October 22, 2004

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: **SAMPLING AND ANALYSIS - ATTACHMENT 1**
TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Key definitions for terms used in this document:

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

PURPOSE

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

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

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

TARGET DETECTION LIMITS

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

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

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

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

DESIGNATED METHODS

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

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

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

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

CONTAMINANTS WITH TDLS HIGHER THAN THE MOST RESTRICTIVE CRITERIA

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

CONTAMINANTS WITHOUT TDLS OR DESIGNATED ANALYTICAL METHODS

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

ELEVATION OF REPORTING LIMITS

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

USE OF ALTERNATE REPORTING LIMITS

Alternate reporting limits may be acceptable:

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

APPLICATION OF REPORTING LIMITS

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

Questions about this memorandum attachment should be directed as follows:

- Site investigation and response activities under Part 201 and Part 213:
  A. Ralph Curtis, Laboratory Specialist
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- Site assessments under Part 211:
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The following documents are rescinded with the issuance of this attachment:

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

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

GENERAL CHANGES FROM PREVIOUS GUIDANCE

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

CHANGES IN METHODS

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

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

TDL REVISIONS MADE WITH THIS DOCUMENT

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

APPENDAGES TO THIS ATTACHMENT:

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

Contaminants	CAS/ID	Water TDL ug/L	Soil TDL ug/Kg	Designated Methods
Specific Contaminants				
Acetic Acid	64197	**[1,000]**	20,000	Analysis for acetate is used
Acetate	ACETATE	1,000	20,000	Ion Chromatography [1]
Chloride	16887006	10,000	200,000	300.1 9056 9212 9250 9251 9253 [325 methods] Use water extracts for soils
Dissolved Oxygen	DO	80	-----	360.1 360.2
Fluoride	7782414	1000	5000	9214 300.1 9056 340.1 Soils [2]
Formic Acid	64186	1,000	20,000	Analysis for formate is used
Formate [3]	FORMATE	1,000	20,000	Ion Chromatography [1]
Hardness[4]	HARDCALC	-----	NA	Calculate from separate Ca and Mg results using SM 2340B
Perchlorate	14797730	3	-----	314.0 9058
pH	PH	-----	-----	9040C (waters) 9045D (soils)
Phosphorus (White)	12185103	0.005	1	7580
Phosphorus (total)	7723140	10	200	365.4 (waters) 6010 6020 200.7 200.8 Soils [5]
Petroleum Hydrocarbon Material	PET_HYD	See Method	See Method	1664 9071B 8440
Sulfate	14808798	1000	50,000	300.1 9056 9035 9036 375.1 375.2 Soils [6]
Sulfide, Dissolved .and Acid Solution.	18496258	200	1000	[9030 with 9034 or 9215] 376.1 376.2
Total Dissolved Solids	TDS	10,000	----	160.1
Cyanide [7]	57125			
Cyanide, Available	CN_AVAIL	5	100	OIA 1677 Soils: Extract with 9013. 335.1 Modified for soils.
Cyanide, Amenable	CN_AMEN	5	----	9019B 9012A
Cyanide, Total	CN_TOTAL	----	100	9010B 9012A Kelada-01 335.2
Nitrogen Forms [8]				
Ammonia-N	7664417	25	1000	350.1/2/3 (Waters) For soils see [9]
Nitrate-N	14797558	100	1000	300.1 9056 353.2 For soils see [10]
Nitrite-N	14797650	100	1000	300.1 9056 353.2 For soils see [10]
Kjeldahl-N	TKN	100	1000	351.1 351.2 351.3 351.4
Urea	57136	400	20,000	983.01
Nitrogen, Total (elemental)	7727379	100	1000	See footnote 8

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

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

TABLE 1. TARGET DETECTION LIMITS AND DESIGNATED ANALYTICAL METHODS

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

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

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

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

Abbreviations used in Table 1:

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

Notations in Table 1:

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

Table 1 Footnotes:

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

TABLE 1. ABBREVIATIONS AND FOOTNOTES

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

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

TABLE 1. ABBREVIATIONS AND FOOTNOTES

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

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

TABLE 1. ABBREVIATIONS AND FOOTNOTES

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

20. GC/MS may be used anytime the laboratory's reporting limits for the method can measure the applicable criteria, including Ion Trap and single/selected ion monitoring (SIM). SIM can be used to lower the reporting limits for the PNAs about twenty times less than obtainable using full scan on the GC/MS.
21. When analyses of these are requested using GC/MS, SIM analyses must be conducted on all samples with no detects found in the full scan mode. Positive detects in the SIM mode should then be appropriately coded to indicate SIM analyses was conducted.
22. Isomer specific concentrations of 2-, 3-, and 4-, methylphenols must be added together for comparison to methylphenols criteria for pathways other than the GSI pathway. For the GSI pathway isomer specific concentrations should be compared to the following values: 2-methylphenol 82 ug/l; 3-methylphenol 71 ug/l; 4-methylphenol 25 ug/l.
23. For response activities under Part 201 and Part 213, if the GSI and the drinking water pathways have been appropriately documented to be "not relevant", then a water TDL of 20 ug/L and soil TDL of 800 ug/Kg may be used.
24. For response activities under Part 201 and Part 213, if the GSI pathway has been appropriately documented to be "not relevant", then a water TDL of 10 ug/L and soil TDL of 330 ug/Kg may be used.
25. This TDL applies only for response activities under Part 201 and Part 213, if the drinking water pathway has been appropriately documented to be not relevant. See the parameter group "Explosives" for the appropriate method for this compound for site assessment and site investigation. Aniline is a product of nitrobenzene degradation in waters and soils and should be included in the analytical scheme when possible.
26. Soil sampling collection and preservation specifications for volatiles including protocol for methanol preservation are contained in RRD Operational Memorandum No. 2, Attachment 6.
27. This is a common laboratory solvent. Cautious review is required of analytical results for laboratory blanks to assess compliance.
28. High temperature purging and/or isotope dilution procedures may be required.
29. This contaminant is a reactive compound which requires special sampling and holding time requirements.
30. The concentrations of the cis and trans isomers must be added and reported as 1,3-Dichloropropene.
31. These contaminants are oxygenates and may be found at sites where gasoline products were used.
32. Trihalomethanes refers to chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The concentrations of all trihalomethanes must be added and compared to the criteria. (See R 299.5750 footnote (W)).
33. The concentrations of the m-, p-, and o- xylene isomers must be added and the total compared to the total xylenes criteria.
34. Aldicarb Sulfone and Aldicarb Sulfoxide are metabolites of Aldicarb.
35. The monoacid (CAS 887547) and diacid (CAS 2136790) metabolites of Dacthal are measured as one compound and compared to the criteria for Dactal (CAS 1861321).
36. For comparison to the criteria, isomer specific concentrations for trans-Chlordane, (CAS RN 5103719), and cis-Chlordane, (CAS RN 510374) must be reported separately and the sum of their concentrations reported as Chlordane, (CAS RN 57749). If compounds other than

TABLE 1. ABBREVIATIONS AND FOOTNOTES

cis and trans-Chlordane are used to calculate the chlordane concentration, report the concentrations of each separately and report Chlordane, (CAS RN 57749) using the guidance in Method 8081B for calculation. Some components of the mixture may have specific criteria, which must also be met.

37. 4,4'-DDD and 4,4'DDE are metabolites of DDT.
38. Isomer specific concentrations of Endosulfan I, (CAS 959988), and Endosulfan II, (CAS 33213659) must be added for comparison to Endosulfan criteria.
39. The term "Polybrominated biphenyls" listed in the rules and in this table (CAS 67774327) refers to a product used in Michigan, called Firemaster FF1. Firemaster FF1 consisted of several polybrominated biphenyls, the most prevalent being hexabrominated biphenyl (56%). Subsequently, cleanup criteria was established for waters and soils which applied to that product, and designated methods for the product were based on the concentrations of hexabrominated biphenyl. Recently the group of contaminants known as brominated biphenyl congeners have become a concern and it is necessary to distinguish between the product Firemaster FF1 and the individual brominated biphenyl congeners. Calibration and quantitation of FireMaster in samples should be accomplished by using technical brand FireMaster as the calibrant and quantitating using the procedures in method 8082 for calibrating Aroclor products. If the FireMaster technical product is not available, use the most dominant hexabromobiphenyl peak present in the FireMaster product as the calibrant, and report the concentrations found for that isomer as FireMaster.
40. Commercial products with specific mixtures of polychlorinated congeners were sold in the United States under product names beginning with Aroclor. The term in the table, Polychlorinated biphenyls (PCBs) refers to the total concentration of all Aroclor products found at a facility. The concentrations of the Aroclors found at a facility must be added together to obtain a total concentration, and the total concentration used for comparison to the criteria. (R 299.5750 footnotes (J) and (T)). Laboratories should report data below the reporting limits and above the method detection limits when possible, coded to indicate estimates.
41. When attempts are not successful to match the patterns of the Aroclor products with the pattern found in a sample, laboratories should report Aroclor (unspecified), (CAS 1267792), and its concentration determined using the Aroclor 1260 calibration.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

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

TOXICITY EQUIVALENT FACTORS FOR CHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

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

COMPOUND	TEF
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HxCDF	0.01
1,2,3,4,7,8,9-HxCDF	0.01
1,2,3,4,6,7,8,9-OCDD	0.0001 (0.001)*

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

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

TABLE 1. ABBREVIATIONS AND FOOTNOTES

44. Organic carbon and total organic carbon are different descriptions for the same parameter being determined, organic carbon. The following are requirements in the sampling and analysis for organic carbon.

    a) Results for organic carbon may not be used to calculate organic matter concentrations without prior approval from the MDEQ.
    b) Results for organic matter may not be used to calculate organic carbon concentrations without prior approval from the MDEQ.
    c) Soil samples must be representative of the soils at sites, from about six inches below the surface down to the mean annual depth of the water table, and representative of the soils based on heterogeneity.
    d) Soil vegetation should not be included with the soil samples as organic carbon results must represent that in the natural soil.
    e) Soil samples should not be taken from areas significantly impacted by contamination.

45. Method 415.3, "Determination of Total Organic Carbon and Specific UV Absorbance at 254 nm in Source Water and Drinking Water", Revision 1.0, June 2003, U.S. EPA, Office of Research and Development, U.S. EPA, Cincinnati, OH 45268, or an equivalent method, is recommended. Other methods can be used upon approval by the MDEQ and equivalency to the analysis and quality control as provided in method 415.3 will be the basis by which other methods are evaluated.
46. Walkley-Black methods measure the organic carbon in soils that is easily oxidized after removal of inorganic forms of carbon by acidification and heating. These methods are most appropriate for soils with less than 2 percent organic matter, and should not be used for soils with more than 6 percent organic matter.
47. Total organic carbon (TOC) methods generally refer to those methods that measure the organic carbon by ignition at high temperatures. See method 415.3 for guidance for waters. For soils, the following are minimum sampling and analysis requirements for these methods. Prior approval must be obtained from the MDEQ to use specific methods. Approval to use proposed methods will be based on a review for adequate quality control and application based on site specific factors.

    a) Instrument systems must be used that are capable of quantitatively determining organic carbon in the presence of inorganic forms of carbon, such as carbonate and bicarbonate.
    b) Methods must demonstrate capability to remove inorganic forms prior to measurements for organic carbon.
    c) Strong acids must be used to remove inorganic forms of carbon. Persulfate and hydrochloric acids are recommended.
    d) Methods that use a mixture of water and soil, and/or use methods designed for waters and/or wastes, are unacceptable.
    e) Methods that determine organic carbon by subtracting inorganic carbon measurements from total carbon measurements are unacceptable.
    f) Organic carbon must be reported as a percentage of the dry weight of the unacidified samples to the nearest 0.1% unit.
    g) TOC methods are most appropriate for soils with greater the 6 percent organic matter.

TABLE 1. ABBREVIATIONS AND FOOTNOTES

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

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

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

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

Method	Title
605	Benzidines

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

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

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

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

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

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

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

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

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

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

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

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

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

Standard Methods for the Examination of Water and Wastewater

Method	Title
SM6651	Glyphosate Herbicide
SM2340 B	Hardness by Calculation

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

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

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

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

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

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Method

Walkley-Black Method

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

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

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

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

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

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

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

Methods of Soil Analysis

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

Modified Wisconsin Methods

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

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

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

ASTM Standards, Americal Society of Testing Materials

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

TABLE 2. SOURCE DOCUMENTS FOR DESIGNATED ANALYTICAL METHODS

Methane Procedures

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

Pesticide Analytical Methods (PAM), I and II

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

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

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

Contaminant Group	Contaminant	CAS/ID	WATER TDL ug/L	SOIL TDL ug/Kg
Specific Contaminants	*Acetate*	ACETATE	1,000	20,000
	Asbestos	1332214	7 MFL	1 %
	Dissolved Oxygen	DO	80	-----
	Formate	FORMATE	1,000	20,000
	Perchlorate	14797730	3	-----
	Petroleum Hydrocarbon Material	PET_HYD	5,000	250,000
	pH	pH	-----	-----
	Total Dissolved Solids	TDS	10,000	----
Nitrogen Forms	Kjeldahl-N	TKN	50	1,000
	Nitrogen, Total (elemental)	7727379	100	1,000
Metals	Chromium III	16065831	10	2,000
	Lead, Coarse Fraction	7439921	3	1,000
	Lead, Fine Fraction	7439921	3	1,000
Glycols	Triethylene Glycol	112276	4,000	50,000
Volatiles	Trihalomethanes (group)	THM	100	-----
	Tetranitromethane	509148	100	500
Oxygenates	*Di-isopropyl ether (DIPE)*	108203	5	250
	Ethyl(tert)butylether (ETBE)	637923	5	250
	Tertiaryamylmethylether (TAME)	994058	5	250
Carbamates	Linuron	330552	0.1	-----
	Oxamyl	23135220	10	100
Acid Herbicides	*Dacthal metabolites*	DACMET	1	-----
Chlorinated Pest.	Endosulfan (group)	115297	0.03	20
Organophosphorus	Disulfoton	198044	1	50
	EPTC (s-ethyl-diproplythiocarbamate)	759944	3	100
	Molinate	2212671	2	100
	Terbacil	5902512	20	-----
	Triphenylphosphate	115866	10	500
	Turbofos	13071799	20	-----
Specific Pesticides	Aminomethylphosphoric acid (AMPA-Glyphosate metabolite)	AMPA	100	10,000
	Clopyralid	1702176	1	20
	Fonofos	944229	10	-----
	Metribuzin	21087649	0.1	10
PCB AND PBB	Aroclor (unspecified)	1267792	0.2	330
Soil Bulk Density	Soil Bulk Density	SBD	-----	-----

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

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

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

TABLE 4. CONTAMINANTS REMOVED FROM TDLs AND DESIGNATED METHODS LIST

Contaminant	CAS/ID
Epifluorohydrin	503093
Epibromohydrin	3132647

Contaminant	CAS/ID
Methane (soils-soil gas))	74828
1,2,3-Trichlorobenzene	87616

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

WATER				
		New TDL	Previous TDL	
CONTAMINANT	CAS/ID	ug/L	ug/L	RATIONALE
Specific Contaminants				
Acetic Acid	64197	**[1,000]**	18,000	GSI = 360
Formic Acid	64186	1,000	18,000	Formate TDL
Nitrogen Forms				
Ammonia-N	7664417	25	50	CALC GSI = 29
Metals				
Antimony	7440360	2	5	GSI DW = 2
Arsenic	7440382	5	20	DW PROPOSED = 10
Copper	7440508	4	5	CALC GSI = 4.1
Nickel	7440020	20	25	CALC GSI = 24
Vanadium	7440622	4	10	DWC = 4.5
DRO and GRO				
Diesel Range Organics	DRO	100	400	Consistency with
Gasoline Range Organics	GRO	200	400	previous guidelines for STD
Organics, Carbonyls				
Acetaldehyde	75070	100	500	GSI = 130
Dissolved Gases				
Methane	74828	500	500,000	Explosive Criteria = 520
Polynuclear Aromatics				
Benzo(ghi)perylene	191242	**[1]**	5	WS = 0.26
Benzo(b)fluoranthene	205992	1	2	WS = 1.5
Benzo(k)fluoranthene	207089	**[1]**	5	WS = 0.8
Benzo(a)pyrene	50328	**[1]**	2	GCC = 0.64
Chrysene	218019	1	5	WS = 1.6
Fluoranthene	206440	1	5	GSI = 1.6
Phenanthrene	85018	2	5	GSI =2.4
Semivolatiles				
Aniline	62533	4	20	GSI = 4
4-Chloroaniline	106478	10	20	Superfund QL = 10
Dibenzofuran	132649	4	5	GSI = 4
Hexachlorobutadiene (C-46)	87683	0.05	5	GSI = 0.053
1,2,4,5-Tetrachlorobenzene	95943	2	5	GSI = 2.9
Volatiles				
Tetrahydrofuran	109999	90	100	DWC = 95

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

WATER				
		New TDL	Previous TDL	
CONTAMINANT	**CAS/ID**	**ug/L**	**ug/L**	**RATIONALE**
Oxygenates				
t-butyl Alcohol	75650	50	800	Monitoring of oxygenates
Acid Herbicides				
Dinoseb	88857	**[1]**	5	GSI = 0.48
Chlorinated Pesticides				
Endosulfan I	959988	0.03	0.05	GSI = 0.03
Endosulfan II	33213659	0.03	0.05	GSI = 0.03
Polychlorinated biphenyls				
Aroclor 1232	11141165	0.2	0.4	Default to total PCB TDL

TABLE 5. RATIONALE FOR REDUCING TDLs FROM PREVIOUS OPERATIONAL MEMORANDA

SOILS				
		New TDL	Previous TDL	
CONTAMINANT	CAS/ID	ug/kG	ug/kG	RATIONALE
Specific Contaminants				
Acetic Acid	64197	20,000	900,000	DW PC = 41,000
Formic Acid	64186	20,000	900,000	Acetate TDL
Cyanides				
Cyanide, Total	CN_TOTAL	100	200	GSI PC = 104
Cyanide, Available	CN_AVAIL	100	500	GSI PC = 104
Metals				
Antimony	7440360	**[300]**	500	GSI DW = 300
Mercury, Total	7439876	**[50]**	100	GSI = 0.026
Silver	7440224	**[100]**	500	GSI PC = 67
Acid Extractables (Phenols)				
2,4-Dinitrophenol	51285	830	1700	Superfund QL = 830
4-Chloro-3-methylphenol	59507	280	330	DW = 280
2-Methyl-4,6-dinitrophenol	534521	**[830]**	1700	DW PC = 400
3-Nitrophenol	554847	830	1700	Consistency
4-Nitrophenol	100027	830	1700	Superfund QL = 830
Semivolatiles				
Aniline	62533	330	1700	DW PC = 420
4-Chloroaniline	106478	330	1700	Superfund QL = 330
Hexachlorobutadiene (C-46)	87683	50	330	GSI PC = 91
2-Nitroaniline	88744	830	1700	Superfund QL = 830
3-Nitroaniline	9909	830	1700	Superfund QL = 830
4-Nitroaniline	100016	830	1700	Superfund QL = 830
Volatiles				
Benzyl Chloride	100447	150	200	DW PC = 154
1,4-Dioxane	123911	500	1000	DW PC = 680
Oxygenates				
t-butyl Alcohol	75650	2500	4400	Monitoring of oxygenates
Ethyl Alcohol	64175	2500	4400	Monitoring of oxygenates
Chlorinated Pesticides				
alpha-Hexachlorocyclohexane (BHC)	319846	10	20	DW PC = 18
Organophosphorus				
Atrazine	1912249	50	150	DW PC = 60
Cyanazine	21725462	200	500	DW PC = 200

Abbreviations Used in Table 5:

CALC GSI: Groundwater to surface water interface criterion that is based on a calculation.
Consistency: TDL was set at a level consistent with other contaminants of this type.
DW: Drinking water.
DWC: Drinking water criteria.
DW PC: Soil protective of drinking water criteria.
GCC: Groundwater direct contact criteria.
GSI: Groundwater to surface water interface.
PC: Protection criteria.
STD: Storage Tank Division.
Superfund QL: Quantitation limit established in the U.S. EPA Contract Laboratory Program.
WS: Water solubility criteria.

TABLE 6. TDLS GREATER THAN THE MOST RESTRICTIVE CRITERIA

CONTAMINANT	CAS/ID	WATER		SOIL	
		TDL	LOWEST HEALTH BASED CRITERIA	TDL	LOWEST HEALTH BASED CRITERIA
		ug/L	ug/L	ug/Kg	ug/Kg
Specific Contaminants					
Acetic Acid	64197	1,000	360		
Metals					
Beryllium	7440417	1 [1]	0.24		
Mercury, Total	7439976			50	1.2
Silver	7440224	0.2 [1]	0.06	100	27
Polynuclear Aromatics					
Benzo(k)fluoranthene	207089	1	0.8		
Benzo(ghi)perylene	191242	1	0.26		
Benzo(a)pyrene	50328	1	0.64		
Dibenzo(ah)anthracene	53703	2	0.21		
Indeno(1,2,3-cd)pyrene	193395	2	0.022		
Nitrosoamines					
N-Nitrosodi-n-propylamine	621647	5	0.19	330	100
Benzidines					
Benzidine	92875	0.3	0.0037	1000	6
3,3'-Dichlorobenzidine	91941	0.3	0.14	2000	28
Acid Extractables (Phenols)					
4-Chloro-3-methylphenol	59507			330	280
2,6-Dimethylphenol	576261			330	88
3,4-Dimethylphenol	95658			330	200
2-Methyl-4,6-dinitrophenol	534521	20	2.6	830	400
Semivolatiles					
Aniline	62533			330	80
Carbazole	86748	10	3.9		
Hexabromobenzene	87821	10	0.17		
Pentachlorobenzene	608935	5	0.019		
Pyridine	110861	20	7.3		
p-Toluidine	106490			660	300
Volatiles					
Acrylonitrile	107131			100	52
1,2-Dibromo-3-chloropropane	96128			10	4
Epichlorohydrin	106898	5	2		
Ethylene Dibromide	106934			20	1
Tetranitromethane	509148			500	51

TABLE 6. TDLS GREATER THAN THE MOST RESTRICTIVE CRITERIA

CONTAMINANT	CAS/ID	WATER		SOIL	
		TDL	LOWEST HEALTH BASED CRITERIA	TDL	LOWEST HEALTH BASED CRITERIA
		ug/L	ug/L	ug/Kg	ug/Kg
Carbamates					
Aldicarb Sulfone	1646884			200	40
Aldicarb Sulfoxide	1646873			200	80
Acid Herbicides					
Dinoseb	88857	1	0.48	200	43
Chlorinated Pesticides					
Aldrin	309002	0.01	8.7E-6		
Chlordane	57749	0.05	0.0025		
Chlorpyrifos, ethyl	2921882	0.2	0.002	10	1.5
4,4'-DDT	50293	0.02	0.00001		
Dieldrin	60571	0.02	6.5E-6		
Heptachlor	76448	0.01	0.0018		
Lindane (gamma BHC)	58899			20	0.99
Mirex	2385855	0.02	6.8E-6		
Toxaphene	8001352	1	0.000068		
tris(2,3-Dibromopropyl) phosphate	126727	10	0.71		
Organophosphorus					
Dichlorvos	62737			50	32
Polychlorinated Biphenyls					
Polychlorinated Biphenyls	1336363	0.2	0.000026		
Dioxins & Furans					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746016	1E-5	3.0E-9		
Asbestos					
Asbestos	1332214			1%	68,000

1. The calculated GSI may be below the TDL in Table 1.

TABLE 7. CONTAMINANTS WITH ESTABLISHED RISK-BASED CRITERIA WITHOUT TDLS AND DESIGNATED ANALYTICAL METHODS

CONTAMINANT	CAS NO
Acrylic acid	79107
Camphene	79925
1-Chloro-1,1-difluoroethane	75683
Diacetone alcohol	123422
Diethylene glycol monobutyl ether	112345
Diisopropylamine	108189
N,N-Dimethylacetamide	127195
N,N-Dimethylaniline	121697
Dimethylformamide	68122
Dimethylsulfoxide	67685
Diquat (soils)	85007
Endothall (soils)	145733
Ethyl Acetate	141786
Ethylene glycol monobutyl ether	111762
1-Formylpiperidine	2591868

CONTAMINANT	CAS NO
Gentian violet	548629
n-Heptane	142825
n-Hexane	110543
2-Methoxyethanol	109864
N-Methyl-morpholine	109024
Oxo-hexyl acetate	88230357
2-Pentene	109682
Phthalic Acid	88993
Phthalic Anhydride	85449
Piperidine	110894
Propionic Acid	79094
Propyl alcohol	71238
Tributylamine	102829
Triethanolamine	102716
2,2,4-Trimethyl-2-pentene	107404