i	2.0E-03	h	4.2E-03	i	2.9E-04	i	1		106-89-8	Epichlorohydrin	7.6E+00	nc	2.6E+01	nc	1.0E+00	nc	2.0E+00	nc		
		5.7E-03	r			5.7E-03	i	0	0.1	106-88-7	1,2-Epoxybutane	3.5E+02	nc	5.0E+03	nc	2.1E+01	nc	2.1E+02	nc		
		2.5E-02	i			2.5E-02	r	0	0.1	759-94-4	EPTC (S-Ethyl dipropylthiocarbamate)	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		5.0E-03	i			5.0E-03	r	0	0.1	16672-87-0	Ethephon (2-chloroethyl phosphonic acid)	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		5.0E-04	i			5.0E-04	r	0	0.1	563-12-2	Ethion	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
		4.0E-01	h			5.7E-02	i	0	0.1	110-80-5	2-Ethoxyethanol	2.4E+04	nc	1.0E+05	max	2.1E+02	nc	1.5E+04	nc		
		3.0E-01	h			3.0E-01	r	0	0.1	111-15-9	2-Ethoxyethanol acetate	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		9.0E-01	r			9.0E-01	r	1		141-78-6	Ethyl acetate	1.9E+04	nc	3.7E+04	sat	3.3E+03	nc	5.5E+03	nc		
4.8E-02	h			4.8E-02	r			1		140-88-5	Ethyl acrylate	2.1E-01	ca	4.5E-01	ca	1.4E-01	ca	2.3E-01	ca		
		1.0E-01	i			2.9E-01	i	1		100-41-4	Ethylbenzene	2.3E+02	sat	2.3E+02	sat	1.1E+03	nc	1.3E+03	nc	1.3E+01	7.0E-01
2.9E-03	n	4.0E-01	n	2.9E-03	r	2.9E+00	i	1		75-00-3	Ethyl chloride	3.0E+00	ca	6.5E+00	ca	2.3E+00	ca	4.6E+00	ca		
		3.0E-01	h			3.0E-01	r	0	0.1	109-78-4	Ethylene cyanohydrin	1.8E+04	nc	1.0E+05	max	1.1E+03	nc	1.1E+04	nc		
		2.0E-02	h			2.0E-02	r	0	0.1	107-15-3	Ethylene diamine	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E+00	i			2.0E+00	i	0	0.1	107-21-1	Ethylene glycol	1.0E+05	max	1.0E+05	max	7.3E+03	nc	7.3E+04	nc		
		5.0E-01	i			3.7E+00	i	0	0.1	111-76-2	**Ethylene glycol, monobutyl ether**	3.1E+04	nc	1.0E+05	max	1.4E+04	nc	1.8E+04	nc		
1.0E+00	h			3.5E-01	h			1		75-21-8	Ethylene oxide	1.4E-01	ca	3.6E-01	ca	1.9E-02	ca	2.4E-02	ca		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION												CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)				SOIL SCREENING LEVELS	
																	Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils	CAS No.		Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m^3)	Tap Water (ug/l)	DAF 20 (mg/kg)	DAF 1 (mg/kg)
1.1E-01	h	8.0E-05	i	1.1E-01	i	8.0E-05	i	0	0.1	96-45-7	Ethylene thiourea (ETU)	4.4E+00 ca**	2.2E+01 ca**	6.1E-02 ca**	6.1E-01 ca**		
		2.0E-01	i			2.0E-01	i	1		60-29-7	Ethyl ether	1.8E+03 sat	1.8E+03 sat	7.3E+02 nc	1.2E+03 nc		
		9.0E-02	h			9.0E-02	i	1		97-63-2	Ethyl methacrylate	1.4E+02 sat	1.4E+02 sat	3.3E+02 nc	5.5E+02 nc		
		1.0E-05	i			1.0E-05	r	0	0.1	2104-64-5	Ethyl p-nitrophenyl phenylphosphorothioate	6.1E-01 nc	8.8E+00 nc	3.7E-02 nc	3.6E-01 nc		
		3.0E+00	i			3.0E+00	r	0	0.1	84-72-0	Ethylphthalyl ethyl glycolate	1.0E+05 max	1.0E+05 max	1.1E+04 nc	1.1E+05 nc		
		8.0E-03	i			8.0E-03	r	0	0.1	101200-48-0	Express	4.9E+02 nc	7.0E+03 nc	2.9E+01 nc	2.9E+02 nc		
		2.5E-04	i			2.5E-04	r	0	0.1	22224-92-6	Fenamiphos	1.5E+01 nc	2.2E+02 nc	9.1E-01 nc	9.1E+00 nc		
		1.3E-02	i			1.3E-02	r	0	0.1	2164-17-2	Fluometuron	7.9E+02 nc	1.1E+04 nc	4.7E+01 nc	4.7E+02 nc		
		6.0E-02	i					0	0.1	16984-48-8	Flouride	3.7E+03 nc	5.3E+04 nc		2.2E+03 nc		
		8.0E-02	i			8.0E-02	r	0	0.1	59756-60-4	Fluoridone	4.9E+03 nc	7.0E+04 nc	2.9E+02 nc	2.9E+03 nc		
		2.0E-02	i			2.0E-02	r	0	0.1	56425-91-3	Flurprimidol	1.2E+03 nc	1.8E+04 nc	7.3E+01 nc	7.3E+02 nc		
		6.0E-02	i			6.0E-02	r	0	0.1	66332-96-5	Flutolanil	3.7E+03 nc	5.3E+04 nc	2.2E+02 nc	2.2E+03 nc		
		1.0E-02	i			1.0E-02	r	0	0.1	69409-94-5	Fluvalinate	6.1E+02 nc	8.8E+03 nc	3.7E+01 nc	3.6E+02 nc		
3.5E-03	i	1.0E-01	i	3.5E-03	i	1.0E-01	r	0	0.1	133-07-3	Folpet	1.4E+02 ca*	7.0E+02 ca	1.9E+00 ca	1.9E+01 ca		
1.9E-01	i			1.9E-01	i			0	0.1	72178-02-0	Fomesafen	2.6E+00 ca	1.3E+01 ca	3.5E-02 ca	3.5E-01 ca		
		2.0E-03	i			2.0E-03	r	0	0.1	944-22-9	Fonofos	1.2E+02 nc	1.8E+03 nc	7.3E+00 nc	7.3E+01 nc		
		1.5E-01	i	4.6E-02	i			0	0.1	50-00-0	Formaldehyde	9.2E+03 nc	1.0E+05 nc	1.5E-01 ca	5.5E+03 nc		
		2.0E+00	h			2.0E+00	i	0	0.1	64-18-6	Formic Acid	1.0E+05 max	1.0E+05 max	7.3E+03 nc	7.3E+04 nc		
		3.0E+00	i			3.0E+00	r	0	0.1	39148-24-8	Fosetyl-al	1.0E+05 max	1.0E+05 max	1.1E+04 nc	1.1E+05 nc		
		3.0E+01	i			8.6E+00	h	1		76-13-1	Freon 113	5.6E+03 sat	5.6E+03 sat	3.1E+04 nc	5.9E+04 nc		
		1.0E-03	i			1.0E-03	i	1		110-00-9	Furan	2.5E+00 nc	8.5E+00 nc	3.7E+00 nc	6.1E+00 nc		
3.8E+00	h			3.8E+00	i			0	0.1	67-45-8	Furazolidone	1.3E-01 nc	6.5E-01 nc	1.8E-03 nc	1.8E-02 ca		
		3.0E-03	i			1.4E-02	h	0	0.1	98-01-1	Furfural	1.8E+02 nc	2.6E+03 nc	5.2E+01 nc	1.1E+02 nc		
5.0E+01	h			5.0E+01	i			0	0.1	531-82-8	Furium	9.7E-03 ca	4.9E-02 ca	1.3E-04 ca	1.3E-03 ca		
3.0E-02	i			3.0E-02	r			0	0.1	60568-05-0	Furmecyclox	1.6E+01 ca	8.2E+01 ca	2.2E-01 ca	2.2E+00 ca		
		4.0E-04	i			4.0E-04	r	0	0.1	77182-82-2	Glufosinate-ammonium	2.4E+01 nc	3.5E+02 nc	1.5E+00 nc	1.5E+01 nc		
		4.0E-04	i			2.9E-04	h	0	0.1	765-34-4	Glycidaldehyde	2.4E+01 nc	3.5E+02 nc	1.0E+00 nc	1.5E+01 nc		
		1.0E-01	i			1.0E-01	r	0	0.1	1071-83-6	Glyphosate	6.1E+03 nc	8.8E+04 nc	3.7E+02 nc	3.6E+03 nc		
		5.0E-05	i			5.0E-05	r	0	0.1	69806-40-2	Haloxyfop-methyl	3.1E+00 nc	4.4E+01 nc	1.8E-01 nc	1.8E+00 nc		
		1.3E-02	i			1.3E-02	r	0	0.1	79277-27-3	Harmony	7.9E+02 nc	1.1E+04 nc	4.7E+01 nc	4.7E+02 nc		
4.5E+00	i	5.0E-04	i	4.6E+00	i	5.0E-04	r	0	0.1	76-44-8	Heptachlor	1.1E-01 ca	5.5E-01 ca	1.5E-03 ca	1.5E-02 ca	2.3E+01	1.0E+00
9.1E+00	i	1.3E-05	i	9.1E+00	i	1.3E-05	r	0	0.1	1024-57-3	Heptachlor epoxide	5.3E-02 ca*	2.7E-01 ca*	7.4E-04 ca*	7.4E-03 ca*	7.0E-01	3.0E-02
		2.0E-03	i			2.0E-03	r	0	0.1	87-82-1	Hexabromobenzene	1.2E+02 nc	1.8E+03 nc	7.3E+00 nc	7.3E+01 nc		
1.6E+00	i	8.0E-04	i	1.6E+00	i	8.0E-04	r	0	0.1	118-74-1	Hexachlorobenzene	3.0E-01 ca	1.5E+00 ca	4.2E-03 ca	4.2E-02 ca	2.0E+00	1.0E-01
7.8E-02	i	3.0E-04	h	7.8E-02	i	3.0E-04	r	0	0.1	87-68-3	**Hexachlorobutadiene**	6.2E+00 ca**	3.2E+01 ca**	8.6E-02 ca*	8.6E-01 ca*	2.0E+00	1.0E-01
6.3E+00	i			6.3E+00	i			0	0.04	319-84-6	HCH (alpha)	9.0E-02 ca	5.9E-01 ca	1.1E-03 ca	1.1E-02 ca	5.0E-04	3.0E-05
1.8E+00	i			1.8E+00	i			0	0.04	319-85-7	HCH (beta)	3.2E-01 ca	2.1E+00 ca	3.7E-03 ca	3.7E-02 ca	3.0E-03	1.0E-04
1.3E+00	h	3.0E-04	i	1.3E+00	i	3.0E-04	r	0	0.04	58-89-9	HCH (gamma) Lindane	4.4E-01 ca*	2.9E+00 ca	5.2E-03 ca	5.2E-02 ca	9.0E-03	5.0E-04
1.8E+00	i			1.8E+00	i			0	0.04	608-73-1	HCH-technical	3.2E-01 ca	2.1E+00 ca	3.8E-03 ca	3.7E-02 ca	3.0E-03	1.0E-04
		7.0E-03	i			2.0E-05	h	0	0.1	77-47-4	Hexachlorocyclopentadiene	4.2E+02 nc	5.9E+03 nc	7.3E-02 nc	2.6E+02 nc	4.0E+02	2.0E+01
6.2E+03	i			4.6E+03	i			0	0.1	19408-74-3	Hexachlorodibenzo-p-dioxin mixture (HxCDD)	7.8E-05 ca	4.0E-04 ca	1.5E-06 ca	1.1E-05 ca		
1.4E-02	i	1.0E-03	i	1.4E-02	i	1.0E-03	r	0	0.1	67-72-1	Hexachloroethane	3.5E+01 ca**	1.8E+02 ca**	4.8E-01 ca**	4.8E+00 ca**	5.0E-01	2.0E-02
		3.0E-04	i			3.0E-04	r	0	0.1	70-30-4	Hexachlorophene	1.8E+01 nc	2.6E+02 nc	1.1E+00 nc	1.1E+01 nc		
1.1E-01	i	3.0E-03	i	1.1E-01	i	3.0E-03	r	0	0.1	121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine	4.4E+00 ca*	2.2E+01 ca	6.1E-02 ca	6.1E-01 ca		
		2.9E-06	r			2.9E-06	i	0	0.1	822-06-0	1,6-Hexamethylene diisocyanate	1.7E-01 nc	2.5E+00 nc	1.0E-02 nc	1.0E-01 nc		
		6.0E-02	h			5.7E-02	i	1		110-54-3	n-Hexane	1.1E+02 sat	1.1E+02 sat	2.1E+02 nc	3.5E+02 nc		
		3.3E-02	i			3.3E-02	r	0	0.1	51235-04-2	Hexazinone	2.0E+03 nc	2.9E+04 nc	1.2E+02 nc	1.2E+03 nc		
		5.0E-02	i			5.0E-02	r	0	0.1	2691-41-0	HMX	3.1E+03 nc	4.4E+04 nc	1.8E+02 nc	1.8E+03 nc		
3.0E+00	i			1.7E+01	i			0	0.1	302-01-2	Hydrazine, hydrazine sulfate	1.6E-01 ca	8.2E-01 ca	3.9E-04 ca	2.2E-02 ca		
3.0E+00	n			1.7E+01	n				0.1	60-34-4	**Hydrazine, monomethyl**	1.6E-01 ca	8.2E-01 ca	4.0E-04 ca	2.2E-02 ca		
3.0E+00	n			1.7E+01	n				0.1	57-14-7	**Hydrazine, dimethyl**	1.6E-01 ca	8.2E-01 ca	4.0E-04 ca	2.2E-02 ca		
						5.7E-03	i			7647-01-0	Hydrogen chloride			2.1E+01 nc			
		3.0E-03	i			2.9E-04	i			7783-06-4	Hydrogen sulfide			1.0E+00 nc	1.1E+02 nc		
		4.0E-02	h			4.0E-02	r	0	0.1	123-31-9	p-Hydroquinone	2.4E+03 nc	3.5E+04 nc	1.5E+02 nc	1.5E+03 nc		

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FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
		1.3E-02	i			1.3E-02	i	0	0.1	35554-44-0	Imazalil	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		2.5E-01	i			2.5E-01	i	0	0.1	81335-37-7	Imazaquin	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		4.0E-02	i			4.0E-02	r	0	0.1	36734-19-7	Iprodione	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		
		3.0E-01	n					0		7439-89-6	Iron	2.3E+04	nc	1.0E+05	max			1.1E+04	nc		
		3.0E-01	i			3.0E-01	r	1		78-83-1	Isobutanol	1.3E+04	nc	4.0E+04	sat	1.1E+03	nc	1.8E+03	nc		
9.5E-04	i	2.0E-01	i	9.5E-04	r	2.0E-01	r	0	0.1	78-59-1	Isophorone	5.1E+02	ca*	2.6E+03	ca*	7.1E+00	ca	7.1E+01	ca	5.0E-01	3.0E-02
		1.5E-02	i			1.5E-02	r	0	0.1	33820-53-0	Isopropalin	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		1.0E-01	i			1.1E-01	r	0	0.1	1832-54-8	Isopropyl methyl phosphonic acid	6.1E+03	nc	8.8E+04	nc	4.0E+02	nc	3.6E+03	nc		
		5.0E-02	i			5.0E-02	r	0	0.1	82558-50-7	Isoxaben	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
1.8E+01	h			1.8E+01	r			0	0.1	143-50-0	Kepone	2.7E-02	ca	1.4E-01	ca	3.7E-04	ca	3.7E-03	ca		
		2.0E-03	i			2.0E-03	r	0	0.1	77501-63-4	Lactofen	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
PRGs Based on EPA Models (IEUBK 1994 and TRW 1996)										7439-92-1	**Lead**	4.0E+02	nc	7.5E+02	nc						
		1.0E-07	i					0	0.1	78-00-2	Lead (tetraethyl)	6.1E-03	nc	8.8E-02	nc			3.6E-03	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	330-55-2	Linuron	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		2.0E-02	x					0		7439-93-2	Lithium	1.6E+03	nc	4.1E+04	nc			7.3E+02	nc		
		2.0E-01	i			2.0E-01	r	0	0.1	83055-99-6	Londax	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	121-75-5	Malathion	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.0E-01	i			1.0E-01	r	0	0.1	108-31-6	Maleic anhydride	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		5.0E-01	i			5.0E-01	r	1		123-33-1	Maleic hydrazide	1.7E+03	nc	2.4E+03	sat	1.8E+03	nc	3.0E+03	nc		
		2.0E-05	h			2.0E-05	r	0	0.1	109-77-3	Malononitrile	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-01	nc		
		3.0E-02	h			3.0E-02	r	0	0.1	8018-01-7	Mancozeb	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
6.0E-02	o	5.0E-03	i	6.0E-02	r	5.0E-03	r	0	0.1	12427-38-2	Maneb	8.1E+00	ca*	4.1E+01	ca	1.1E-01	ca	1.1E+00	ca		
		2.4E-02	i			1.4E-05	i	0		7439-96-5	Manganese and compounds	1.8E+03	nc	3.2E+04	nc	5.1E-02	nc	8.8E+02	nc		
		9.0E-05	h			9.0E-05	r	0	0.1	950-10-7	Mephosfolan	5.5E+00	nc	7.9E+01	nc	3.3E-01	nc	3.3E+00	nc		
		3.0E-02	i			3.0E-02	r	0	0.1	24307-26-4	Mepiquat	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
2.9E-02	n	1.0E-01	n	2.9E-02	r	1.0E-01	r	0	0.1	149-30-4	2-Mercaptobenzothiazole	1.7E+01	ca	8.5E+01	ca	2.3E-01	ca	2.3E+00	ca		
		3.0E-04	i					0		7487-94-7	Mercury and compounds	2.3E+01	nc	6.1E+02	nc			1.1E+01	nc		
						8.6E-05	i			7439-97-6	Mercury (elemental)					3.1E-01	nc				
		1.0E-04	i					0	0.1	22967-92-6	Mercury (methyl)	6.1E+00	nc	8.8E+01	nc			3.6E+00	nc		
		3.0E-05	i			3.0E-05	r	0	0.1	150-50-5	Merphos	1.8E+00	nc	2.6E+01	nc	1.1E-01	nc	1.1E+00	nc		
		3.0E-05	i			3.0E-05	r	0	0.1	78-48-8	Merphos oxide	1.8E+00	nc	2.6E+01	nc	1.1E-01	nc	1.1E+00	nc		
		6.0E-02	i			6.0E-02	r	0	0.1	57837-19-1	Metalaxyl	3.7E+03	nc	5.3E+04	nc	2.2E+02	nc	2.2E+03	nc		
		1.0E-04	i			2.0E-04	h	1		126-98-7	Methacrylonitrile	2.1E+00	nc	8.8E+00	nc	7.3E-01	nc	1.0E+00	nc		
		5.0E-05	i			5.0E-05	r	0	0.1	10265-92-6	Methamidophos	3.1E+00	nc	4.4E+01	nc	1.8E-01	nc	1.8E+00	nc		
		5.0E-01	i			5.0E-01	r	0	0.1	67-56-1	Methanol	3.1E+04	nc	1.0E+05	max	1.8E+03	nc	1.8E+04	nc		
		1.0E-03	i			1.0E-03	r	0	0.1	950-37-8	Methidathion	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.5E-02	i			2.5E-02	r	1		16752-77-5	Methomyl	4.4E+01	nc	1.5E+02	nc	9.1E+01	nc	1.5E+02	nc		
		5.0E-03	i			5.0E-03	r	0	0.1	72-43-5	Methoxychlor	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc	1.6E+02	8.0E+00
		1.0E-03	h			5.7E-03	i	0	0.1	109-86-4	2-Methoxyethanol	6.1E+01	nc	8.8E+02	nc	2.1E+01	nc	3.6E+01	nc		
		2.0E-03	h			2.0E-03	r	0	0.1	110-49-6	2-Methoxyethanol acetate	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
4.6E-02	h			4.6E-02	r			0	0.1	99-59-2	2-Methoxy-5-nitroaniline	1.1E+01	ca	5.4E+01	ca	1.5E-01	ca	1.5E+00	ca		
		1.0E+00	h			1.0E+00	r	1		79-20-9	Methyl acetate	2.2E+04	nc	9.6E+04	nc	3.7E+03	nc	6.1E+03	nc		
		3.0E-02	h			3.0E-02	r	1		96-33-3	Methyl acrylate	7.0E+01	nc	2.3E+02	nc	1.1E+02	nc	1.8E+02	nc		
2.4E-01	h			2.4E-01	r			0	0.1	95-53-4	2-Methylaniline (o-toluidine)	2.0E+00	ca	1.0E+01	ca	2.8E-02	ca	2.8E-01	ca		
1.8E-01	h			1.8E-01	r			0	0.1	636-21-5	2-Methylaniline hydrochloride	2.7E+00	ca	1.4E+01	ca	3.7E-02	ca	3.7E-01	ca		
		1.0E+00	x			1.0E+00	r	0	0.1	79-22-1	Methyl chlorocarbonate	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		5.0E-04	i			5.0E-04	r	0	0.1	94-74-6	2-Methyl-4-chlorophenoxyacetic acid	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	94-81-5	4-(2-Methyl-4-chlorophenoxy) butyric acid	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		1.0E-03	i			1.0E-03	r	0	0.1	93-65-2	2-(2-Methyl-4-chlorophenoxy) propionic acid	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		1.0E-03	i			1.0E-03	r	0	0.1	16484-77-8	2-(2-Methyl-1,4-chlorophenoxy) propionic acid	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		8.6E-01	r			8.6E-01	h	1		108-87-2	Methylcyclohexane	2.6E+03	nc	8.8E+03	nc	3.1E+03	nc	5.2E+03	nc		
2.5E-01	h			2.5E-01	r			0	0.1	101-77-9	4,4'-Methylenebisbenzeneamine	1.9E+00	ca	9.9E+00	ca	2.7E-02	ca	2.7E-01	ca		
1.3E-01	h	7.0E-04	h	1.3E-01	h	7.0E-04	r	0	0.1	101-14-4	4,4'-Methylene bis(2-chloroaniline)	3.7E+00	ca*	1.9E+01	ca*	5.2E-02	ca*	5.2E-01	ca*		
4.6E-02	i			4.6E-02	r			0	0.1	101-61-1	4,4'-Methylene bis(N,N'-dimethyl)aniline	1.1E+01	ca	5.4E+01	ca	1.5E-01	ca	1.5E+00	ca		

Key i=IRIS h=HEAST n=NCEA x=WITHDRAWN o=Other EPA DOCUMENTS r=ROUTE EXTRAPOLATION ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SATURATION max=CEILING LIMIT *(where nc < 100X ca) **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																			Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs. soils	CAS No.	Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
		1.0E-02	h			1.0E-02	r	1		74-95-3	Methylene bromide	6.7E+01	nc	2.4E+02	nc	3.7E+01	nc	6.1E+01	nc		
7.5E-03	i	6.0E-02	i	1.6E-03	i	8.6E-01	h	1		75-09-2	Methylene chloride	8.9E+00	ca	2.1E+01	ca	4.1E+00	ca	4.3E+00	ca	2.0E-02	1.0E-03
		1.7E-04	i			1.7E-04	r	0	0.1	101-68-8	4,4'-Methylene diphenyl diisocyanate	1.0E+01	nc	1.5E+02	nc	6.2E-01	nc	6.2E+00	nc		
		6.0E-01	i			2.9E-01	r	1		78-93-3	Methyl ethyl ketone	7.3E+03	nc	2.8E+04	nc	1.0E+03	nc	1.9E+03	nc		
1.1E+00	h			1.1E+00	r			0	0.1	60-34-4	Methyl hydrazine	4.4E-01	ca	2.2E+00	ca	6.1E-03	ca	6.1E-02	ca		
		8.0E-02	h			2.3E-02	h	1		108-10-1	Methyl isobutyl ketone	7.9E+02	nc	2.9E+03	nc	8.3E+01	nc	1.6E+02	nc		
		5.7E-04	i			5.7E-04	n	0	0.1	74-93-1	Methyl Mercaptan	3.5E+01	nc	5.0E+02	nc	2.1E+00	nc	2.1E+01	nc		
		1.4E+00	i			2.0E-01	i	1		80-62-6	Methyl methacrylate	2.2E+03	nc	2.7E+03	sat	7.3E+02	nc	1.4E+03	nc		
3.3E-02	h			3.3E-02	r			0	0.1	99-55-8	2-Methyl-5-nitroaniline	1.5E+01	ca	7.5E+01	ca	2.0E-01	ca	2.0E+00	ca		
		2.5E-04	i			2.5E-04	r	0	0.1	298-00-0	Methyl parathion	1.5E+01	nc	2.2E+02	nc	9.1E-01	nc	9.1E+00	nc		
		5.0E-02	i			5.0E-02	r	0	0.1	95-48-7	2-Methylphenol	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc	1.5E+01	8.0E-01
		5.0E-02	i			5.0E-02	r	0	0.1	108-39-4	3-Methylphenol	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		5.0E-03	h			5.0E-03	r	0	0.1	106-44-5	4-Methylphenol	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.0E-02	n			2.0E-02	r	0	0.1	993-13-5	Methyl phosphonic acid	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		6.0E-03	h			1.1E-02	h	1		25013-15-4	Methyl styrene (mixture)	1.3E+02	nc	5.6E+02	nc	4.2E+01	nc	6.0E+01	nc		
		7.0E-02	h			7.0E-02	r	1		98-83-9	Methyl styrene (alpha)	6.8E+02	sat	6.8E+02	sat	2.6E+02	nc	4.3E+02	nc		
						8.6E-01	i	1		1634-04-4	Methyl tertbutyl ether (MTBE)					3.1E+03	nc	2.0E+01	nc/ca		
1.8E-03				1.8E-03				1			**"CAL-Modified PRG"**	1.7E+01	ca	3.7E+01	ca	3.7E+00	ca	6.2E+00	ca		
		1.5E-01	i			1.5E-01	r	0	0.1	51218-45-2	Metolaclor (Dual)	9.2E+03	nc	1.0E+05	max	5.5E+02	nc	5.5E+02	nc		
		2.5E-02	i			2.5E-02	r	0	0.1	21087-64-9	Metribuzin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
1.8E+00	x	2.0E-04	i	1.8E+00	r	2.0E-04	r	0	0.1	2385-85-5	Mirex	2.7E-01	ca*	1.4E+00	ca	3.7E-03	ca	3.7E-02	ca		
		2.0E-03	i			2.0E-03	r	0	0.1	2212-67-1	Molinate	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		5.0E-03	h					0		7439-98-7	Molybdenum	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc		
		1.0E-01	h			1.0E-01	h	0	0.1	10599-90-3	Monochloramine	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-03	i			2.0E-03	r	0	0.1	300-76-5	Naled	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		1.0E-01	i			1.0E-01	r	0	0.1	15299-99-7	Napropamide	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		2.0E-02	i					0		7440-02-0	Nickel (soluble salts)	1.6E+03	nc	4.1E+04	nc			7.3E+02	nc	1.3E+02	7.0E+00
											"CAL-Modified PRG" (PEA, 1994)	1.5E+02									
				8.4E-01	i			0			Nickel refinery dust					8.0E-03	ca				
				1.7E+00	i			0		12035-72-2	Nickel subsulfide			1.1E+04	ca	4.0E-03	ca				
		1.5E-03	x			1.5E-03	r	0	0.1	1929-82-4	Nitrapyrin	9.2E+01	nc	1.3E+03	nc	5.5E+00	nc	5.5E+01	nc		
Tap Water PRG Based on Infant NOAEL (see IRIS)										14797-55-8	Nitrate							1.0E+04	nc		
		1.0E-01	x							10102-43-9	Nitric Oxide	7.8E+03	nc	1.0E+05	max			3.6E+03	nc		
Tap Water PRG Based on Infant NOAEL (see IRIS)										14797-65-0	Nitrite							1.0E+03	nc		
		5.7E-05	r			5.7E-05	h	0	0.1	88-74-4	2-Nitroaniline	3.5E+00	nc	5.0E+01	nc	2.1E-01	nc	2.1E+00	nc		
		5.0E-04	i			5.7E-04	h	1		98-95-3	Nitrobenzene	2.0E+01	nc	1.1E+02	nc	2.1E+00	nc	3.4E+00	nc	1.0E-01	7.0E-03
		7.0E-02	h			7.0E-02	r	0	0.1	67-20-9	Nitrofurantoin	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
1.5E+00	h			9.4E+00	h			0	0.1	59-87-0	Nitrofurazone	3.2E-01	ca	1.6E+00	ca	7.2E-04	ca	4.5E-02	ca		
1.4E-02	n			1.4E-02	r			0	0.1	55-63-0	Nitroglycerin	3.5E+01	ca	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		1.0E-01	i			1.0E-01	r	0	0.1	556-88-7	Nitroguanidine	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
		8.0E-03	n			8.0E-03	r	0	0.1	100-02-7	4-Nitrophenol	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
9.4E+00	r	5.7E-03	i	9.4E+00	h	5.7E-03	i	1		79-46-9	2-Nitropropane					7.2E-04	ca	1.2E-03	ca		
5.4E+00	i			5.6E+00	i			1		924-16-3	N-Nitrosodi-n-butylamine	2.4E-02	ca	6.1E-02	ca	1.2E-03	ca	2.0E-03	ca		
2.8E+00	i			2.8E+00	r			0	0.1	1116-54-7	N-Nitrosodiethanolamine	1.7E-01	ca	8.8E-01	ca	2.4E-03	ca	2.4E-02	ca		
1.5E+02	i			1.5E+02	i			0	0.1	55-18-5	N-Nitrosodiethylamine	3.2E-03	ca	1.6E-02	ca	4.5E-05	ca	4.5E-04	ca		
5.1E+01	i			4.9E+01	i			0	0.1	62-75-9	N-Nitrosodimethylamine	9.5E-03	ca	4.8E-02	ca	1.4E-04	ca	1.3E-03	ca		
4.9E-03	i			4.9E-03	r			0	0.1	86-30-6	N-Nitrosodiphenylamine	9.9E+01	ca	5.0E+02	ca	1.4E+00	ca	1.4E+01	ca	1.0E+00	6.0E-02
7.0E+00	i			7.0E+00	r			0	0.1	621-64-7	N-Nitroso di-n-propylamine	6.9E-02	ca	3.5E-01	ca	9.6E-04	ca	9.6E-03	ca	5.0E-05	2.0E-06
2.2E+01	i			2.2E+01	r			0	0.1	10595-95-6	N-Nitroso-N-methylethylamine	2.2E-02	ca	1.1E-01	ca	3.1E-04	ca	3.1E-03	ca		
2.1E+00	i			2.1E+00	r			0	0.1	930-55-2	N-Nitrosopyrrolidine	2.3E-01	ca	1.2E+00	ca	3.1E-03	ca	3.2E-02	ca		
		1.0E-02	h			1.0E-02	r	1		99-08-1	m-Nitrotoluene	3.7E+02	nc	1.0E+03	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	h			1.0E-02	r	1		88-72-2	o-Nitrotoluene	3.7E+02	nc	1.0E+03	sat	3.7E+01	nc	6.1E+01	nc		
		1.0E-02	h			1.0E-02	r	1		99-99-0	p-Nitrotoluene	3.7E+02	nc	1.0E+03	sat	3.7E+01	nc	6.1E+01	nc		
		4.0E-02	i			4.0E-02	r	0	0.1	27314-13-2	Norflurazon	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+03	nc		

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION										CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																			Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)	DAF 20 (mg/kg)	DAF 1 (mg/kg)
		7.0E-04	i			7.0E-04	r	0	0.1	85509-19-9	NuStar	4.3E+01	nc	6.2E+02	nc	2.6E+00	nc	2.6E+0	nc		
		3.0E-03	i			3.0E-03	r	0	0.1	32536-52-0	Octabromodiphenyl ether	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+0	nc		
		2.0E-03	h			2.0E-03	r	0	0.1	152-16-9	Octamethylpyrophosphoramide	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+0	nc		
		5.0E-02	r			5.0E-02	r	0	0.1	19044-88-3	*Oryzalin*	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+0	nc		
		5.0E-03	i			5.0E-03	r	0	0.1	19666-30-9	Oxadiazon	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+0	nc		
		2.5E-02	i			2.5E-02	r	0	0.1	23135-22-0	Oxamyl	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+0	nc		
		3.0E-03	i			3.0E-03	r	0	0.1	42874-03-3	Oxyfluorfen	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+0	nc		
		1.3E-02	i			1.3E-02	r	0	0.1	76738-62-0	Paclobutrazol	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+0	nc		
		4.5E-03	i			4.5E-03	r	0	0.1	4685-14-7	Paraquat	2.7E+02	nc	4.0E+03	nc	1.6E+01	nc	1.6E+0	nc		
		6.0E-03	h			6.0E-03	r	0	0.1	56-38-2	Parathion	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+0	nc		
		5.0E-02	h			5.0E-02	r	0	0.1	1114-71-2	Pebulate	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+0	nc		
		4.0E-02	i			4.0E-02	r	0	0.1	40487-42-1	*Pendimethalin*	2.4E+03	nc	3.5E+04	nc	1.5E+02	nc	1.5E+0	nc		
2.3E-02	h			2.3E-02	r		0	0.1		87-84-3	Pentabromo-6-chloro cyclohexane	2.1E+01	ca	1.1E+02	ca	2.9E-01	ca	2.9E+0	ca		
		2.0E-03	i			2.0E-03	r	0	0.1	32534-81-9	Pentabromodiphenyl ether	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		8.0E-04	i			8.0E-04	r	0	0.1	608-93-5	Pentachlorobenzene	4.9E+01	nc	7.0E+02	nc	2.9E+00	nc	2.9E+01	nc		
2.6E-01	h	3.0E-03	i	2.6E-01	r	3.0E-03	r	0	0.1	82-68-8	*Pentachloronitrobenzene*	1.9E+00	ca*	9.5E+00	ca	2.6E-02	ca	2.6E-01	ca		
1.2E-01	i	3.0E-02	i	1.2E-01	r	3.0E-02	r	0	0.25	87-86-5	Pentachlorophenol	3.0E+00	ca	1.1E+01	ca	5.6E-02	ca	5.6E-01	ca	3.0E-02	1.0E-03
		5.0E-04	x					0		7601-90-3	Perchlorate	3.9E+01	nc	1.0E+03	nc			1.8E+01	nc		
		5.0E-02	i			5.0E-02	r	0	0.1	52645-53-1	Permethrin	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		2.5E-01	i			2.5E-01	r	0	0.1	13684-63-4	*Phenmedipham*	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		6.0E-01	i			6.0E-01	r	0	0.1	108-95-2	Phenol	3.7E+04	nc	1.0E+05	max	2.2E+03	nc	2.2E+04	nc	1.0E+02	5.0E+00
		2.0E-03	n			2.0E-03	r	0	0.1	92-84-2	Phenothiazine	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		6.0E-03	i			6.0E-03	r	0	0.1	108-45-2	m-Phenylenediamine	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc		
		1.9E-01	h			1.9E-01	r	0	0.1	106-50-3	*p-Phenylenediamine*	1.2E+04	nc	1.0E+05	max	6.9E+02	nc	6.9E+03	nc		
		8.0E-05	i			8.0E-05	r	0	0.1	62-38-4	Phenylmercuric acetate	4.9E+00	nc	7.0E+01	nc	2.9E-01	nc	2.9E+00	nc		
1.9E-03	h			1.9E-03	r		0	0.1		90-43-7	2-Phenylphenol	2.5E+02	ca	1.3E+03	ca	3.5E+00	ca	3.5E+01	ca		
		2.0E-04	h			2.0E-04	r	0	0.1	298-02-2	Phorate	1.2E+01	nc	1.8E+02	nc	7.3E-01	nc	7.3E+00	nc		
		2.0E-02	i			2.0E-02	r	0	0.1	732-11-6	Phosmet	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		3.0E-04	h			8.6E-05	i	0	0.1	7803-51-2	Phosphine	1.8E+01	nc	2.6E+02	nc	3.1E-01	nc	1.1E+01	nc		
						2.9E-03	i			7664-38-2	Phosphoric acid					1.0E+01	nc				
		2.0E-05	i					0		7723-14-0	Phosphorus (white)	1.6E+00	nc	4.1E+01	nc			7.3E-01	nc		
		1.0E+00	h			1.0E+00	r	0	0.1	100-21-0	p-Phthalic acid	6.1E+04	nc	1.0E+05	max	3.7E+03	nc	3.6E+04	nc		
		2.0E+00	i			3.4E-02	h	0	0.1	85-44-9	Phthalic anhydride	1.0E+05	max	1.0E+05	max	1.2E+02	nc	7.3E+04	nc		
		7.0E-02	i			7.0E-02	r	0	0.1	1918-02-1	Picloram	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
		1.0E-02	i			1.0E-02	r	0	0.1	23505-41-1	Pirimiphos-methyl	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
8.9E+00	h	7.0E-06	h	8.9E+00	r	7.0E-06	r	0	0.1		Polybrominated biphenyls	5.5E-02	ca**	2.8E-01	ca*	7.6E-04	ca*	7.6E-03	ca*		
2.0E+00	i			2.0E+00	i		0	0.14		1336-36-3	Polychlorinated biphenyls (PCBs)	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
7.0E-02	i	7.0E-05	i	7.0E-02	i	7.0E-05	r	0	0.14	12674-11-2	Aroclor 1016	3.9E+00	nc	2.9E+01	ca**	9.6E-02	ca**	9.6E-01	ca**		
2.0E+00	i			2.0E+00	i		0	0.14		11104-28-2	Aroclor 1221	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	i			2.0E+00	i		0	0.14		11141-16-5	Aroclor 1232	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	i			2.0E+00	i		0	0.14		53469-21-9	Aroclor 1242	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	i			2.0E+00	i		0	0.14		12672-29-6	Aroclor 1248	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
2.0E+00	i	2.0E-05	i	2.0E+00	i	2.0E-05	r	0	0.14	11097-69-1	Aroclor 1254	2.2E-01	ca**	1.0E+00	ca*	3.4E-03	ca*	3.4E-02	ca*		
2.0E+00	i			2.0E+00	i		0	0.14		11096-82-5	Aroclor 1260	2.2E-01	ca	1.0E+00	ca	3.4E-03	ca	3.4E-02	ca		
								0.13			Polynuclear aromatic hydrocarbons (PAHs)										
		6.0E-02	i			6.0E-02	r	1		83-32-9	Acenaphthene	3.7E+03	nc	3.8E+04	nc	2.2E+02	nc	3.7E+02	nc	5.7E+02	2.9E+01
		3.0E-01	i			3.0E-01	r	1		120-12-7	Anthracene	2.2E+04	nc	1.0E+05	max	1.1E+03	nc	1.8E+03	nc	1.2E+04	5.9E+02
7.3E-01	n			3.1E-01	n		0	0.13		56-55-3	Benz[a]anthracene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	2.0E+00	8.0E-02
7.3E-01	n			3.1E-01	n		0	0.13		205-99-2	Benzo[b]fluoranthene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	5.0E+00	2.0E-01
7.3E-02	n			3.1E-02	n		0	0.13		207-08-9	Benzo[k]fluoranthene	6.2E+00	ca	2.9E+01	ca	2.2E-01	ca	9.2E-01	ca	4.9E+01	2.0E+00
											"CAL-Modified PRG" (PEA, 1994)	6.1E-01									
7.3E+00	i			3.1E+00	n		0	0.13		50-32-8	Benzo[a]pyrene	6.2E-02	ca	2.9E-01	ca	2.2E-03	ca	9.2E-03	ca	8.0E+00	4.0E-01
											"CAL-Modified PRG" (PEA, 1994)							1.5E-03			
7.3E-03	n			3.1E-03	n		0	0.13		218-01-9	Chrysene	6.2E+01	ca	2.9E+02	ca	2.2E+00	ca	9.2E+00	ca	1.6E+02	8.0E+00

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=Other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION								CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C skin abs. soils	CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		Migration to Ground Water DAF 20 (mg/kg)	DAF 1 (mg/kg)
										"CAL-Modified PRG" (PEA, 1994)	6.1E+00									
7.3E+00	n			3.1E+00	n			0 0.13	53-70-3	Dibenz[ah]anthracene	6.2E-02	ca	2.9E-01	ca	2.2E-03	ca	9.2E-03	ca	2.0E+00	8.0E-02
		4.0E-02	i			4.0E-02	r	0 0.13	206-44-0	Fluoranthene	2.3E+03	nc	3.0E+04	nc	1.5E+02	nc	1.5E+03	nc	4.3E+03	2.1E+02
		4.0E-02	i			4.0E-02	r	1	86-73-7	Fluorene	2.6E+03	nc	3.3E+04	nc	1.5E+02	nc	2.4E+02	nc	5.6E+02	2.8E+01
7.3E-01	n			3.1E-01	n			0 0.13	193-39-5	Indeno[1,2,3-cd]pyrene	6.2E-01	ca	2.9E+00	ca	2.2E-02	ca	9.2E-02	ca	1.4E+01	7.0E-01
		2.0E-02	i			8.6E-04	i	1	91-20-3	Naphthalene	5.6E+01	nc	1.9E+02	nc	3.1E+00	nc	6.2E+00	nc	8.4E+01	4.0E+00
		3.0E-02	i			3.0E-02	r	1	129-00-0	Pyrene	2.3E+03	nc	5.4E+04	nc	1.1E+02	nc	1.8E+02	nc	4.2E+03	2.1E+02
1.5E-01	i	9.0E-03	i	1.5E-01	r	9.0E-03	r	0 0.1	67747-09-5	Prochloraz	3.2E+00	ca	1.6E+01	ca	4.5E-02	ca	4.5E-01	ca		
		6.0E-03	h			6.0E-03	r	0 0.1	26399-36-0	Profluralin	3.7E+02	nc	5.3E+03	nc	2.2E+01	nc	2.2E+02	nc		
		1.5E-02	i			1.5E-02	r	0 0.1	1610-18-0	Prometon	9.2E+02	nc	1.3E+04	nc	5.5E+01	nc	5.5E+02	nc		
		4.0E-03	i			4.0E-03	r	0 0.1	7287-19-6	Prometryn	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		7.5E-02	i			7.5E-02	r	0 0.1	23950-58-5	Pronamide	4.6E+03	nc	6.6E+04	nc	2.7E+02	nc	2.7E+03	nc		
		1.3E-02	i			1.3E-02	r	0 0.1	1918-16-7	Propachlor	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		5.0E-03	i			5.0E-03	r	0 0.1	709-98-8	Propanil	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		2.0E-02	i			2.0E-02	r	0 0.1	2312-35-8	Propargite	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-03	i			2.0E-03	r	0 0.1	107-19-7	Propargyl alcohol	1.2E+02	nc	1.8E+03	nc	7.3E+00	nc	7.3E+01	nc		
		2.0E-02	i			2.0E-02	r	0 0.1	139-40-2	Propazine	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		2.0E-02	i			2.0E-02	r	0 0.1	122-42-9	Propham	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.3E-02	i			1.3E-02	r	0 0.1	60207-90-1	Propiconazole	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		1.0E-01	i			1.1E-01	i	1	98-82-8	Isopropylbenzene (Cumene)	1.6E+02	nc	5.2E+02	nc	4.0E+02	nc	6.6E+02	nc		
		1.0E-02	n			1.0E-02	r	1	103-65-1	n-Propylbenzene	1.4E+02	nc	2.4E+02	sat	3.7E+01	nc	6.1E+01	nc		
		2.0E+01	h			2.0E+01	r	0 0.1	57-55-6	Propylene glycol	1.0E+05	max	1.0E+05	max	7.3E+04	nc	7.3E+05	nc		
		7.0E-01	h			7.0E-01	r	0 0.1	111-35-3	Propylene glycol, monoethyl ether	4.3E+04	nc	1.0E+05	max	2.6E+03	nc	2.6E+04	nc		
		7.0E-01	h			5.7E-01	i	0 0.1	107-98-2	Propylene glycol, monomethyl ether	4.3E+04	nc	1.0E+05	max	2.1E+03	nc	2.6E+04	nc		
2.4E-01	i	8.6E-03	r	1.3E-02	i	8.6E-03	i	1	75-56-9	Propylene oxide	1.9E+00	ca*	9.1E+00	ca*	5.2E-01	ca*	2.2E-01	ca		
		2.5E-01	i			2.5E-01	r	0 0.1	81335-77-5	Pursuit	1.5E+04	nc	1.0E+05	max	9.1E+02	nc	9.1E+03	nc		
		2.5E-02	i			2.5E-02	r	0 0.1	51630-58-1	Pydrin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		1.0E-03	i			1.0E-03	r	0 0.1	110-86-1	Pyridine	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		5.0E-04	i			5.0E-04	r	0 0.1	13593-03-8	Quinalphos	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
1.2E+01	h			1.2E+01	i			0 0.1	91-22-5	Quinoline	4.1E-02	ca	2.1E-01	ca	5.6E-04	ca	5.6E-03	ca		
1.1E-01	i	3.0E-03	i	1.1E-01	r	3.0E-03	r	0 0.1	121-82-4	RDX (Cyclonite)	4.4E+00	ca*	2.2E+01	ca	3.1E-02	ca	6.1E-01	ca		
		3.0E-02	i			3.0E-02	r	0 0.1	10453-86-8	Resmethrin	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		5.0E-02	h			5.0E-02	r	0 0.1	299-84-3	Ronnel	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		
		4.0E-03	i			4.0E-03	r	0 0.1	83-79-4	Rotenone	2.4E+02	nc	3.5E+03	nc	1.5E+01	nc	1.5E+02	nc		
		2.5E-02	i			2.5E-02	r	0 0.1	78587-05-0	Savey	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		5.0E-03	i					0 0.1	7783-00-8	Selenious Acid	3.1E+02	nc	4.4E+03	nc			1.8E+02	nc		
		5.0E-03	i					0	7782-49-2	Selenium	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc	5.0E+00	3.0E-01
		5.0E-03	h					0 0.1	630-10-4	Selenourea	3.1E+02	nc	4.4E+03	nc			1.8E+02	nc		
		9.0E-02	i			9.0E-02	r	0 0.1	74051-80-2	Sethoxydim	5.5E+03	nc	7.9E+04	nc	3.3E+02	nc	3.3E+03	nc		
		5.0E-03	i					0	7440-22-4	Silver and compounds	3.9E+02	nc	1.0E+04	nc			1.8E+02	nc	3.4E+01	2.0E+00
1.2E-01	h	5.0E-03	i	1.2E-01	r	2.0E-03	r	0 0.1	122-34-9	Simazine	4.1E+00	ca*	2.1E+01	ca	5.6E-02	ca	5.6E-01	ca		
		4.0E-03	i						26628-22-8	Sodium azide										
2.7E-01	h	3.0E-02	i	2.7E-01	r	3.0E-02	r	0 0.1	148-18-5	Sodium diethyldithiocarbamate	1.8E+00	ca	9.1E+00	ca	2.5E-02	ca	2.5E-01	ca		
		2.0E-05	i			2.0E-05	r	0 0.1	62-74-8	Sodium fluoroacetate	1.2E+00	nc	1.8E+01	nc	7.3E-02	nc	7.3E-01	nc		
		1.0E-03	h			1.0E-03	r	0 0.1	13718-26-8	Sodium metavanadate	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		6.0E-01	i					0	7440-24-6	Strontium, stable	4.7E+04	nc	1.0E+05	max			2.2E+04	nc		
		3.0E-04	i			3.0E-04	r	0 0.1	57-24-9	Strychnine	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		2.0E-01	i			2.9E-01	i	1	100-42-5	Styrene	1.7E+03	sat	1.7E+03	sat	1.1E+03	nc	1.6E+03	nc	4.0E+00	2.0E-01
		1.0E-03	n			1.0E-03	r		80-07-9	**1,1'-Sulfonylbis (4-chlorobenzene)**	7.8E+01	nc	2.0E+03	nc	3.7E+00	nc	3.6E+01	nc		
		2.5E-02	i			2.5E-02	r	0 0.1	88671-89-0	Systhane	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
1.5E+05	h			1.5E+05	h			0 0.03	1746-01-6	2,3,7,8-TCDD (dioxin)	3.9E-06	ca	2.7E-05	ca	4.5E-08	ca	4.5E-07	ca		
		7.0E-02	i			7.0E-02	r	0 0.1	34014-18-1	Tebuthiuron	4.3E+03	nc	6.2E+04	nc	2.6E+02	nc	2.6E+03	nc		
		2.0E-02	h			2.0E-02	r	0 0.1	3383-96-8	Temephos	1.2E+03	nc	1.8E+04	nc	7.3E+01	nc	7.3E+02	nc		
		1.3E-02	i			1.3E-02	r	0 0.1	5902-51-2	Terbacil	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		

Key: i=IRIS, h=HEAST, n=NCEA, x=WITHDRAWN, o=other EPA DOCUMENTS, r=ROUTE EXTRAPOLATION, ca=CANCER PRG, nc=NONCANCER PRG, sat=SOIL SATURATION, max=CEILING LIMIT, *(where nc < 100X ca), **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION												CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																					Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils		CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
		2.5E-05	h			2.5E-05	r	0	0.1		13071-79-9	Terbufos	1.5E+00	nc	2.2E+01	nc	9.1E-02	nc	9.1E-01	nc		
		1.0E-03	i			1.0E-03	r	0	0.1		886-50-0	Terbutryn	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		3.0E-04	i			3.0E-04	r	0	0.1		95-94-3	1,2,4,5-Tetrachlorobenzene	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
2.6E-02	i	3.0E-02	i	2.6E-02	i	3.0E-02	r	1			630-20-6	1,1,1,2-Tetrachloroethane	3.0E+00	ca	7.0E+00	ca	2.6E-01	ca	4.3E-01	ca		
2.0E-01	i	6.0E-02	n	2.0E-01	i	6.0E-02	r	1			79-34-5	1,1,2,2-Tetrachloroethane	3.8E-01	ca	9.0E-01	ca	3.3E-02	ca	5.5E-02	ca	3.0E-03	2.0E-04
5.2E-02	n	1.0E-02	i	2.0E-03	n	1.1E-01	n	1			127-18-4	Tetrachloroethylene (PCE)	5.7E+00	ca*	1.9E+01	ca*	3.3E+00	ca	1.1E+00	ca	6.0E-02	3.0E-03
												"CAL-Modified PRG" (PEA, 1994)					3.2E-01					
		3.0E-02	i			3.0E-02	r	0	0.1		58-90-2	2,3,4,6-Tetrachlorophenol	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
2.0E+01	h			2.0E+01	i			0	0.1		5216-25-1	p,a,a,a-Tetrachlorotoluene	2.4E-02	ca	1.2E-01	ca	3.4E-04	ca	3.4E-03	ca		
2.4E-02	h	3.0E-02	i	2.4E-02	i	3.0E-02	r	0	0.1		961-11-5	Tetrachlorovinphos	2.0E+01	ca*	1.0E+02	ca	2.8E-01	ca	2.8E+00	ca		
		5.0E-04	i			5.0E-04	r	0	0.1		3689-24-5	Tetraethyldithiopyrophosphate	3.1E+01	nc	4.4E+02	nc	1.8E+00	nc	1.8E+01	nc		
7.6E-03	n	2.1E-01	n	6.8E-03	n	8.6E-02	n	0	0.1		109-99-9	Tetrahydrofuran	6.4E+01	ca	3.2E+02	ca	9.9E-01	ca	8.8E+00	ca		
		6.6E-05	i					0			7440-28-0	**Thallium and compounds**	5.2E+00	nc	1.3E+02	nc			2.4E+00	nc		
		1.0E-02	i			1.0E-02	r	0	0.1		28249-77-6	Thiobencarb	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		1.0E-01	n			1.0E-01	r	0	0.1		N/A	Thiocyanate	6.1E+03	nc	1.0E+05	max	3.7E+02	nc	3.6E+03	nc		
		3.0E-04	h			3.0E-04	r	0	0.1		39196-18-4	Thiofanox	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		8.0E-02	i			8.0E-02	r	0	0.1		23564-05-8	Thiophanate-methyl	4.9E+03	nc	7.0E+04	nc	2.9E+02	nc	2.9E+03	nc		
		5.0E-03	i			5.0E-03	r	0	0.1		137-26-8	Thiram	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		6.0E-01	h					0				Tin (inorganic, see tributyltin oxide for organic tin)	4.7E+04	nc	1.0E+05	max			2.2E+04	nc		
		2.0E-01	i			1.1E-01	h	1			108-88-3	Toluene	5.2E+02	sat	5.2E+02	sat	4.0E+02	nc	7.2E+02	nc	1.2E+01	6.0E-01
3.2E+00	h			3.2E+00	i			0	0.1		95-80-7	Toluene-2,4-diamine	1.5E-01	ca	7.7E-01	ca	2.1E-03	ca	2.1E-02	ca		
		6.0E-01	h			6.0E-01	r	0	0.1		95-70-5	Toluene-2,5-diamine	3.7E+04	nc	1.0E+05	max	2.2E+03	nc	2.2E+04	nc		
		2.0E-01	h			2.0E-01	r	0	0.1		823-40-5	Toluene-2,6-diamine	1.2E+04	nc	1.0E+05	max	7.3E+02	nc	7.3E+03	nc		
1.9E-01	i			1.9E-01	i			0	0.1		106-49-0	p-Toluidine	2.6E+00	ca	1.3E+01	ca	3.5E-02	ca	3.5E-01	ca		
1.1E+00	i			1.1E+00	i			0	0.1		8001-35-2	Toxaphene	4.4E-01	ca	2.2E+00	ca	6.0E-03	ca	6.1E-02	ca	3.1E+01	2.0E+00
		7.5E-03	i			7.5E-03	r	0	0.1		66841-25-6	Tralomethrin	4.6E+02	nc	6.6E+03	nc	2.7E+01	nc	2.7E+02	nc		
		1.3E-02	i			1.3E-02	r	0	0.1		2303-17-5	Triallate	7.9E+02	nc	1.1E+04	nc	4.7E+01	nc	4.7E+02	nc		
		1.0E-02	i			1.0E-02	r	0	0.1		82097-50-5	Triasulfuron	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		5.0E-03	i			5.0E-03	r	0	0.1		615-54-3	1,2,4-Tribromobenzene	3.1E+02	nc	4.4E+03	nc	1.8E+01	nc	1.8E+02	nc		
		3.0E-04	i					0	0.1		56-35-9	Tributyltin oxide (TBTO)	1.8E+01	nc	2.6E+02	nc			1.1E+01	nc		
3.4E-02	h			3.4E-02	r			0	0.1		634-93-5	2,4,6-Trichloroaniline	1.4E+01	ca	7.3E+01	ca	2.0E-01	ca	2.0E+00	ca		
2.9E-02	h			2.9E-02	r			0	0.1		33663-50-2	2,4,6-Trichloroaniline hydrochloride	1.7E+01	ca	8.5E+01	ca	2.3E-01	ca	2.3E+00	ca		
		1.0E-02	i			5.7E-02	n	1			120-82-1	1,2,4-Trichlorobenzene	6.5E+02	nc	3.0E+03	sat	2.1E+02	nc	1.9E+02	nc	5.0E+00	3.0E-01
		2.0E-02	n			2.9E-01	n	1			71-55-6	1,1,1-Trichloroethane	6.3E+02	nc	1.4E+03	sat	1.0E+03	nc	5.4E+02	nc	2.0E+00	1.0E-01
5.7E-02	i	4.0E-03	i	5.6E-02	i	4.0E-03	r	1			79-00-5	1,1,2-Trichloroethane	8.4E-01	ca*	1.9E+00	ca*	1.2E-01	ca	2.0E-01	ca	2.0E-02	9.0E-04
1.1E-02	n	6.0E-03	x	6.0E-03	n	6.0E-03	r	1			79-01-6	Trichloroethylene (TCE)	2.8E+00	ca**	6.1E+00	ca*	1.1E+00	ca*	1.6E+00	ca*	6.0E-02	3.0E-03
		3.0E-01	i			2.0E-01	h	1			75-69-4	Trichlorofluoromethane	3.9E+02	nc	2.0E+03	sat	7.3E+02	nc	1.3E+03	nc		
		1.0E-01	i			1.0E-01	r	0	0.1		95-95-4	2,4,5-Trichlorophenol	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc	2.7E+02	1.4E+01
1.1E-02	i			1.1E-02	i			0	0.1		88-06-2	2,4,6-Trichlorophenol	4.4E+01	ca	2.2E+02	ca	6.2E-01	ca	6.1E+00	ca	2.0E-01	8.0E-03
		1.0E-02	i			1.0E-02	r	0	0.1		93-76-5	2,4,5-Trichlorophenoxyacetic Acid	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		
		8.0E-03	i			8.0E-03	r	0	0.1		93-72-1	2-(2,4,5-Trichlorophenoxy) propionic acid	4.9E+02	nc	7.0E+03	nc	2.9E+01	nc	2.9E+02	nc		
		5.0E-03	i			5.0E-03	r	1			598-77-6	1,1,2-Trichloropropane	1.5E+01	nc	5.1E+01	nc	1.8E+01	nc	3.0E+01	nc		
7.0E+00	h	6.0E-03	i	7.0E+00	r	5.0E-03	r	1			96-18-4	1,2,3-Trichloropropane	1.4E-03	ca	3.1E-03	ca	9.6E-04	ca	1.6E-03	ca		
		5.0E-03	h			5.0E-03	r	1			96-19-5	1,2,3-Trichloropropene	1.2E+01	nc	3.9E+01	nc	1.8E+01	nc	3.0E+01	nc		
		3.0E+01	i			8.5E+00	h	1			76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	5.6E+03	sat	5.6E+03	sat	3.1E+04	nc	5.9E+04	nc		
		3.0E-03	i			3.0E-03	r	0	0.1		58138-08-2	Tridiphane	1.8E+02	nc	2.6E+03	nc	1.1E+01	nc	1.1E+02	nc		
		2.0E-03	i			2.0E-03	i	1			121-44-8	Triethylamine	2.3E+01	nc	8.8E+01	nc	7.3E+00	nc	1.2E+01	nc		
7.7E-03	i	7.5E-03	i	7.7E-03	r	7.5E-03	r	0	0.1		1582-09-8	Trifluralin	6.3E+01	ca**	3.2E+02	ca*	8.7E-01	ca*	8.7E+00	ca*		
		1.4E-04	r			1.4E-04	n		0.1		552-30-7	**Trimellitic Anhydride (TMAN)**	8.6E+00	nc	1.2E+02	nc	5.1E-01	nc	5.1E+00			
		5.0E-02	n			1.7E-03	n	1			95-63-6	1,2,4-Trimethylbenzene	5.2E+01	nc	1.7E+02	nc	6.2E+00	nc	1.2E+01	nc		
		5.0E-02	n			1.7E-03	n	1			108-67-8	1,3,5-Trimethylbenzene	2.1E+01	nc	7.0E+01	nc	6.2E+00	nc	1.2E+01	nc		
3.7E-02	h			3.7E-02	r			0	0.1		512-56-1	Trimethyl phosphate	1.3E+01	ca	6.7E+01	ca	1.8E-01	ca	1.8E+00	ca		
		3.0E-02	i			3.0E-02	r	0	0.1		99-35-4	1,3,5-Trinitrobenzene	1.8E+03	nc	2.6E+04	nc	1.1E+02	nc	1.1E+03	nc		
		1.0E-02	h			1.0E-02	r	0	0.1		479-45-8	Trinitrophenylmethylnitramine	6.1E+02	nc	8.8E+03	nc	3.7E+01	nc	3.6E+02	nc		

Key: i=IRIS; h=HEAST; n=NCEA; x=WITHDRAWN; o=Other EPA DOCUMENTS; r=ROUTE EXTRAPOLATION; ca=CANCER PRG; nc=NONCANCER PRG; sat=SOIL SATURATION; max=CEILING LIMIT; *(where nc < 100X ca); **(where nc < 10X ca)

FOR PLANNING PURPOSES

TOXICITY INFORMATION												CONTAMINANT	PRELIMINARY REMEDIATION GOALS (PRGs)								SOIL SCREENING LEVELS	
																					Migration to Ground Water	
SFo 1/(mg/kg-d)		RfDo (mg/kg-d)		SFi 1/(mg/kg-d)		RfDi (mg/kg-d)		V O C	skin abs soils		CAS No.		Residential Soil (mg/kg)		Industrial Soil (mg/kg)		Ambient Air (ug/m^3)		Tap Water (ug/l)		DAF 20 (mg/kg)	DAF 1 (mg/kg)
3.0E-02	i	5.0E-04	i	3.0E-02	r	5.0E-04	r	0	0.1		118-96-7	2,4,6-Trinitrotoluene	1.6E+01	ca**	8.2E+01	ca**	2.2E-01	ca**	2.2E+00	ca**		
		1.0E-01	n			1.0E-01	r		0.1		791-28-6	**Triphenylphosphine oxide**	6.1E+03	nc	8.8E+04	nc	3.7E+02	nc	3.6E+03	nc		
1.4E-02	n	3.0E-01	n	1.4E-02	r	3.0E-01	r		0.1		115-96-8	**Tris(2-chloroethyl) phosphate**	3.5E+01	ca	1.8E+02	ca	4.8E-01	ca	4.8E+00	ca		
		2.0E-04	n								7440-61-0	**Uranium (chemical toxicity only)**	1.6E+01	nc	4.1E+02	nc			7.3E+00	nc		
		7.0E-03	h					0			7440-62-2	Vanadium and compounds	5.5E+02	nc	1.4E+04	nc			2.6E+02	nc	6.0E+03	3.0E+02
		1.0E-03	i			1.0E-03	r	0	0.1		1929-77-7	Vernam	6.1E+01	nc	8.8E+02	nc	3.7E+00	nc	3.6E+01	nc		
		2.5E-02	i			2.5E-02	r	0	0.1		50471-44-8	Vinclozolin	1.5E+03	nc	2.2E+04	nc	9.1E+01	nc	9.1E+02	nc		
		1.0E+00	h			5.7E-02	i	1			108-05-4	Vinyl acetate	4.3E+02	nc	1.4E+03	nc	2.1E+02	nc	4.1E+02	nc	1.7E+02	8.0E+00
1.1E-01	r	8.6E-04	r	1.1E-01	h	8.6E-04	i	1			593-60-2	Vinyl bromide (bromoethene)	1.9E-01	ca*	4.2E-01	ca*	6.1E-02	ca*	1.0E-01	ca*		
1.5E+00	i	3.0E-03	i	3.1E-02	i	2.9E-02	i	1			75-01-4	**Vinyl chloride (child/adult)**	1.5E-01	ca			2.2E-01	ca	4.1E-02	ca	1.0E-02	7.0E-04
7.5E-01	i	3.0E-03	i	1.6E-02	i	2.9E-02	i	1			75-01-4	**Vinyl chloride (adult)**			8.3E-01	ca						
		3.0E-04	i			3.0E-04	r	0	0.1		81-81-2	Warfarin	1.8E+01	nc	2.6E+02	nc	1.1E+00	nc	1.1E+01	nc		
		2.0E+00	i			2.0E-01	x	1	0.1		1330-20-7	Xylenes	2.1E+02	sat	2.1E+02	sat	7.3E+02	nc	1.4E+03	nc	2.1E+02	1.0E+01
		3.0E-01	i					0			7440-66-6	Zinc	2.3E+04	nc	1.0E+05	max			1.1E+04	nc	1.2E+04	6.2E+02
		3.0E-04	i					0			1314-84-7	Zinc phosphide	2.3E+01	nc	6.1E+02	nc			1.1E+01	nc		
		5.0E-02	i			5.0E-02	r	0	0.1		12122-67-7	Zineb	3.1E+03	nc	4.4E+04	nc	1.8E+02	nc	1.8E+03	nc		

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40 CFR - CHAPTER I - PART 261

View Part

§ 261.24 Toxicity characteristic.

(a) A solid waste (except manufactured gas plant waste) exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter, the extract from a representative sample of the waste contains any of the contaminants listed in table 1 at the concentration equal to or greater than the respective value given in that table. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using the methodology outlined in Method 1311, is considered to be the extract for the purpose of this section.

(b) A solid waste that exhibits the characteristic of toxicity has the EPA Hazardous Waste Number specified in Table I which corresponds to the toxic contaminant causing it to be hazardous.

Table 1--Maximum Concentration of Contaminants for the Toxicity Characteristic

EPA HW No.\1\	Contaminant	CAS No.\2\	Regulatory Level (mg/L)
D004	Arsenic.....	7440-38-2	5.0
D005	Barium.....	7440-39-3	100.0
D018	Benzene.....	71-43-2	0.5
D006	Cadmium.....	7440-43-9	1.0
D019	Carbon tetrachloride.....	56-23-5	0.5
D020	Chlordane.....	57-74-9	0.03
D021	Chlorobenzene.....	108-90-7	100.0
D022	Chloroform.....	67-66-3	6.0
D007	Chromium.....	7440-47-3	5.0
D023	o-Cresol.....	95-48-7	\4\200.0
D024	m-Cresol.....	108-39-4	\4\200.0
D025	p-Cresol.....	106-44-5	\4\200.0
D026	Cresol.....	.....	\4\200.0
D016	2,4-D.....	94-75-7	10.0
D027	1,4-Dichlorobenzene.....	106-46-7	7.5
D028	1,2-Dichloroethane.....	107-06-2	0.5
D029	1,1-Dichloroethylene.....	75-35-4	0.7
D030	2,4-Dinitrotoluene.....	121-14-2	\3\0.13

D012	Endrin.....	72-20-8	0.02
D031	Heptachlor (and its epoxide).	76-44-8	0.008
D032	Hexachlorobenzene.....	118-74-1	\3\0.13
D033	Hexachlorobutadiene.....	87-68-3	0.5
D034	Hexachloroethane.....	67-72-1	3.0
D008	Lead.....	7439-92-1	5.0
D013	Lindane.....	58-89-9	0.4
D009	Mercury.....	7439-97-6	0.2
D014	Methoxychlor.....	72-43-5	10.0
D035	Methyl ethyl ketone.....	78-93-3	200.0
D036	Nitrobenzene.....	98-95-3	2.0
D037	Pentrachlorophenol.....	87-86-5	100.0
D038	Pyridine.....	110-86-1	\3\5.0
D010	Selenium.....	7782-49-2	1.0
D011	Silver.....	7440-22-4	5.0
D039	Tetrachloroethylene.....	127-18-4	0.7
D015	Toxaphene.....	8001-35-2	0.5
D040	Trichloroethylene.....	79-01-6	0.5
D041	2,4,5-Trichlorophenol.....	95-95-4	400.0
D042	2,4,6-Trichlorophenol.....	88-06-2	2.0
D017	2,4,5-TP (Silvex).....	93-72-1	1.0
D043	Vinyl chloride.....	75-01-4	0.2

\1\ Hazardous waste number.
\2\ Chemical abstracts service number.
\3\ Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
\4\ If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

[55 FR 11862, Mar. 29, 1990, as amended at 55 FR 22684, June 1, 1990; 55 FR 26987, June 29, 1990; 58 FR 46049, Aug. 31, 1993; 67 FR 11254, Mar. 13, 2002]

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	0.05
Barium	mg/L	2
Beryllium	mg/L	0.004
Boron	mg/L	2
Cadmium	mg/L	0.005
Chloride	mg/L	200
Chromium	mg/L	0.1
Cobalt	mg/L	1
Copper	mg/L	0.65
Cyanide	mg/L	0.2
Fluoride	mg/L	4.0
Iron	mg/L	5
Lead	mg/L	0.0075
Maganese	mg/L	0.15
Mercury	mg/L	0.002
Nickel	mg/L	0.1
Nitrate as N	mg/L	10
Radium-226	pCi/l	20
Radium-228	pCi/l	20

Selenium	mg/L	0.05
Silver	mg/L	0.05
Sulfate	mg/L	400
Thallium	mg/L	0.002
Total Dissolved Solids (TDS)	mg/L	1,200
Zinc	mg/L	5

b) Organic Chemical Constituents

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

Constituent	Standard (mg/L)
Alachlor*	0.002
Aldicarb	0.003
Atrazine	0.003
Benzene*	0.005
Benzo(a)pyrene*	0.0002
Carbofuran	0.04
Carbon Tetrachloride*	0.005
Chlordane*	0.002
Dalapon	0.2
Dichloromethane*	0.005
Di(2-ethylhexyl)phthalate*	0.006
Dinoseb	0.007
Endothall	0.1
Endrin	0.002
Ethylene Dibromide*	0.00005
Heptachlor*	0.0004
Heptachlor Epoxide*	0.0002
Hexachlorocyclopentadiene	0.05
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
Methoxychlor	0.04
Monochlorobenzene	0.1
Pentachlorophenol*	0.001
Phenols	0.1
Picloram	0.5
Polychlorinated Biphenyls(PCB's)(as decachloro- biphenyl)*	0.0005
Simazine	0.004
Styrene	0.1
2,4,5-TP (Silvex)	0.05
Tetrachloroethylene*	0.005
Toluene	1
Toxaphene*	0.003
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethane	0.005
1,2,4-Trichlorobenzene	0.07
Trichloroethylene*	0.005
Vinyl Chloride*	0.002
Xylenes	10

*Denotes a carcinogen.

c) Complex Organic Chemical Mixtures

Concentrations of the following chemical constitutents 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.

d) pH

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

e) 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 (e)(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 in 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
Strontium-90	Bone marrow	8

(Source: Amended at 18 Ill. Reg. 14084, effective August 24, 1994)

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 (d) 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

	C-carcinogen		N-noncarcinogen		
		Ambient		Soil	
	Tap Water	Ambient Air	Fish	Industrial/ Commerical	Residential
Contaminant	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Acephate	770 C	72 C	36 C	66000 C	7300 C
Acetaldehyde	94 N	81 C	0	0	0
Acetochlor	730 N	730 N	270 N	410000 N	16000 N
Acetone	3700 N	3700 N	1400 N	2000000 N	78000 N
Acetone cyanohydrin	2600 N	1500 N	950 N	1400000 N	55000 N
Acetonitrile	220 N	520 N	81 N	120000 N	4700 N
Acetophenone	0.042 N	0.21 N	1400 N	1000000 N	78000 N
Acifluorfen	470 N	470 N	180 N	270000 N	10000 N
Acrolein	730 N	0.21 N	270 N	410000 N	16000 N
Acrylamide	1.5 C	0.14 C	0.07 C	130 C	14 C
Acrylic acid	18000 N	10 N	6800 N	1000000 N	390000 N
Acrylonitrile	12 C	2.6 C	0.58 C	1100 C	120 C
Alachlor	84 C	7.8 C	3.9 C	7200 C	800 C
Alar	5500 N	5500 N	2000 N	1000000 N	120000 N
Aldicarb	37 N	37 N	14 N	20000 N	780 N
Aldicarb sulfone	37 N	37 N	14 N	20000 N	780 N
Aldrin	0.4 C	0.037 C	0.019 C	34 C	3.8 C
Ally	9100 N	9100 N	3400 N	1000000 N	200000 N
Allyl alcohol	180 N	180 N	68 N	100000 N	3900 N
Allyl chloride	1800 N	10 N	680 N	1000000 N	39000 N
Aluminum	37000 N	37000 N	14000 N	1000000 N	780000 N
Aluminum phosphide	15 N	15 N	5.4 N	8200 N	310 N
Amdro	11 N	11 N	4.1 N	6100 N	230 N
Ametryn	330 N	330 N	120 N	180000 N	7000 N
m-Aminophenol	2600 N	2600 N	950 N	1000000 N	55000 N
4-Aminopyridine	0.73 N	0.73 N	0.27 N	410 N	16 N
Amitraz	91 N	91 N	34 N	51000 N	2000 N
Ammonia	1000 N	1000 N	0	0	0
Ammonium sulfamate	7300 N	7300 N	2700 N	1000000 N	160000 N
Aniline	10 N	10 N	55 C	100000 C	11000 C
Antimony and compounds	15 N	15 N	5.4 N	8200 N	310 N
Antimony pentoxide	18 N	18 N	6.8 N	10000 N	390 N
Antimony potassium tartrate	33 N	33 N	12 N	18000 N	700 N
Antimony tetroxide	15 N	15 N	5.4 N	8200 N	310 N
Antimony trioxide	15 N	15 N	5.4 N	8200 N	310 N
[illegible]	470 N	470 N	180 N	270000 N	10000 N
[illegible]	[illegible]	25 C	13 C	23000 C	2600 C

Contaminant	C-carcinogen		N-noncarcinogen		
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Arsenic	11 N	11 N	4.1 N	6100 N	230 N
Arsenic (as carcinogen)	4.5 C	0.041 C	0.21 C	380 C	43 C
Arsine	0.52 N	0.52 N	0	0	0
Assure	330 N	330 N	120 N	180000 N	7000 N
Asulam	1800 N	1800 N	680 N	1000000 N	39000 N
Atrazine	30 C	2.8 C	1.4 C	2600 C	290 C
Avermectin B1	15 N	15 N	5.4 N	8200 N	310 N
Azobenzene	61 C	5.8 C	2.9 C	5200 C	580 C
Barium and compounds	2600 N	5.2 N	950 N	1000000 N	55000 N
Baygon	150 N	150 N	54 N	82000 N	3100 N
Baylaton	1100 N	1100 N	410 N	610000 N	23000 N
Baythroid	910 N	910 N	340 N	510000 N	20000 N
Benefin	11800 N	11000 N	4100 N	1000000 N	230000 N
Benomyl	1800 N	1800 N	680 N	1000000 N	39000 N
Bentazon	91 N	91 N	34 N	51000 N	2000 N
Benzaldehyde	610 N	3700 N	1400 N	1000000 N	78000 N
Benzene	36 C	22 C	11 C	20000 C	2200 C
Benzenethiol	0.37 N	0.37 N	0.14 N	200 N	7.8 N
Benzidine	0.029 C	0.0027 C	0.0014 C	2.5 C	0.28 C
Benzoic acid	150000 N	150000 N	54000 N	1000000 N	1000000 N
Benzotrichloride	0.52 C	0.048 C	0.024 C	44 C	4.9 C
Benzyl alcohol	11000 N	11000 N	4100 N	1000000 N	230000 N
Benzyl chloride	6.2 C	3.7 C	1.9 C	3400 C	380 C
Beryllium and compounds	1.6 C	0.075 C	0.073 C	130 C	15 C
Bidrin	3.7 N	3.7 N	1.4 N	2000 N	78 N
Biphenthrin (Talstar)	550 N	550 N	200 N	310000 N	12000 N
1,1-Biphenyl	1800 N	1800 N	680 N	1000000 N	39000 N
Bis(2-chloroethyl)ether	0.92 C	0.54 C	0.29 C	520 C	58 C
Bis(2-chloroisopropyl)ether	26 C	18 C	4.5 C	8200 C	910 C
Bis(chloromethyl)ether	0.0049 C	0.0029 C	0.0014 C	2.6 C	0.29 C
Bis(2-chloro-1-methylethyl)ether	96 C	8.9 C	4.5 C	8200 C	910 C
Bis(2-ethylhexyl)phthalate (DEHP)	480 C	45 C	23 C	41000 C	4600 C
Bisphenol A	1800 N	1800 N	680 N	1000000 N	39000 N
Boron (and borates)	3300 N	210 N	1200 N	1000000 N	70000 N
Boron trifluoride	7.3 N	7.3 N	0	0	0
Bromodichloromethane	17 C	10 C	5.1 C	9200 C	1000 C
Bromoform	9.6 C	5.7 C	0	0	0

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Bromoform (tribromomethane)	240 C	160 C	40 C	72000 C	8100 C
Bromomethane	8.7 N	52 N	19 N	29000 N	1100 N
4-Bromophenyl phenyl ether	2100 N	2100 N	780 N	1000000 N	45000 N
Bromophos	180 N	180 N	68 N	100000 N	3900 N
Bromoxynil	730 N	730 N	270 N	410000 N	16000 N
Bromoxynil octanoate	730 N	730 N	270 N	410000 N	16000 N
1,3-Butadiene	1.1 C	0.64 C	0	0	0
1-Butanol	3700 N	3700 N	1400 N	1000000 N	78000 N
Butyl benzyl phthalate	7300 N	7300 N	2700 N	1000000 N	160000 N
Butylate	1800 N	1800 N	680 N	1000000 N	39000 N
sec-Butylbenzene	61 N	370 N	140 N	200000 N	7800 N
tert-Butylbenzene	61 N	370 N	140 N	200000 N	7800 N
Butylphthalyl butylglycolate	37000 N	37000 N	14000 N	1000000 N	780000 N
Cacodylic acid	110 N	110 N	41 N	61000 N	2300 N
Cadmium and compounds	18 N	0.099 C	6.8 N	10000 N	390 N
Caprolactam	18000 N	18000 N	6800 N	1000000 N	390000 N
Captafol	780 C	73 C	37 C	67000 C	74 C
Captan	1900 C	180 C	90 C	160000 C	18000 C
Carbaryl	3700 N	3700 N	1400 N	1000000 N	78000 N
Carbofuran	180 N	180 N	68 N	100000 N	3900 N
Carbon disulfide	1000 N	7300 N	1400 N	1000000 N	78000 N
Carbon tetrachloride	16 C	12 C	2.4 C	4400 C	490 C
Carbosulfan	370 N	370 N	140 N	200000 N	7800 N
Carboxin	3700 N	3700 N	1400 N	1000000 N	78000 N
Chloral	73 N	73 N	27 N	41000 N	1600 N
Chloramben	550 N	550 N	200 N	310000 N	12000 N
Chloranil	17 C	1.6 C	0.78 C	1400 C	160 C
Chlordane	5.2 C	0.49 C	0.24 C	440 C	49 C
Chlorimuron-ethyl	730 N	730 N	270 N	410000 N	16000 N
Chlorine	3700 N	3700 N	1400 N	1000000 N	78000 N
Chlorine dioxide	2.1 N	2.1 N	0	0	0
Chloroacetaldehyde	250 N	250 N	93 N	140000 N	5400 N
Chloroacetic acid	73 N	73 N	27 N	41000 N	1600 N
2-Chloroacetophenone	0.31 N	0.31 N	0	0	0
4-Chloroaniline	150 N	150 N	54 N	82000 N	3100 N
Chlorobenzene	39 N	210 N	270 N	410000 N	16000 N
Chlorobenzilate	25 C	2.3 C	1.2 C	2100 C	240 C

Contaminant	C - carcinogen N - noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
p-Chlorobenzoic acid	7300 N	7300 N	2700 N	1000000 N	160000 N
4-Chlorobenzotrifluoride	730 N	730 N	270 N	410000 N	16000 N
2-Chloro-1,3-butadiene	14 N	73 N	270 N	410000 N	16000 N
1-Chlorobutane	2400 N	15000 N	5400 N	1000000 N	310000 N
Chlorodibromomethane	13 C	7.5 C	3.8 C	6800 C	760 C
1-Chloro-1,1-difluoroethane	87000 N	520000 N	0	0	0
Chlorodifluoromethane	87000 N	520000 N	0	0	0
Chloroethane	8600 N	100000 N	5400 N	1000000 N	310000 N
2-Chloroethyl vinyl ether	150 N	910 N	340 N	510000 N	20000 N
Chloroform	15 C	7.8 C	52 C	94000 C	7800 N
Chloromethane	140 C	99 C	24 C	44000 C	4900 C
4-Chloro-2,2-methylaniline hydrochloride	15 C	1.4 C	0.69 C	1200 C	140 C
4-Chloro-2-methylaniline	12 C	1.1 C	0.54 C	990 C	110 C
beta-Chloronaphthalene	2900 N	2900 N	1100 N	1000000 N	63000 N
o-Chloronitrobenzene	42 C	25 C	13 C	23000 C	2600 C
p-Chloronitrobenzene	59 C	35 C	18 C	32000 C	3500 C
2-Chlorophenol	180 N	180 N	68 N	100000 N	3900 N
2-Chloropropane	170 N	1000 N	0	0	0
Chlorothalonil	610 C	57 C	29 C	52000 C	5800 C
o-Chlorotoluene	120 N	730 N	270 N	410000 N	16000 N
Chlorpropham	7300 N	7300 N	2700 N	1000000 N	160000 N
Chlorpyrifos	110 N	110 N	41 N	61000 N	2300 N
Chlorpyrifos-methyl	370 N	370 N	140 N	200000 N	7800 N
Chlorsulfuron	1800 N	1800 N	680 N	1000000 N	39000 N
Chlorthiophos	29 N	29 N	11 N	16000 N	630 N
Chromium III and compounds	37000 N	0.021 N	14000 N	1000000 N	780000 N
Chromium VI and compounds	180 N	0.015 C	68 N	100000 N	3900 N
Coal tar	0	0.28 C	0	0	0
Cobalt	2200 N	2200 N	810 N	1000000 N	47000 N
Coke Oven Emissions	0	0.29 C	0	0	0
Copper and compounds	1500 N	1500 N	540 N	820000 N	31000 N
Crotonaldehyde	3.5 C	0.33 C	0.17 C	300 C	34 C
Cumene	1500 N	94 N	540 N	820000 N	31000 N
Cyanides:	0	0	0	0	0
Barium cyanide	3700 N	3700 N	1400 N	1000000 N	78000 N
Calcium cyanide	1500 N	1500 N	540 N	820000 N	31000 N
**Chlorine cyanide	1800 N	1800 N	680 N	1000000 N	39000 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Copper cyanide	180 N	180 N	68 N	100000 N	3900 N
Cyanazine	8 C	0.75 C	0.38 C	680 C	76 C
Cyanogen	1500 N	1500 N	540 N	820000 N	31000 N
Cyanogen bromide	3300 N	3300 N	1200 N	1000000 N	70000 N
Cyanogen chloride	1800 N	1800 N	680 N	1000000 N	39000 N
Free cyanide	730 N	730 N	270 N	410000 N	16000 N
Hydrogen cyanide	730 N	31 N	270 N	410000 N	16000 N
Potassium cyanide	1800 N	1800 N	680 N	1000000 N	39000 N
Potassium silver cyanide	7300 N	7300 N	2700 N	1000000 N	160000 N
Silver cyanide	3700 N	3700 N	1400 N	1000000 N	78000 N
Sodium cyanide	1500 N	1500 N	540 N	820000 N	31000 N
Thiocyanate	730 N	730 N	270 N	410000 N	16000 N
Zinc cyanide	1800 N	1800 N	680 N	1000000 N	39000 N
Cyclohexanone	30000 N	180000 N	68000 N	1000000 N	1000000 N
Cyclohexlamine	7300 N	7300 N	2700 N	1000000 N	160000 N
Cyhalothrin/Karate	180 N	180 N	68 N	100000 N	3900 N
Cypermethrin	370 N	370 N	140 N	200000 N	7800 N
Cyromazine	270 N	270 N	100 N	150000 N	5900 N
Dacthal	370 N	370 N	140 N	200000 N	7800 N
Dalapon	1100 N	1100 N	410 N	610000 N	23000 N
Danitol	910 N	910 N	340 N	510000 N	20000 N
DDD	28 C	2.6 C	1.3 C	2400 C	270 C
DDE	20 C	1.8 C	0.93 C	1700 C	190 C
DDT	20 C	1.8 C	0.93 C	1700 C	190 C
Decabromodiphenyl ether	61 N	370 N	140 N	200000 N	7800 N
Demeton	1.5 N	1.5 N	0.54 N	820 N	31 N
Diallate	17 C	10 C	5.2 C	9400 C	1000 C
Diazinon	33 N	33 N	12 N	18000 N	700 N
Dibenzofuran	150 N	150 N	54 N	82000 N	3100 N
1,4-Dibromobenzene	61 N	370 N	140 N	200000 N	7800 N
1,2-Dibromo-3-chloropropane	4.8 C	2.1 N	0.23 C	410 C	46 C
1,2-Dibromoethane	0.075 C	0.81 C	0.0037 C	6.7 C	0.75 C
Dibutyl phthalate	3700 N	3700 N	1400 N	1000000 N	78000 N
Dicamba	1100 N	1100 N	410 N	610000 N	23000 N
1,2-Dichlorobenzene	270 N	1500 N	1200 N	1000000 N	70000 N
1,3-Dichlorobenzene	540 N	3200 N	1200 N	1000000 N	70000 N
1,4-Dichlorobenzene	44 C	26 C	13 C	24000 C	[illegible]

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
3,3'-Dichlorobenzidine	15 C	1.4 C	0.7 C	1300 C	140 C
1,4-Dichloro-2-butene	0.11 C	0.067 C	0	0	0
Dichlorodifluoromethane	390 N	2100 N	2700 N	1000000 N	160000 N
1,1-Dichloroethane	810 N	5200 N	1400 N	1000000 N	78000 N
1,2-Dichloroethane (EDC)	12 C	6.9 C	3.5 C	6300 C	700 C
1,1-Dichloroethylene	4.4 C	3.6 C	0.53 C	950 C	110 C
1,2-Dichloroethylene (cis)	61 N	370 N	140 N	200000 N	7800 N
1,2-Dichloroethylene (trans)	120 N	730 N	270 N	410000 N	16000 N
1,2-Dichloroethylene (mixture)	55 N	330 N	120 N	180000 N	7000 N
2,4-Dichlorophenol	110 N	110 N	41 N	61000 N	2300 N
2,4-Dichlorophenoxyacetic Acid (2,4-D)	61 N	370 N	140 N	200000 N	7800 N
4-(2,4-Dichlorophenoxy)butyric Acid	290 N	290 N	110 N	160000 N	6300 N
1,2-Dichloropropane	16 C	9.2 C	4.6 C	8400 C	940 C
2,3-Dichloropropanol	110 N	110 N	41 N	61000 N	2300 N
1,3-Dichloropropene	7.7 C	4.8 C	1.8 C	3300 C	230 N
Dichlorvos	23 C	2.2 C	1.1 C	2000 C	220 C
Dicofol	15 C	1.4 C	0.72 C	1300 C	150 C
Dicyclopentadiene	0.42 N	2.1 N	410 N	610000 N	23000 N
Dieldrin	0.42 C	0.039 C	0.02 C	36 C	4 C
Diesel emissions	52 N	52 N	0	0	0
Diethyl phthalate	29000 N	29000 N	11000 N	1000000 N	630000 N
Diethylene glycol, monobutyl ether	210 N	210 N	0	0	0
Diethylene glycol, monoethyl ether	73000 N	73000 N	27000 N	1000000 N	1000000 N
Diethylformamide	400 N	400 N	150 N	220000 N	8600 N
Di(2-ethylhexyl)adipate	5600 C	520 C	260 C	480000 C	53000 C
Diethylstilbestrol	0.0014 C	0.00013 C	0.000067 C	0.12 C	0.014 C
Difenzoquat (Avenge)	2900 N	2900 N	1100 N	1000000 N	63000 N
Diflubenzuron	730 N	730 N	270 N	410000 N	16000 N
1,1-Difluoroethane	69000 N	420000 N	0	0	0
Diisopropyl methylphosphonate (DIMP)	2900 N	2900 N	1100 N	1000000 N	63000 N
Dimethipin	730 N	730 N	270 N	410000 N	16000 N
Dimethoate	7.3 N	7.3 N	2.7 N	4100 N	160 N
3,3'-Dimethoxybenzidine	480 C	45 C	23 C	41000 C	4600 C
Dimethylamine	0.21 N	0.21 N	0	0	0
2,4-Dimethylaniline hydrochloride	12 C	1.1 C	0.54 C	990 C	110 C
2,4-Dimethylaniline	9 C	0.83 C	0.42 C	760 C	85 C
N,N-Dimethylaniline	73 N	73 N	27 N	41000 N	1600 N

	C = carcinogen		N = noncarcinogen		
		Ambient		Soil	
	Tap Water	Ambient Air	Fish	Industrial/ Commerical	Residential
Contaminant	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
3,3'-Dimethylbenzidine	0.73 C	0.068 C	0.034 C	62 C	6.9 C
N,N-Dimethylformamide	3700 N	310 N	1400 N	1000000 N	78000 N
1,1-Dimethylhydrazine	2.6 C	0.18 C	0.12 C	220 C	25 C
1,2-Dimethylhydrazine	0.18 C	0.017 C	0.0085 C	15 C	1.7 C
2,4-Dimethylphenol	730 N	730 N	270 N	410000 N	16000 N
2,6-Dimethylphenol	22 N	22 N	8.1 N	12000 N	470 N
3,4-Dimethylphenol	37 N	37 N	14 N	20000 N	780 N
Dimethyl phthalate	370000 N	370000 N	140000 N	1000000 N	1000000 N
Dimethyl terephthalate	3700 N	3700 N	1400 N	1000000 N	78000 N
1,2-Dinitrobenzene	15 N	15 N	5.4 N	8200 N	310 N
1,3-Dinitrobenzene	3.7 N	3.7 N	1.4 N	2000 N	78 N
1,4-Dinitrobenzene	15 N	15 N	5.4 N	8200 N	310 N
4,6-Dinitro-o-cyclohexyl phenol	73 N	73 N	27 N	41000 N	1600 N
2,4-Dinitrophenol	73 N	73 N	27 N	41000 N	1600 N
Dinitrotoluene mixture	9.9 C	0.92 C	0.46 C	840 C	94 C
2,4-Dinitrotoluene	73 N	73 N	27 N	41000 N	1600 N
2,6-Dinitrotoluene	37 N	37 N	14 N	20000 N	780 N
Dinoseb	37 N	37 N	14 N	20000 N	780 N
di-n-Octyl phthalate	730 N	730 N	270 N	410000 N	16000 N
1,4-Dioxane	610 C	57 C	29 C	52000 C	5800 C
Diphenamid	1100 N	1100 N	410 N	610000 N	23000 N
Diphenylamine	910 N	910 N	340 N	510000 N	20000 N
1,2-Diphenylhydrazine	8.4 C	0.81 C	0.39 C	720 C	80 C
Diquat	80 N	80 N	30 N	45000 N	1700 N
Direct black 38	0.78 C	0.073 C	0.037 C	67 C	7.4 C
Direct blue 6	0.83 C	0.077 C	0.039 C	71 C	7.9 C
Direct brown 95	0.72 C	0.067 C	0.034 C	62 C	6.9 C
Disulfoton	1.5 N	1.5 N	0.54 N	820 N	31 N
1,4-Dithiane	370 N	370 N	140 N	200000 N	7800 N
Diuron	73 N	73 N	27 N	41000 N	1600 N
Dodine	150 N	150 N	54 N	82000 N	3100 N
Endosulfan	220 N	220 N	81 N	120000 N	4700 N
Endothall	730 N	730 N	270 N	410000 N	16000 N
Endrin	11 N	11 N	4.1 N	6100 N	230 N
[illegible]	[illegible] C	10 N	32 C	58000 C	6500 C
[illegible]	[illegible]	[illegible] N	0	0	0
[illegible]	[illegible]	[illegible]	[illegible] N	100000 N	3900 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Ethion	18 N	18 N	6.8 N	10000 N	390 N
2-Ethoxyethanol acetate	11000 N	11000 N	4100 N	1000000 N	230000 N
2-Ethoxyethanol	15000 N	2100 N	5400 N	1000000 N	310000 N
Ethyl acrylate	140 C	13 C	6.6 C	12000 C	1300 C
EPTC (S-Ethyl dipropylthiocarbamate)	910 N	910 N	340 N	510000 N	20000 N
Ethyl acetate	33000 N	33000 N	12000 N	1000000 N	700000 N
Ethylbenzene	1300 N	10000 N	1400 N	1000000 N	78000 N
Ethylene cyanohydrin	11000 N	11000 N	4100 N	1000000 N	230000 N
Ethylene diamine	730 N	730 N	270 N	410000 N	16000 N
Ethylene glycol	73000 N	73000 N	27000 N	1000000 N	1000000 N
Ethylene glycol, monobutyl ether	210 N	210 N	0	0	0
Ethylene oxide	6.6 C	1.8 C	0.31 C	560 C	63 C
Ethylene thiourea (ETU)	57 C	5.3 C	2.7 C	4800 C	540 C
Ethyl ether	1200 N	7300 N	2700 N	1000000 N	160000 N
Ethyl methacrylate	3300 N	3300 N	1200 N	1000000 N	70000 N
Ethyl p-nitrophenyl phenylphosphorothioate	0.37 N	0.37 N	0.14 N	200 N	7.8 N
Ethylnitrosourea	0.048 C	0.0045 C	0.0023 C	4.1 C	0.46 C
Ethylphthalyl ethyl glycolate	110000 N	110000 N	41000 N	1000000 N	1000000 N
Express	290 N	290 N	110 N	160000 N	6300 N
Famphur	9.1 N	9.1 N	3.4 N	5100 N	200 N
Fluometuron	470 N	470 N	180 N	270000 N	10000 N
Fluoride	2200 N	2200 N	810 N	1000000 N	47000 N
Fluoridone	2900 N	2900 N	1100 N	1000000 N	63000 N
Fluridone	730 N	730 N	270 N	410000 N	16000 N
Flutolanil	2200 N	2200 N	810 N	1000000 N	47000 N
Fluvalinate	370 N	370 N	140 N	200000 N	7800 N
Folpet	1900 C	180 C	98 C	160000 C	18000 C
Formosulfon	35 C	3.3 C	1.7 C	3000 C	340 C
Formotion	73 N	73 N	27 N	41000 N	1600 N
Formaldehyde	7300 N	14 C	2700 N	1000000 N	160000 N
Formic Acid	73000 N	73000 N	27000 N	1000000 N	1000000 N
Fosetyl-al	110000 N	110000 N	41000 N	1000000 N	1000000 N
Furan	37 N	37 N	14 N	20000 N	780 N
Furazolidone	1.8 C	0.16 C	0.083 C	150 C	17 C
Furfural	110 N	520 N	41 N	61000 N	2300 N
Furium	0.13 C	0.813 C	0.0063 C	11 C	1.3 C
Fuxtocycloxr	220 C	21 C	11 C	19000 C	2100 C

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Glufosinate-ammonium	15 N	15 N	5.4 N	8200 N	310 N
Glycidaldehyde	15 N	10 N	5.4 N	8200 N	310 N
Glyphosate	3700 N	3700 N	1400 N	1000000 N	78000 N
Haloxyfop-methyl	1.8 N	1.8 N	0.68 N	1000 N	39 N
Harmony	470 N	470 N	180 N	270000 N	10000 N
HCH (alpha)	1.1 C	0.099 C	0.05 C	91 C	10 C
HCH (beta)	3.7 C	0.35 C	0.18 C	320 C	35 C
HCH (gamma) Lindane	5.2 C	0.48 C	0.24 C	440 C	49 C
HCH-technical	3.7 C	0.35 C	0.18 C	320 C	35 C
Heptachlor	0.23 C	0.14 C	0.07 C	130 C	14 C
Heptachlor epoxide	0.12 C	0.069 C	0.035 C	63 C	7 C
Hexabromobenzene	12 N	73 N	27 N	41000 N	1600 N
Hexachlorobenzene	0.66 C	0.39 C	0.2 C	360 C	40 C
Hexachlorobutadiene	14 C	8.1 C	4.0 C	7300 C	820 C
Hexachlorocyclopentadiene	0.15 N	0.73 N	95 N	140000 N	5500 N
Hexachlorodibenzo-p-dioxin mixture	0.0011 C	0.00014 C	0.000051 C	0.092 C	0.01 C
Hexachloroethane	75 C	45 C	23 C	410000 C	4600 C
Hexachlorophene	11 N	11 N	4.1 N	6100 N	230 N
Hexahydro-1,3,5-trinitro-1,3,5-triazine	61 C	5.7 C	2.9 C	5200 C	580 C
1,6-Hexamethylene diisocyanate	0.1 N	0.1 N	0	0	0
n-Hexane	350 N	2100 N	810 N	1000000 N	47000 N
Hexazinone	1200 N	1200 N	450 N	670000 N	26000 N
Hydrazine, hydrazine sulfate	2.2 C	0.037 C	0.11 C	190 C	21 C
Hydrogen chloride	210 N	210 N	0	0	0
Hydrogen sulfide	110 N	10 N	41 N	61000 N	2300 N
Hydroquinone	1500 N	1500 N	540 N	820000 N	31000 N
Imazalil	470 N	470 N	180 N	270000 N	10000 N
Imazaquin	9100 N	9100 N	3400 N	1000000 N	200000 N
Iprodione	1500 N	1500 N	540 N	820000 N	31000 N
Iron	11000 N	11000 N	4100 N	1000000 N	230000 N
Isobutanol	1800 N	11000 N	4100 N	1000000 N	230000 N
Isophorone	7100 C	660 C	330 C	600000 C	67000 C
Isopropalin	550 N	550 N	200 N	310000 N	12000 N
Isopropyl methyl phosphonic acid	3700 N	3700 N	1400 N	1000000 N	78000 N
Isoxaben	1800 N	1800 N	680 N	1000000 N	39000 N
Kepone	0.37 C	0.035 C	0.018 C	32 C	3.5 C
Lindane	73 N	73 N	27 N	41000 N	1600 N

	C-carcinogen		N-noncarcinogen		
		Ambient		Soil	
	Tap Water	Ambient Air	Fish	Industrial/ Commerical	Residential
Contaminant	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Linuron	73 N	73 N	27 N	41000 N	1600 N
Lithium	730 N	730 N	270 N	410000 N	16000 N
Londax	7300 N	7300 N	2700 N	1000000 N	160000 N
Malathion	730 N	730 N	270 N	410000 N	16000 N
Maleic anhydride	3700 N	3700 N	1400 N	1000000 N	78000 N
Maleic hydrazide	18000 N	18000 N	6800 N	1000000 N	390000 N
Malononitrile	0.73 N	0.73 N	0.27 N	410 N	16 N
Mancozeb	1100 N	1100 N	410 N	610000 N	23000 N
Maneb	180 N	180 N	68 N	100000 N	3900 N
**Manganese and compounds	8.0 N	0.52 N	310 N	470000 N	18000 N
Mephosfolan	3.3 N	3.3 N	1.2 N	1800 N	70 N
Mepiquat chloride	1100 N	1100 N	410 N	610000 N	23000 N
Mercuric chloride	11 N	11 N	4.1 N	6100 N	230 N
Mercury (inorganic)	11 N	3.1 N	4.1 N	6100 N	230 N
Mercury (methyl)	3.7 N	3.7 N	1.4 N	2000 N	78 N
Merphos	1.1 N	1.1 N	0.41 N	610 N	23 N
Merphos oxide	1.1 N	1.1 N	0.41 N	610 N	23 N
Metalaxyl	2200 N	2200 N	810 N	1000000 N	47000 N
Methacrylonitrile	3.7 N	7.3 N	1.4 N	2000 N	78 N
Methamidophos	1.8 N	1.8 N	0.68 N	1000 N	39 N
Methanol	18000 N	18000 N	6800 N	1000000 N	390000 N
Methidathion	37 N	37 N	14 N	20000 N	780 N
Methomyl	910 N	910 N	340 N	510000 N	20000 N
Methoxychlor	180 N	180 N	68 N	100000 N	3900 N
2-Methoxyethanol acetate	73 N	73 N	27 N	41000 N	1600 N
2-Methoxyethanol	37 N	210 N	14 N	20000 N	780 N
2-Methoxy-5-nitroaniline	150 C	14 C	6.9 C	12000 C	1400 C
Methyl acetate	37000 N	37000 N	14000 N	1000000 N	780000 N
Methyl acrylate	1180 N	1100 N	410 N	610000 N	23000 N
2-Methylaniline hydrochloride	37 C	3.5 C	1.8 C	3200 C	350 C
2-Methylaniline	28 C	2.6 C	1.3 C	2400 C	270 C
Methyl chlorocarbonate	37000 N	37000 N	14000 N	1000000 N	780000 N
4-(2-Methyl-4-chlorophenoxy) butyric acid	370 N	370 N	140 N	200000 N	7800 N
2-Methyl-4-chlorophenoxyacetic acid	18 N	18 N	6.8 N	10000 N	390 N
2-(2-Methyl-14-chlorophenoxy)propionic acid	37 N	37 N	14 N	20000 N	780 N
Methylcyclohexane	31000 N	31000 N	0	0	0
Methylene bromide	61 N	370 N	140 N	200000 N	7800 N

Contaminant	Tap Water ug/L	Ambient Ambient Air ug/m3	Fish mg/kg	Soil Industrial/ Commerical mg/kg	Soil Residential mg/kg
	C-carcinogen	N-noncarcinogen			
Methylene chloride	410 C	380 C	42 C	76000 C	8500 C
4,4'-Methylene bis(2-chloroaniline)	52 C	4.8 C	2.4 C	4400 C	490 C
4,4'-Methylenebisbenzeneamine	27 C	2.5 C	1.3 C	2300 C	260 C
4,4'-Methylene bis(N,N'-dimethyl)aniline	150 C	14 C	6.9 C	12000 C	1400 C
4,4'-Methylenediphenyl isocyanate	0.035 N	0.21 N	0	0	0
Methyl ethyl ketone	1900 N	10000 N	8100 N	1000000 N	470000 N
Methyl hydrazine	6.1 C	0.57 C	0.29 C	520 C	58 C
Methyl isobutyl ketone	2900 N	840 N	1100 N	1000000 N	63000 N
Methyl methacrylate	2900 N	2900 N	1100 N	1000000 N	63000 N
2-Methyl-5-nitroaniline	200 C	19 C	9.6 C	17000 C	1900 C
Methyl parathion	9.1 N	9.1 N	3.4 N	5100 N	200 N
2-Methylphenol (o-cresol)	1800 N	1800 N	680 N	1000000 N	39000 N
3-Methylphenol (m-cresol)	1800 N	1800 N	680 N	1000000 N	39000 N
4-Methylphenol (p-cresol)	180 N	180 N	68 N	100000 N	3900 N
Methyl styrene (mixture)	60 N	420 N	81 N	120000 N	4700 N
Methyl styrene (alpha)	430 N	2600 N	950 N	1000000 N	55000 N
Methyl tertbutyl ether (MTBE)	180 N	31000 N	68 N	100000 N	3900 N
Metolaclor (Dual)	5500 N	5500 N	2000 N	1000000 N	120000 N
Metribuzin	910 N	910 N	340 N	510000 N	20000 N
Mirex	3.7 C	0.35 C	0.18 C	320 C	35 C
Molinate	73 N	73 N	27 N	41000 N	1600 N
Molybdenum	180 N	180 N	68 N	100000 N	3900 N
Monochloramine	3700 N	3700 N	1400 N	1000000 N	78000 N
Naled	73 N	73 N	27 N	41000 N	1600 N
2-Naphthylamine	0.052 C	0.0048 C	0.0024 C	4.4 C	0.49 C
Napropamide	3700 N	3700 N	1400 N	1000000 N	78000 N
Nickel refinery dust	0	0.75 C	0	0	0
Nickel and compounds	730 N	730 N	270 N	410000 N	16000 N
Nickel subsulfide	0	0.37 C	0	0	0
Nitrapyrin	55 N	55 N	20 N	31000 N	1200 N
Nitrate	58000 N	58000 N	22000 N	1000000 N	1000000 N
Nitric oxide	3700 N	3700 N	1400 N	1000000 N	78000 N
Nitrite	3700 N	3700 N	1400 N	1000000 N	78000 N
2-Nitroaniline	2.2 N	2.1 N	0.81 N	1200 N	47 N
3-Nitroaniline	110 N	110 N	41 N	61000 N	2300 N
4-Nitroaniline	110 N	110 N	41 N	61000 N	2300 N
Nitrobenzene	3.4 N	21 N	6.8 N	10000 N	200 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Nitrofurantoin	2600 N	2600 N	950 N	1000000 N	55000 N
Nitrofurazone	4.5 C	0.067 C	0.21 C	380 C	43 C
Nitrogen dioxide	37000 N	37000 N	14000 N	1000000 N	780000 N
Nitroguanidine	3700 N	3700 N	1400 N	1000000 N	78000 N
4-Nitrophenol	2300 N	2300 N	840 N	1000000 N	48000 N
2-Nitropropane	210 N	0.067 C	0	0	0
N-Nitrosodi-n-butylamine	1.2 C	0.11 C	0.058 C	110 C	12 C
N-Nitrosodiethanolamine	2.4 C	0.22 C	0.11 C	200 C	23 C
N-Nitrosodiethylamine	0.045 C	0.0041 C	0.0021 C	3.8 C	0.43 C
N-Nitrosodimethylamine	0.13 C	0.013 C	0.0062 C	11 C	1.3 C
N-Nitrosodiphenylamine	1400 C	130 C	64 C	120000 C	13000 C
N-Nitroso di-n-propylamine	0.96 C	0.089 C	0.045 C	82 C	9.1 C
N-Nitroso-N-methylethylamine	0.31 C	0.028 C	0.014 C	26 C	2.9 C
N-Nitrosopyrrolidine	3.2 C	0.29 C	0.15 C	270 C	30 C
m-Nitrotoluene	61 N	370 N	140 N	200000 N	7800 N
o-Nitrotoluene	61 N	370 N	140 N	200000 N	7800 N
p-Nitrotoluene	61 N	370 N	140 N	200000 N	7800 N
Norflurazon	1500 N	1500 N	540 N	820000 N	31000 N
NuStar	26 N	26 N	9.5 N	14000 N	550 N
Octabromodiphenyl ether	110 N	110 N	41 N	61000 N	2300 N
Octahydro-1357-tetranitro-1357-tetrazocine	1800 N	1800 N	680 N	1000000 N	39000 N
Octamethylpyrophosphoramide	73 N	73 N	27 N	41000 N	1600 N
Oryzalin	1800 N	1800 N	680 N	1000000 N	39000 N
Oxadiazon	180 N	180 N	68 N	100000 N	3900 N
Oxamyl	910 N	910 N	340 N	510000 N	20000 N
Oxyfluorfen	110 N	110 N	41 N	61000 N	2300 N
Paclobutrazol	470 N	470 N	180 N	270000 N	10000 N
Paraquat	160 N	160 N	61 N	92000 N	3500 N
Parathion	220 N	220 N	81 N	120000 N	4700 N
Pebulate	1800 N	1800 N	680 N	1000000 N	39000 N
Pendimethalin	1500 N	1500 N	540 N	820000 N	31000 N
Pentabromo-6-chloro cyclohexane	290 C	27 C	14 C	25000 C	2800 C
Pentabromodiphenyl ether	73 N	73 N	27 N	41000 N	1600 N
Pentachlorobenzene	4.9 N	29 N	11 N	16000 N	630 N
Pentachloronitrobenzene	4.1 C	2.4 C	1.2 C	2200 C	250 C
Pentachlorophenol	56 C	5.2 C	2.6 C	4800 C	530 C
Permethrin	1800 N	1800 N	680 N	1000000 N	39000 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil	
				Industrial/ Commerical	Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Phenmedipham	9100 N	9100 N	3400 N	1000000 N	200000 N
Phenol	22000 N	22000 N	8100 N	1000000 N	470000 N
m-Phenylenediamine	220 N	220 N	81 N	120000 N	4700 N
p-Phenylenediamine	6900 N	6900 N	2600 N	1000000 N	150000 N
Phenylmercuric acetate	2.9 N	2.9 N	1.1 N	1600 N	63 N
2-Phenylphenol	3500 C	320 C	160 C	300000 C	33000 C
Phorate	7.3 N	7.3 N	2.7 N	4100 N	160 N
Phosmet	730 N	730 N	270 N	410000 N	16000 N
Phosphine	11 N	3.1 N	4.1 N	6100 N	230 N
Phosphoric acid	100 N	100 N	0	0	0
Phosphorus (white)	0.73 N	0.73 N	0.27 N	410 N	16 N
p-Phthalic acid	37000 N	37000 N	14000 N	1000000 N	780000 N
Phthalic anhydride	73000 N	1300 N	27000 N	1000000 N	1000000 N
Picloram	2600 N	2600 N	950 N	1000000 N	55000 N
Pirimiphos-methyl	370 N	370 N	140 N	200000 N	7800 N
Polybrominated biphenyls	0.76 C	0.07 C	0.035 C	64 C	5.5 N
Polychlorinated biphenyls (PCBs)	3.35 C	0.313 C	0.160 C	286 C	31.9 C
Aroclor 1016	2.6 N	2.6 N	0.95 N	1400 N	55 N
Aroclor 1254	0.73 N	0.73 N	0.27 N	410 N	16 N
Polychlorinated terphenyls (PCTs)	1.5 C	0.14 C	0.07 C	130 C	14 C
Polynuclear aromatic hydrocarbons	0	0	0	0	0
Acenaphthene	2200 N	2200 N	810 N	1000000 N	47000 N
Anthracene	11000 N	11000 N	4100 N	1000000 N	230000 N
Benz[a]anthracene	9.2 C	1 C	0.43 C	780 C	88 C
Benzo[b]fluoranthene	9.2 C	1 C	0.43 C	780 C	88 C
Benzo[k]fluoranthene	92 C	10 C	4.3 C	7800 C	870 C
Benzo[a]pyrene	0.92 C	0.1 C	0.043 C	78 C	8.8 C
Carbazole	340 C	31 C	16 C	29000 C	3200 C
Chrysene	920 C	100 C	43 C	78000 C	8700 C
Dibenz[ah]anthracene	0.92 C	0.1 C	0.043 C	78 C	8.8 C
Fluoranthene	1500 N	1500 N	540 N	820000 N	31000 N
Fluorene	1500 N	1500 N	540 N	820000 N	31000 N
Indeno[1,2,3-cd]pyrene	9.2 C	1 C	0.43 C	780 C	88 C
Naphthalene	1500 N	1500 N	540 N	820000 N	31000 N
Pyrene	1100 N	1100 N	410 N	610000 N	23000 N
Prochloraz	45 C	4.2 C	2.1 C	3800 C	430 C
Profluralin	220 N	220 N	81 N	120000 N	4700 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Prometon	550 N	550 N	200 N	310000 N	12000 N
Prometryn	150 N	150 N	54 N	82000 N	3100 N
Pronamide	2700 N	2700 N	1000 N	1000000 N	59000 N
Propachlor	470 N	470 N	180 N	270000 N	10000 N
Propanil	180 N	180 N	68 N	100000 N	3900 N
Propargite	730 N	730 N	270 N	410000 N	16000 N
Propargyl alcohol	73 N	73 N	27 N	41000 N	1600 N
Propazine	730 N	730 N	270 N	410000 N	16000 N
Propham	730 N	730 N	270 N	410000 N	16000 N
Propiconazole	470 N	470 N	180 N	270000 N	10000 N
Propylene glycol	730000 N	730000 N	270000 N	1000000 N	1000000 N
Propylene glycol, monomethyl ether	26000 N	26000 N	9500 N	1000000 N	550000 N
Propylene glycol, monomethyl ether	26000 N	21000 N	9500 N	1000000 N	550000 N
Propylene oxide	28 C	49 C	1.3 C	2400 C	270 C
Pursuit	9100 N	9100 N	3400 N	1000000 N	200000 N
Pydrin	910 N	910 N	340 N	510000 N	20000 N
Pyridine	37 N	37 N	14 N	20000 N	780 N
Quinalphos	18 N	18 N	6.8 N	10000 N	390 N
Quinoline	0.56 C	0.052 C	0.026 C	48 C	5.3 C
Resmethrin	1100 N	1100 N	410 N	610000 N	23000 N
Rescue	1800 N	1800 N	680 N	1000000 N	39000 N
Rotenone	150 N	150 N	54 N	82000 N	3100 N
Savey	910 N	910 N	340 N	510000 N	20000 N
Selenious Acid	180 N	180 N	68 N	100000 N	3900 N
Selenium	180 N	180 N	68 N	100000 N	3900 N
Selenourea	180 N	180 N	68 N	100000 N	3900 N
Sethoxydim	3300 N	3300 N	1200 N	1000000 N	70000 N
Silver and compounds	180 N	180 N	68 N	100000 N	3900 N
Simazine	56 C	5.2 C	2.6 C	4800 C	530 C
Sodium azide	150 N	150 N	54 N	82000 N	3100 N
Sodium diethyldithiocarbamate	25 C	2.3 C	1.2 C	2100 C	240 C
Sodium fluoroacetate	0.73 N	0.73 N	0.27 N	410 N	16 N
Sodium metavanadate	37 N	37 N	14 N	20000 N	780 N
Strontium, stable	22000 N	22000 N	8100 N	1000000 N	470000 N
Strychnine	11 N	11 N	4.1 N	6100 N	230 N
Styrene	1600 N	10000 N	2700 N	1000000 N	160000 N
Systhane	810 N	[illegible]	[illegible]	[illegible]	[illegible]

Contaminant	C=carcinogen N=noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
2,3,7,8-TCDD (dioxin)	0.000043 C	0.0000054 C	0.000002 C	0.0037 C	0.00041 C
Tebuthiuron	2600 N	2600 N	950 N	1000000 N	55000 N
Temephos	730 N	730 N	270 N	410000 N	16000 N
Terbacil	470 N	470 N	180 N	270000 N	10000 N
Terbufos	0.91 N	0.91 N	0.34 N	510 N	20 N
Terbutryn	37 N	37 N	14 N	20000 N	780 N
1,2,4,5-Tetrachlorobenzene	1.8 N	11 N	4.1 N	6100 N	230 N
1,1,1,2-Tetrachloroethane	41 C	24 C	12 C	22000 C	2500 C
1,1,2,2-Tetrachloroethane	5.2 C	3.1 C	1.6 C	2900 C	320 C
Tetrachloroethylene (PCE)	110 C	310 C	6.1 C	11000 C	1200 C
2,3,4,6-Tetrachlorophenol	1100 N	1100 N	410 N	610000 N	23000 N
p,a,a,a-Tetrachlorotoluene	0.053 C	0.031 C	0.016 C	29 C	3.2 C
Tetrachlorovinphos	280 C	26 C	13 C	24000 C	2700 C
Tetraethyldithiopyrophosphate	18 N	18 N	6.8 N	10000 N	390 N
Tetraethyl lead	0.0037 N	0.0037 N	0.0014 N	2 N	0.078 N
1,1,1,2-Tetrafluoroethane	140000 N	840000 N	0	0	0
Thallic oxide	2.6 N	2.6 N	0.95 N	1400 N	55 N
Thallium	0	0	0	0	0
Thallium acetate	3.3 N	3.3 N	1.2 N	1800 N	70 N
Thallium carbonate	2.9 N	2.9 N	1.1 N	1600 N	63 N
Thallium chloride	2.9 N	2.9 N	1.1 N	1600 N	63 N
Thallium nitrate	3.3 N	3.3 N	1.2 N	1800 N	70 N
Thallium selenite	3.3 N	3.3 N	1.2 N	1800 N	70 N
Thallium sulfate	2.9 N	2.9 N	1.1 N	1600 N	63 N
Thiobencarb	370 N	370 N	140 N	200000 N	7800 N
2-(Thiocyanomethylthio)-benzothiazole	1100 N	1100 N	410 N	610000 N	23000 N
Thiofanox	11 N	11 N	4.1 N	6100 N	230 N
Thiophanate-methyl	2900 N	2900 N	1100 N	1000000 N	63000 N
Thiram	180 N	180 N	68 N	100000 N	3900 N
Tin and compounds	22000 N	22000 N	8100 N	1000000 N	470000 N
Toluene	750 N	4200 N	2700 N	1000000 N	160000 N
Toluene-2,4-diamine	2.1 C	0.2 C	0.099 C	180 C	20 C
Toluene-2,5-diamine	22000 N	22000 N	8100 N	1000000 N	470000 N
Toluene-2,6-diamine	7300 N	7300 N	2700 N	1000000 N	160000 N
p-Toluidine	35 C	3.3 C	1.7 C	3000 C	340 C
Toxaphene	6.1 C	0.56 C	0.29 C	520 C	58 C
Tralomethrin	270 N	270 N	100 N	150000 N	5900 N

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Triallate	470 N	470 N	180 N	270000 N	10000 N
Triasulfuron	370 N	370 N	140 N	200000 N	7800 N
1,2,4-Tribromobenzene	30 N	180 N	68 N	100000 N	3900 N
Tributyltin oxide (TBTO)	1.1 N	1.1 N	0.41 N	610 N	23 N
2,4,6-Trichloroaniline hydrochloride	230 C	22 C	11 C	20000 C	2230 C
2,4,6-Trichloroaniline	200 C	18 C	9.3 C	17000 C	1900 C
1,2,4-Trichlorobenzene	190 N	2100 N	140 N	200000 N	7800 N
*1,1,1-Trichloroethane	790 N	10000 N	470 N	720000 N	27000 N
1,1,2-Trichloroethane	19 C	11 C	5.5 C	10000 C	1100 C
Trichloroethylene (TCE)	160 C	100 C	29 C	52000 C	4700 N
Trichlorofluoromethane	1300 N	7300 N	4100 N	1000000 N	230000 N
2,4,5-Trichlorophenol	3700 N	3700 N	1400 N	1000000 N	78000 N
2,4,6-Trichlorophenol	610 C	57 C	29 C	52000 C	5800 C
2,4,5-Trichlorophenoxyacetic acid	370 N	370 N	140 N	200000 N	7800 N
2-(2,4,5-Trichlorophenoxy)propionic acid	290 N	290 N	110 N	160000 N	6300 N
1,1,2-Trichloropropane	30 N	180 N	68 N	100000 N	3900 N
1,2,3-Trichloropropane	0.15 C	0.089 C	0.045 C	82 C	9.1 C
1,2,3-Trichloropropane	30 N	180 N	68 N	100000 N	3900 N
1,1,2-Trichloro-1,2,2- trifluoroethane	59000 N	310000 N	410000 N	1000000 N	1000000 N
Triflphene	110 N	110 N	41 N	61000 N	2300 N
Triethylamine	73 N	73 N	0	0	0
Trifluralin	870 C	81 C	41 C	74000 C	5900 N
1,2,4-Trimethylbenzene	300 N	1800 N	680 N	1000000 N	39000 N
1,3,5-Trimethylbenzene	300 N	1800 N	680 N	1000000 N	39000 N
Trimethyl phosphate	180 C	17 C	8.5 C	15000 C	1700 C
1,3,5-Trinitrobenzene	1.8 N	1.8 N	0.68 N	1000 N	39 N
Trinitrophenylmethylnitramine	370 N	370 N	140 N	200000 N	7800 N
2,4,6-Trinitrotoluene	18 N	18 N	6.8 N	10000 N	390 N
Uranium (soluble salts)	110 N	110 N	41 N	61000 N	2300 N
Vanadium	260 N	260 N	95 N	140000 N	5500 N
Vanadium pentoxide	330 N	330 N	120 N	180000 N	7000 N
Vanadium sulfate	730 N	730 N	270 N	410000 N	16000 N
Vernam	37 N	37 N	14 N	20000 N	780 N
Vinclozolin	910 N	910 N	340 N	510000 N	20000 N
Vinyl acetate	37000 N	2100 N	14000 N	1000000 N	780000 N
Vinyl bromide	5.2 N	31 N	0	0	0
Vinyl chloride	1.9 C	2.1 C	0.17 C	300 C	34 C

Contaminant	C-carcinogen N-noncarcinogen				
	Tap Water	Ambient Ambient Air	Fish	Soil Industrial/ Commerical	Soil Residential
	ug/L	ug/m3	mg/kg	mg/kg	mg/kg
Warfarin	11 N	11 N	4.1 N	6100 N	230 N
m-Xylene	1400 N	7300 N	27000 N	1000000 N	1000000 N
o-Xylene	1400 N	7300 N	27000 N	1000000 N	1000000 N
p-Xylene	520 N	3100 N	0	0	0
Xylene (mixed)	12000 N	73000 N	27000 N	1000000 N	1000000 N
Zinc	11000 N	11000 N	4100 N	1000000 N	230000 N
Zinc phosphide	11 N	11 N	4.1 N	6100 N	230 N
Zineb	1800 N	1800 N	680 N	1000000 N	39000 N

Current Drinking Water Standards

En español
Printable PDF version

National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. The table below divides these contaminants into:

Microorganisms ~ Disinfectants & Disinfection Byproducts
Inorganic Chemicals ~ Organic Chemicals ~ Radionuclides

For more information, see Setting Standards for Safe Drinking Water to learn about EPA's standard-setting process or look at a timeline that shows the order in which EPA regulated these contaminants. For copies of the complete regulations regarding these contaminants, follow these links to the National Primary Drinking Water Regulations and National Secondary Drinking Water Regulations.

National Primary Drinking Water Regulations

Microorganisms	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Cryptosporidium	as of 01/01/02: zero	as of 01/01/02: TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Giardia lamblia	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count	n/a	TT[3]	HPC has no health effects, but can indicate how effective treatment is at controlling microorganisms.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	zero	TT[3]	Legionnaire's Disease, commonly known as pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and *E. Coli*)	zero	5.0%[4]	Used as an indicator that other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment; fecal coliforms and E. coli come from human and animal fecal waste.
Turbidity	n/a	TT[3]	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 symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff
Viruses (enteric)	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste

Disinfectants & Disinfection Byproducts	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Bromate	as of 01/01/02: zero	as of 01/01/02: 0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chloramines (as Cl_2)	as of 01/01/02: MRDLG=4	as of 01/01/02: MRDL=4.0	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl_2)	as of 01/01/02: MRDLG=4	as of 01/01/02: MRDL=4.0	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as ClO_2)	as of 01/01/02: MRDLG=0.8	as of 01/01/02: MRDL=0.8	Anemia; infants & young children: nervous system effects	Water additive used to control microbes
Chlorite	as of 01/01/02: 0.8	as of 01/01/02: 1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	as of 01/01/02: n/a	as of 01/01/02: 0.060	Increased risk of cancer	Byproduct of drinking water disinfection
Total Trihalomethanes (TTHMs)	none / as of 01/01/02: n/a	0.10 / as of 01/01/02: 0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection

Inorganic Chemicals	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood glucose	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	none	0.05	Skin damage; circulatory system problems, increased risk of cancer	Erosion of natural deposits; runoff from glass & electronics production wastes
Asbestos (fiber >10 micrometers)	7 million fibers per liter	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (total)	0.1	0.1	Some people who use water containing chromium well in excess of the MCL over many years could experience allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	TT; 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 their water systems exceed the copper action level.	Corrosion of household plumbing systems; erosion of natural deposits
Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	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
Lead	zero	TT; Action Level=0.015	Infants and children: Delays in physical or mental development. Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits;

				factories; runoff from landfills and cropland
Nitrate (measured as Nitrogen)	10	10	"Blue baby syndrome" in infants under six months - life threatening without immediate medical attention. Symptoms: Infant looks blue and has shortness of breath.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	"Blue baby syndrome" in infants under six months - life threatening without immediate medical attention. Symptoms: Infant looks blue and has shortness of breath.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and pharmaceutical companies

Organic Chemicals	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Acrylamide	zero	TT[9]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system problems; reproductive difficulties	Runoff from herbicide used on row crops
Benzene	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills
Benzo(a)pyrene (PAHs)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
Carbofuran	0.04	0.04	Problems with blood or nervous system; reproductive difficulties.	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories
p-Dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-Dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-Dichloroethylene	0.1	0.1	Liver problems	Discharge from industrial chemical factories
Dichloromethane	zero	0.005	Liver problems; increased risk of cancer	Discharge from pharmaceutical and chemical factories
1,2-Dichloropropane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	General toxic effects or reproductive difficulties	Leaching from PVC plumbing systems; discharge from chemical factories
Di(2-ethylhexyl) phthalate	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on

Dioxin (2,3,7,8-TCDD)	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
Endrin	0.002	0.002	Nervous system effects	Residue of banned insecticide
Epichlorohydrin	zero	TT	Stomach problems; reproductive difficulties; increased risk of cancer	Discharge from industrial chemical factories; added to water during treatment process
Ethylbenzene	0.7	0.7	Liver or kidney problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Stomach problems; reproductive difficulties; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use
Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	zero	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
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased risk of cancer	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, and circulatory problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
Trichloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from petroleum refineries
Vinyl chloride	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Alpha particles	none[7] ——— as of 12/08/03: zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits
Beta particles and photon emitters	none[7] ——— as of 12/08/03: zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits
Radium 226 and Radium 228 (combined)	none[7] ——— as of 12/08/03: zero	5 pCi/L	Increased risk of cancer	Erosion of natural deposits
Uranium	as of 12/08/03: zero	as of 12/08/03: 30 ug/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

Notes

[1] Definitions:
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 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 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.
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.
Treatment Technique - 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.

[3] 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:* (as of January 1, 2002) 99% removal/inactivation
- *Giardia lamblia:* 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter.

[4] No more than 5.0% 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). Every sample that has total coliforms must be analyzed for fecal coliforms. There may not be any fecal coliforms or *E. coli*.

[5] Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

[6] *Although there is no collective* MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L). Chloroform is regulated with this group but has no MCLG.
- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L). Monochloroacetic acid, bromoacetic acid, and dibromoacetic acid are regulated with this group but have no MCLGs.

[7] MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act. Therefore, there is no MCLG for this contaminant.

[8] Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% 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.

[9] Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are *non-enforceable guidelines regulating 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, states may choose to adopt them as enforceable standards. For more information, read Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals.

Contaminant	Secondary Standard
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

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Section 742.APPENDIX B: Tier 1 Tables and Illustrations

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	Class I (mg/L)	Class II (mg/L)
83-32-9	Acenaphthene	0.42	2.1
67-64-1	Acetone	0.7	0.7
15972-60-8	Alachlor	0.002[c]	0.01[c]
116-06-3	Aldicarb	0.003[c]	0.015[c]
309-00-2	Aldrin	0.00004[a]	0.0002
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]
111-44-4	Bis(2-chloroethyl)ether	0.01[a]	0.01
117-81-7	Bis(2-ethylhexyl)phthalate	0.006[a,c]	0.06[c]
75-27-4	Bromodichloromethane (Dichlorobromomethane)	0.00002[a]	0.00002
75-25-2	Bromoform	0.0002[a]	0.0002
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)
108-90-7	Chlorobenzene (Monochlorobenzene)	0.1[c]	0.5[c]
124-48-1	Chlorodibromomethane (Dibromochloromethane)	0.14	0.14
67-66-3	Chloroform	0.00002[a]	0.0001
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	0.00011[a]	0.00055
72-55-9	DDE	0.00004[a]	0.0002
50-29-3	DDT	0.00012[a]	0.0006
53-70-3	Dibenzo(*a,h*)anthracene	0.0003[a]	0.0015
96-12-8	1,2-Dibromo-3-chloropropane	0.0002[c]	0.0002[c]
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	0.00005[a,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]
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	0.00002[a]	0.0001
84-66-2	Diethyl phthalate	5.6	5.6
121-14-2	2,4-Dinitrotoluene[a]	0.00002	0.00002
606-20-2	2,6-Dinitrotoluene[a]	0.0001	0.0001
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)	0.00003[a]	0.00015
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
75-09-2	Methylene chloride (Dichloromethane)	0.005[c]	0.05[c]
91-20-3	Naphthalene[2]	0.025	0.039
98-95-3	Nitrobenzene[2]	0.0035	0.0035

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
1918-02-1	Picloram	0.5[c]	5.0[c]
1336-36-3	Polychlorinated biphenyls (PCBs)[a]	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[2]	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]
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]
	Ionizable Organics		
65-85-0	Benzoic Acid	28	28
106-47-8	4-Chloroaniline (*p*-Chloroaniline)	0.028	0.028
95-57-8	2-Chlorophenol	0.035	0.175
120-83-2	2,4-Dichlorophenol	0.021	0.021
105-67-9	2,4-Dimethylphenol	0.14	0.14
51-28-5	2,4-Dinitrophenol	0.014	0.014
95-48-7	2-Methylphenol (*o* - Cresol)	0.35	0.35
86-30-6	*N*-Nitrosodiphenylamine	0.01[a]	0.05

		Groundwater Remediation Objective	
CAS No.	Chemical Name	Class I (mg/L)	Class II (mg/L)
621-64-7	*N*-Nitrosodi-*n*-propylamine	0.01[a]	0.01
87-86-5	Pentachlorophenol	0.001[a,c]	0.005[c]
108-95-2	Phenol	0.1[c]	0.1[c]
95-95-4	2,4,5-Trichlorophenol	0.7	3.5
88-06-2	2,4,6 Trichlorophenol	0.0064[a]	0.032
	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]
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]
7439-96-5	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]
7782-49-2	Selenium	0.05[c]	0.05[c]
7440-22-4	Silver	0.05[c]	---
14808-79-8	Sulfate	400[c]	400[c]