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WORK PLAN FOR THE
TOMAH MUNICIPAL SANITARY LANDFILL
TOMAH, WISCONSIN
March 10, 1994

Attachments C through E

DAMES & MOORE

DRAFT

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TOMAH MUNICIPAL SANITARY LANDFILL
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Dames & Moore No. 27504-002

ATTACHMENT C
QUALITY ASSURANCE PROJECT PLAN
TOMAH MUNICIPAL SANITARY LANDFILL
TOMAH, WISCONSIN

March 10, 1994

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1.0 INTRODUCTION

This document presents the Quality Assurance Project Plan (QAPP) for the RI/FS to be performed at the Tomah Municipal Sanitary Landfill (TMSL) site in Tomah, Wisconsin. The QAPP presents the organization, objectives, and specific Quality Assurance (QA) and Quality Control (QC) procedures associated with the RI/FS at the TMSL. The overall objective of the QAPP is to ensure compatibility between the project investigation and laboratory procedures and state and federal requirements regarding data collection and usage. The procedures to be implemented to ensure that the data collected during this investigation is precise, complete, and representative of actual conditions are detailed in this QAPP. The contract laboratories (Enseco-Wadsworth/Alert) general QAPP is also included as Appendix A of this document. The Contract Laboratories (Enseco Wadsworth/Alert) general QAPP is also included as Appendix A of this document.

1.1 Project Description/Background

The project description, including information on the site history, past data collection activities, and existing site conditions is included in the Work Plan. The Work Plan also includes the project objectives, a summary of RI/FS tasks to be performed, and a project schedule.

1.2 Sample Network Design and Rationale

The sample network design and rationale for sample locations is described in detail in Section 4.0 of the Work Plan.

1.3 Parameters to be Tested and Frequency

Sample matrices, analytical parameters and frequencies of sample collection can be found in Table 1-1.

1.4 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during RI/FS activities and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. Two analytical levels address the data uses and the QA/QC effort required to achieve the desired level of quality appropriate for the Tomah Landfill Project. These levels are:

- Screening (DQO Level 1): This provides the lowest data quality but the most rapid results. It is often used for health and safety monitoring at the site, preliminary comparison to ARARs, initial site characterization to locate areas for subsequent and more accurate analyses, and for engineering screening of alternatives (bench-scale tests). These types of data include those generated on-site through the use of HNu, pH, conductivity, and other real-time monitoring equipment at the site.

- Confirmational (DQO Level 4): This provides the highest level of data quality and is used for purposes of risk assessment, evaluation of remedial alternatives and PRP determination. These analyses require full Contract Laboratory Program (CLP) analytical and data validation procedures in accordance with EPA recognized protocol. The parameters and matrices requiring Level 4 data are listed in Table 1-1.

TABLE 1-1

PHASE I REMEDIAL INVESTIGATION ANALYTICAL PROGRAM

			Investigative Samples			Field Quality Control Samples			
Sample Matrix	Field Parameters	Laboratory Parameters	Sample Points[a]	Sampling Rounds[b]	Total Samples	Field Duplicates	Field Blanks	Trip Blanks	Matrix Total[a]
Surface Water	pH, temp., conductivity	RAS CLP VOCs	4	1	4	1	1	1	7
		RAS CLP Metals	4	1	4	1	1	--	6
Sediment		RAS CLP VOCs	4	1	4	1	1	--	7
		RAS CLP Metals	4	1	4	1	--	--	6
Groundwater[c]	pH, temp., conductivity	RAS CLP VOCs	7	1	7	1	1	1	10
		RAS CLP Metals[d]	11	1	11	2	2	--	15
		RAS CLP TCL/TAL[e]	4	1	4	1	1	1	7

[a] Matrix spike/matrix spike duplicate (MS/MSD) samples are required for organic analysis. Samples designated for MS/MSD analysis will be collected with extra volumes at a frequency of one per group of 10 or fewer investigative samples. Triple the normal sample volumes will be collected for VOCs and double the normal volumes will be collected for extractable organics.

[b] The first round of analytical data and hydrogeologic data obtained from the Phase I investigation, will be used to assess the monitoring network and the need for additional data points. Additional rounds of groundwater sampling will be required to monitor groundwater quality at the site.

[c] One trip blank will be submitted in each cooler shipped to the laboratory containing water samples for VOC analysis.

[d] Groundwater samples collected for metals analyses will be field filtered.

[e] Four of the 11 wells to be installed will be sampled for full TAL/TCL analysis as discussed in Section 3.1.2.

1.5 Project Schedule

Samples are planned for collection in July of 1994. A project schedule is included in Section 5.0 of the Work Plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

At the direction of the USEPA Remedial Project Manager, Dames & Moore has overall responsibility for all phases of the RI/FS. Dames & Moore will provide project management, perform the field investigation, prepare the RI report, and perform the subsequent feasibility study. The project organization and key individuals of the Dames & Moore project team are outlined in Section 6 of the Work Plan (Figure 6-1). The various quality assurance responsibilities of key project personnel are defined below.

Remedial Project Manager/State Project Manager

The USEPA Remedial Project Manager (RPM) for this project will be Mr. Matt Mankowski. The RPM has the overall responsibility for all phases of the RI/FS. The State Project Manager will assist the RPM with oversight. The State Project Manager for this project will be Ms. Wendy Anderson.

Contractor Program Director

The program director has overall responsibility for ensuring that the project meets EPA and PRP objectives and Dames & Moore's quality standards. In addition, the program director is responsible for technical quality control and project oversight, and will provide the site manager with access to corporate management. The program director will:

- Approve all external reports (deliverables) before their submission to USEPA Region V;
- Ultimately be responsible for the preparation and quality of interim and final reports; and
- Represent the project team at meetings and public hearings.

Project Manager

The Project Manager is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The project manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved. The project manager will report directly to the USEPA Region V RPM/State Project Manager and will provide the major point of contact and control for matters concerning the project. The project manager will:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;

Field Manager

The project manager will be supported by the RI field manager. He is responsible for leading and coordinating the day-to-day activities of the various resource specialists under his supervision. The RI field manager is an experienced environmental professional and will report directly to the project manager. Specific field team leader responsibilities include:

- Provision of day-to-day coordination with the site manager on technical issues in specific areas of expertise;

- Development and implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;

- Coordination and management of field staff including sampling, drilling, and field laboratory staff;

- Implementation of QC for technical data provided by the field staff including field measurement data;

- Adherence to work schedules provided by the project manager;

- Preparation, review, and approval of text and graphics required for field team efforts;

- Coordination and oversight of technical efforts of subcontractors assisting the field team;

- Identification of problems at the field team level, discussion of resolutions with the site manager, and provision of communication between team and upper management; and

- Participation in the preparation of the final report.

EPA Region V Quality Assurance Officer

EPA Region V Quality Assurance Officer has the responsibility to review and approve all Quality Assurance Project Plans.

Laboratory Project Manager

- coordinates the completion and delivery of the final analytical report;
- ensures that client DQOs are met;
- oversees the overall completeness of the final analytical report.

Laboratory Operations Manager

- directs the laboratory's analytical programs
- coordinates projects and associated workloads;
- executes laboratory administrative functions;
- ensures compliance with appropriate analytical methods.

Laboratory Quality Assurance Officer

- oversees laboratory quality assurance;
- oversees QA/QC documentation;
- oversees detailed data review;
- decides laboratory corrective actions, if required;
- provides technical representation of laboratory QA procedures;
- prepares of laboratory Standard Operation Procedures;
- approves the QAPP.

Laboratory Sample Custodian

- receives and inspects the incoming sample containers;
- records the condition of the incoming sample containers;
- signs appropriate documents;
- verifies chain of custody and its correctness;
- notifies laboratory project manager and laboratory analysts of sample receipt and inspection;
- assigns a unique identification number and customer number, and enters each into the data management system;
- arranges proper secure sample storage.

Analytical Group Coordinators

- implements and supervises all analytical activities pertaining to their respective analytical groups (GC, GC/MS, Inorganics, etc.);
- coordinates projects and workloads;
- reviews raw data and analytical results.

Laboratory Analysts

- responsible for equipment maintenance and calibration;
- assume direct responsibility for data generation;

- provide self-review of generated data;
- document sample analysis anomalies;
- provide inclusion of appropriate quality control samples into analysis scheme.

The primary responsibility for project quality rests with Dames & Moore's Project Director. Independent quality assurance will be provided by the Laboratory Project Manager, the Laboratory Analysts, the Analytical Group Coordinators, and the QA Officer as required prior to release of all data to Dames & Moore.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The Overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability related to the Tomah Landfill Project.

3.1 Level of Quality Control Effort

Field blanks, trip blanks, duplicates and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling program. Field and trip blanks consisting of distilled water will be submitted to the analytical Laboratories to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site which may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. All matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. One matrix spike/matrix spike duplicate will be collected for every 20 or fewer investigative samples.

The general level of the QC effort will be one field duplicate and one field blank for every 10 or fewer investigative samples. One volatile organic analysis (VOA) trip blank consisting of distilled deionized ultra pure water will be included along with each shipment of aqueous VOA samples.

MS/MSD samples are investigative samples. Results are used to evaluate matrix effect on analytes of interest. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., groundwater, surface water and sediment). The number of duplicate and field blank samples to be collected are listed in Table 1-1. Sampling procedures are specified in the Field Sampling Plan.

Laboratory control samples are integrated into each preparative batch according to those procedures detailed in CLP analytical methods SOW/0LM01.9 for organics and SOW/ILM02.1 for inorganics. The laboratory control sample provides assessment data to determine if the analytical process is within control criteria.

All sediment, surface water, and groundwater and will be sent to the Enseco-Wadsworth/Alert Laboratory (Enseco) for analysis. The analysis will be performed according to RAS protocols (Analytical Level IV) for organics and inorganics. The level of laboratory QC effort for RAS analysis provided by Enseco is specified in the following CLP statements of work (SOW/OLM01.9 for organic and SOW/ILM02.1 for inorganic analyses). Tables 3-1, 3-2, and 3-3 contain the quantitation levels for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic compounds, respectively.

3.2 Accuracy, Precision, and Sensitivity of Analysis

The fundamental QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

The accuracy and precision requirements for RAS from the CLP are specified in SOW/OLM01.9 for organics and SOW/ILM02.1 for inorganics. The sensitivities required for CLP analyses will be the Contract-Required Quantitation Limits (CRQLs) shown in Tables 3-1 and 3-2, and the Contract-Required Detection Limits (CRDLs) shown in Table 3-3 of this QAPP. The Standard

Operating Procedures (SOPs) for the field equipment to measure pH, conductivity, Eh, and temperature are outlined in Appendix A of the Field Sampling Plan.

3.3 Completeness, Representativeness and Comparability

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data generated. It is expected that the CLP laboratory, Enseco, will provide data meeting QC acceptance criteria for 95 percent or more for all samples tested using the RAS. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{\text{\# of samples in control}}{\text{\# of samples attempted}} \times 100$$

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this network, consideration was given to past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the Superfund program. The rationale of the sampling network is discussed in detail in the field sampling plan (FSP). Representativeness will be satisfied by insuring that the FSP is followed, proper sampling techniques are used, proper analytical procedure are followed and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field duplicate samples.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of difference in procedures and QA objectives.

TABLE 3-1
TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

		Quantitation Limits*			
Volatiles	**CAS Number**	**Water µg/L**	**Low Soil µg/Kg**	**Med. Soil µg/Kg**	**On Column (ng)**
1. Chloromethane	74-87-3	10	10	1200	(50)
2. Bromomethane	74-83-9	10	10	1200	(50)
3. Vinyl Chloride	75-01-4	10	10	1200	(50)
4. Chloroethane	75-00-3	10	10	1200	(50)
5. Methylene Chloride	75-09-2	10	10	1200	(50)
6. Acetone	67-64-1	10	10	1200	(50)
7. Carbon Disulfide	75-15-0	10	10	1200	(50)
8. 1,1-Dichloroethene	75-35-4	10	10	1200	(50)
9. 1,1-Dichloroethane	75-34-3	10	10	1200	(50)
10. 1,2-Dichloroethene(total)	540-59-0	10	10	1200	(50)
11. Chloroform	67-66-3	10	10	1200	(50)
12. 1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13. 2-Butanone	78-93-3	10	10	1200	(50)
14. 1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15. Carbon Tetrachloride	56-23-5	10	10	1200	(50)
16. Bromodichloromethane	75-27-4	10	10	1200	(50)
17. 1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18. cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19. Trichloroethene	79-01-6	10	10	1200	(50)
20. Dibromochloromethane	124-48-1	10	10	1200	(50)
21. 1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22. Benzene	71-43-2	10	10	1200	(50)
23. trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24. Bromoform	75-25-2	10	10	1200	(50)
25. 4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26. 2-Hexanone	591-78-6	10	10	1200	(50)
27. Tetrachloroethene	127-18-4	10	10	1200	(50)
28. Toluene	108-88-3	10	10	1200	(50)
29. 1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
30. Chlorobenzene	108-90-7	10	10	1200	(50)
31. Ethyl benzene	100-41-4	10	10	1200	(50)
32. Styrene	100-42-5	10	10	1200	(50)
33. Xylenes (total)	1330-20-7	10	10	1200	(50)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3-2
TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

			Quantitation Limits*			
	Semivolatiles	**CAS Number**	**Water µg/L**	**Low Soil µg/Kg**	**Med. Soil µg/Kg**	**On Column (ng)**
34.	Phenol	108-95-2	10	330	10000	(20)
35.	bis(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36.	2-Chlorophenol	95-57-8	10	330	10000	(20)
37.	1,3-Dichlorobenzene	541-73-1	10	330	10000	(20)
38.	1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39.	1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40.	2-Methylphenol	95-48-7	10	330	10000	(20)
41.	2,2'-oxybis-(1-Chloropropane)**	108-60-1	10	330	10000	(20)
42.	4-Methylphenol	106-44-5	10	330	10000	(20)
43.	N-Nitroso-di-n-dipropylamine	621-64-7	10	330	10000	(20)
44.	Hexachloroethane	67-72-1	10	330	10000	(20)
45.	Nitrobenzene	98-95-3	10	330	10000	(20)
46.	Isophorone	78-59-1	10	330	10000	(20)
47.	2-Nitrophenol	88-75-5	10	330	10000	(20)
48.	2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49.	bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50.	2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51.	1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52.	Naphthalene	91-20-3	10	330	10000	(20)
53.	4-Chloroaniline	106-47-8	10	330	10000	(20)
54.	Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55.	4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56.	2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57.	Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58.	2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59.	2,4,5-Trichlorophenol	95-95-4	25	800	25000	(50)
60.	2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61.	2-Nitroaniline	88-74-4	25	800	25000	(50)
62.	Dimethylphthalate	131-11-3	10	330	10000	(20)
63.	Acenaphthylene	208-96-8	10	330	10000	(20)
64.	2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65.	3-Nitroaniline	99-09-2	25	800	25000	(50)
66.	Acenaphthene	83-32-9	10	330	10000	(20)
67.	2,4-Dinitrophenol	51-28-5	25	800	25000	(50)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

** Previously known by the name of bis(2-chloroisopropyl) ether.

TABLE 3-2
- Continued -
TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

		Quantitation Limits*			
Semivolatiles	**CAS Number**	**Water µg/L**	**Low Soil µg/Kg**	**Med. Soil µg/Kg**	**On Column (ng)**
68. 4-Nitrophenol	100-02-7	25	800	25000	(50)
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	800	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	800	25000	(50)
76. N-Nitrosodiphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenyl ether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	800	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	86-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	210-81-9	10	330	10000	(20)
90. bis(2-Ethylhexyl) phthalate	117-81-7	10	330	10000	(20)
91. Di-n-Octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd)pyrene	193-39-5	10	330	10000	(20)
96. Dibenzo(a,h)anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

TABLE 3-3
INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	**Contract Required[1,2] Detection Limit (μg/L)**
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

(1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstances:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the values may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 200
Contract Required Detection Limit (CRDL) = 3

The value of 200 may be reported even though instrument detection limit is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

(2) The CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

4.0 SAMPLING PROCEDURES

Sampling procedures are described in the Field Sampling Plan (FSP) (Work Plan Attachment B).

5.0 SAMPLE CUSTODY

A sample is physical evidence of a condition collected from a site or from the environment. As such, each sample must be documented in a manner that makes it legally defensible and which provides all data necessary for proper analysis. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area. Dames & Moore and Enseco personnel will complete all proper forms for each sample taken and/or analyzed.

A sample or evidence file is under your custody if:

- the item is in actual possession of a person;
- the item is in the view of the person after being in actual possession of the person;
- the item was in actual physical possession but is secured to prevent tampering;
- the item is in a designated and identified secure area.

5.1 Field Chain of Custody Procedures

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the laboratory with the chain of custody intact. The protocol for specific sample numbering are included in the FSP, Attachment B of the Work Plan.

5.1.1 Initiation of Chain-of-Custody Field Procedures

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All bottles will be tagged with sample numbers and locations.

(c) Sample tags are to be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.

(d) The Dames & Moore Tomah Landfill Project Manager will review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

5.1.2 Field Logbooks/Documentation

Dedicated field logbooks will provide the means of recording data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could re-construct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.
- Project start date, and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the Field Sample Plan (FSP), Appendix B of the Work Plan. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. A sample identification number will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be tracked in such a way that the data users and not the laboratory can identify the samples as duplicates.

5.1.3 Transfer of Custody and Shipment Procedures

(a) Samples are accompanied by a properly completed chain of custody form. The sample numbers and locations will be listed on the chain of custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This procedure documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.

(b) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. Custody seals will be attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

(c) Whenever samples are co-directed to a source or government agency, a separate Sample Receipt is prepared for those samples and marked to indicate with whom the samples are being co-directed. The person relinquishing the samples to the facility or agency should request the representatives' signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

(d) All shipments will be accompanied by the Chain of Custody Record identifying the contents. The original record will accompany the shipment, and the copies will be retained by the sampler for returning to the sampling office.

(e) Samples will be shipped by a common carrier and a bill of lading will be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

5.2 Laboratory Chain of Custody Procedures

The designated Laboratory Sample Custodian receives and documents all sample submittals into the Laboratory. The Laboratory Sample Custodian examines the condition, preservation, and accompanying documentation of all submitted samples prior to the approval and formal acceptance into the Laboratory. Any sample, preservation, or documentation discrepancies (e.g., broken sample container, improper preservations, inadequate sample volume, poor documentation, etc.) are resolved before the sample is approved and actually accepted for analyses. All required acceptance data is then recorded and documented in the Laboratory Sample Log and Laboratory Computerized Data Management System. The sample is then labeled with a unique code which allows traceability and placed in the secure sample storage area for distribution to the appropriate analyst(s).

Custody protocols detailed in the CLP SOW/OLM01.9 and SOW/ILM02.1 are maintained.

5.3 Final Evidence Files Custody Procedures

Evidence files originating in the laboratory will be maintained in secure areas according to the following schedule.

• Client Report Package (CLP)	2 years
• Laboratory Generated Records (Hardcopy)	7 years
• Electronically Stored Data	1 year

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all instruments and measuring equipment which are used for conducting field tests and laboratory analyses. These instruments and equipment will be calibrated prior to each use or scheduled on a periodic basis.

6.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Equipment to be used during field sampling will be examined to certify that it is operating correctly. This includes checking the manufacturer's operating manual for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notations on any prior equipment problems are not overlooked, and all necessary repairs to equipment have been carried out. A spare electrode will be sent with each pH meter to be used for field measurements. Two thermometers will be sent to sampling locations where measurement of temperature is required, including those locations where a specific conductance probe/thermometer is required.

Calibration of field instruments is governed by the specific Standard Operating Procedure (SOP) for the applicable field analysis method, and such procedures take precedence over the following general discussion. Standard operating procedures are included in the Field Sampling Plan.

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a pH meter, thermometer, specific conductivity meter, combustible gas indicator, and Organic Vapor

Photoionization Detector (PID). In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

The pH meter will be calibrated with standard buffer solutions prior to the field trip. In the field, the meter will be calibrated daily with two buffers before use. Calibration procedures and frequency will be recorded in a field log book along with the lot numbers of the buffer. General calibration procedures for pH meters, specific conductivity meters and thermometers are described below:

pH Calibration

- Temperature of sample and buffer should be the same.
- Connect pH electrode into pH meter and turn on pH meter.
- Set temperature setting based on the temperature of buffer; place electrode in first buffer solution.
- After reading has stabilized, adjust "CALIB" knob to display correct value.
- Repeat procedure for second buffer solution.
- Place pH electrode in the sample and record the pH as displayed.
- Remove pH electrode from sample and rinse off with distilled water.
- The pH meter must be recalibrated every time it is turned off and turned back on, or in the event that it starts giving erratic results.

The calibrations performed, standards used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

Temperature Calibration

Temperature measurements are carried out utilizing a thermometer. The thermometers must be inspected before use to ensure there is no mercury separation. The thermometers should be rechecked in the field before and after use to see if the readings are logical and the mercury is still intact. The thermometers should be checked biannually for calibration, by immersing them in a bath of known temperature until equilibrium is reached. They should be discarded if found to have more than 10% error. The reference thermometer used for the bath calibration should be National Bureau of Standards (NBS) traceable.

Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards before each field trip. In the field, the instrument will be checked daily with NBS traceable standards. The calibration procedure is described below.

- Place the probe in conductivity calibration standard solution.
- Set temperature knob for temperature of standard solution.
- Turn to appropriate scale and set the instrument for the value of the calibration standard.
- Rinse off the electrode with distilled water.
- Measure the conductivity for distilled water to be used for a field blank, making sure temperature is set correctly for temperature of solution to be tested.
- If the conductivity of blank (distilled water) is high, it must be discarded and a new blank sample procured.

All readings and calibrations should be recorded in the field notebook.

Organic Vapor Analyzer (OVA)/Photoionization Detector (PID)

The OVA will be checked daily by use of the internal calibration mechanism. The PID will be calibrated daily with a gas of known concentration.

6.2 Laboratory Instruments

Enseco uses specific procedures for the operation and calibration of all analytical instruments. Along with proper maintenance, these practices ensure optimum instrument performance and accuracy. These procedures include proper operator training and supervision; mandatory instrument performance specifications; and systematic instrument calibration, verification, and monitoring schedules.

The calibration procedures detailed in SOW/OLM01.9 for organic analysis and SOW/ILM02.1 for inorganic analysis will be followed. Calibration criteria will be met before sample analysis is initiated. The laboratory adheres to the calibration frequencies established for both the organic and inorganic SOWs.

7.0 ANALYTICAL PROCEDURES

All groundwater samples, surface water samples, and sediment samples collected during field sampling activities for the Tomah Landfill RI will be analyzed by Enseco according to the methods presented in Table 1-1.

7.1 Laboratory Analysis

Routine Analytical Services (RAS) Laboratory Procedures

All samples for CLP target compound list (TCL) VOAs and semivolatiles and CLP target analyte list (TAL) inorganic (total metals and cyanide) will be analyzed according to analytical procedures set forth in the U.S. EPA CLP RAS SOW (OLM01.9) for organics analysis and RAS SOW (ILM02.1) for inorganic analysis.

7.2 Field Screening Analytical Protocols

The procedures for field measurement of pH, temperature, and specific conductivity are described in the SOPs in Appendix A of the Field Sampling Plan Work Plan (Attachment B).

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Field Sample Collection

Please see FIELD SAMPLING PLAN (FSP) for initial QC check procedures. The assessment of field sampling precision and accuracy will be made through collection of field duplicates and field blanks in accordance with the applicable procedures described in the Field Sampling Plan (Work Plan Attachment B).

8.2 Field Measurement

QC procedures for pH, conductivity, and temperature measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments.

8.3 Laboratory Analysis

8.3.1 Quality Assurance Program

The laboratory has a written Quality Assurance/Quality Control program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory's Quality Assurance Unit (QAU), which is independent of the operating departments.

The stated objectives of the laboratory QA/QC Program are to:

- Ensure that all procedures are documented, including any changes in administrative and/or technical procedures.

- Ensure that all analytical processes are conducted according to established program or laboratory procedures.

- Monitor the performance of the laboratory by a systematic inspection program and provide for corrective action as necessary.

- Ensure control of analytical processes by comparison of laboratory generated QC data to those of specific procedures or programs.

8.3.2 Laboratory Quality Control Checks

The laboratory will perform those QC checks specified in SOW/OLM01.9 and SOW/ILM02.1. Specified within these procedures are the types, frequencies, and criteria of all quality control checks required by the CLP.

The laboratory will document, in each data package provided, that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in non-conformance with the QC criteria will be reanalyzed by the laboratory, if sufficient sample volume is available. If reanalysis cannot be performed or if reanalysis indicates that QC data failure is matrix dependent, the circumstance will be addressed in the narrative which accompanies each sample case.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 Data Reduction

9.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in the field log book. If the data are to be used in the project reports, they will be reduced and summarized and the method of reduction will be documented in the report.

9.1.2 Laboratory Services

All samples collected at the Tomah Landfill site will be sent to Enseco/Wadsworth Alert. Data reduction, evaluation, and reporting for samples analyzed by the laboratory will be performed according to specifications outlined in the CLP RAS SOWs (OLM01.9 and ILM02.1). Data validation will then be performed by qualified and experienced Dames & Moore analytical QA/QC personnel.

9.2 Data Validation

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to the requirements contained in the corresponding RAS methods. Qualified and experienced Dames & Moore analytical QA/QC personnel will examine raw data such as GC/MS Total Ion Current (TIC) chromatograms, GC chromatograms, and mass spectra, Inductively Coupled Argon Plasma (ICAP) and Flame/Furnace Atomic Absorption (FAA) data reports, and data station printouts to ensure that reported results are accurate. Analytical data validation will be performed according to the *National Functional Guidelines For Organic Data Review* (USEPA, June, 1991) and the *Laboratory Data Validation Functional Guidelines For Evaluating Inorganics Analyses* (USEPA, July, 1988).

9.3 Data Reporting

The RAS analytical laboratories will prepare and submit full analytical and QC reports to the Dames & Moore Tomah Landfill Project Manager in compliance with requirements of the CLP to include the following (as applicable):

1. Narrative including statement of samples received, description of any deviations from RAS procedures, explanation of qualifications regarding data quality, and any other significant problems encountered during analysis.
2. An organic QA/QC report summarizing surrogate spike results (Form II), MS/MSD results (Form III), GC/MS instrument performance checks (Form V), GC/MS internal standard area summaries (Form VIII) and method blank summaries (Form IV).
3. An inorganic and organic sample data package (Form I).
4. All calibration data associated with sample analyses (Organics Forms VI, VII, Inorganics Form II).
5. Field and laboratory chain-of-custody documentation pertaining to each sample delivery group analyzed.

All data generated for the Tomah Landfill RI/FS will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include the data flags provided by Enseco in accordance with the *National Functional Guidelines For Organic Data Review* (USEPA, June, 1991) and the *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, July, 1988) as well as additional comments of the Data Reviewer. The laboratory-provided data flags will include such items as: 1) concentration below required detection limit, 2) estimated concentration due to poor recovery below required detection limit, 3) estimated concentration due to poor spike recovery, and 4) concentration of chemical also found in laboratory bank. The Data Reviewer comments will indicate that the reviewed data are: 1) usable as a quantitative concentration, 2) usable with caution as an estimated concentration, or 3) unusable due to out-of-control QC results.

The Tomah Landfill site RI/FS data set will be available for controlled access by the Project Manager, and authorized personnel using a site-specific code. The complete data set will be incorporated into the RI report. A more detailed description of data management procedures will be provided in the Data Management Plan (DMP) (Work Plan Attachment D).

10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis is performed in accordance with the procedures established in the FSP and QAPP. The audits of field and laboratory activities include two separate, independent parts: Internal and External audits.

10.1 Field Audits

Internal audits of field activities (sampling and measurements) will be conducted by the Dames & Moore QA Officer and/or Field Team Leader. The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, chain of custody, etc. These audits will occur at the onset of the project to verify that all established procedures are followed. Follow-up audits will be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the entire project. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

External audits will be conducted by U.S. EPA Region V Central Regional Laboratory (CRL) and/or Central District Office (CDO).

10.2 Internal Audits

Enseco maintains an internal system of performance and systems audits to verify the quality of its measurement systems. These audits are conducted on a regular basis as a part of normal Laboratory operations.

The QA department conducts data audits of randomly selected projects. This data review is referred to as a Level IV review. The Level IV review involves verification of the presence and correctness of the Level I, II, and III reviews as well as checking the sample data back to bench-level for each project audited. A report is compiled of any data package errors and corrective action plans are implemented to eliminate repetition of these errors. An ongoing tally of the types of errors is used to address problem areas with additional training and education. The frequency of the level IV review is determined by the error rate found. The checklists used for Level IV reviews are available upon request.

On an annual basis, the QA Manager audits the laboratory facilities. The audits include logbook review, chromatogram review, equipment inspection, and compliance with Laboratory SOPs. Audit reports are submitted to the General Manager, Regional QA Director, Laboratory Manager, and Group Coordinators. The Group Coordinators are required to respond in writing to the QA Manager with the corrective actions taken. Depending on the nature of the problems found, follow-up audits are conducted to determine that corrective actions were sufficient and appropriate. Audit reports and checklists are available upon request.

10.3 External Laboratory Certification, Audits, and Approvals

Enseco has been an active participant in the USEPA Contract Laboratory Program (CLP) since 1985. In addition, the Laboratory participates in a number of other federal, state, and private Laboratory Certification, Audit and/or Approval Programs to demonstrate its analytical capabilities and expertise. Participation in these programs require the Laboratory to demonstrate acceptable Laboratory performance through satisfactory completion of routine systems and/or performance audits. As a part of its certification by these various federal, state, and private agencies, Enseco submits to on-site external systems audits. The inspection audits evaluate the adequacy of Laboratory personnel, equipment, documentation, and QA/QC. Performance audits require satisfactory blind analyses of unknown intralaboratory performance evaluation samples.

A listing of Laboratory Certifications, Audits, and/or Approvals currently maintained by the Laboratory is available upon request.

10.4 Voluntary Intralaboratory Performance Evaluations

Enseco participates in Intralaboratory Performance Evaluations administered by the Laboratory QA Manager. The QA Manager periodically submits single blind performance evaluation samples into the Laboratory to assess analytical performance. These single blind performance evaluation samples are generated in-lab by the QA Manager or obtained from various commercial and regulatory sources. When internal criteria are not met with these Performance Evaluation samples, the Laboratory Manager and appropriate Group Coordinators are notified. They must determine what caused the out-of-control situation and respond to the QA Manager in writing with the corrective action taken. Additional samples of known concentration may then be submitted to determine whether or not the corrective action taken was sufficient.

11.0 PREVENTATIVE MAINTENANCE PROCEDURES

11.1 Field Instruments/Equipment

The field equipment for this project includes thermometers, pH meter, and conductivity meter. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer.

Field instruments will be checked and calibrated in the warehouse before they are shipped or carried to the field. These instruments will be checked and calibrated daily before use. Calibration checks will be performed after every 10 samples and will be documented on the Field Meter/Calibration Log Sheets (Figure 11-1).

Critical spare parts such as tape, pH probes, electrodes and batteries will be kept on-site to minimize instrument down time. Backup instruments and equipment should be available on-site or within one-day shipment to avoid delays in the field schedule.

11.2 Laboratory Instruments

All laboratory analysts receive proper training in the operation of applicable instruments prior to actual sample analysis. This training may include attendance at the instrument manufacturer's operator training classes, seminars with in-lab instruction, and supervision by the group coordinators. This training is documented and updated as appropriate.

For GC and GC/MS instruments, selected operators have been trained to perform routine maintenance procedures (e.g., changing oven fans, replacing electronic control boards, changing vacuum pump oil, cleaning, etc.). Additionally, the Laboratory maintains service contracts with the manufacturers for some of the major instrumentation. For other instrumentation, operators perform routine maintenance (e.g., changing electrodes, changing bulbs, etc.). Routine maintenance procedures allow the Laboratory workload to be scheduled around planned downtime.

Laboratory Instrument Service Logbooks are assigned to document the service of all equipment included within this program. A substantial spare parts inventory is also maintained to assure timely repair of instruments. When routine maintenance procedures do not correct a problem with instrumentation, outside repair services are available on a next-day basis. The Laboratory does not maintain test equipment used in the maintenance of instrumentation. Service representatives bring the necessary test equipment for this evaluation.

Additional specified preventive maintenance procedures for Laboratory instruments are listed in Table 11-1.

Figure 11-1

INSTRUMENT CALIBRATION LOG

INSTRUMENT:

MANUFACTURER:

MODEL NUMBER:

SERIAL NUMBER:

DAMES & MOORE ASSET NUMBER:

DATE ACQUIRED OR SERVICED:

ORIGINAL OR PREVIOUS CALIBRATION DATE:

CALIBRATED BY:

NOTES ON ORIGINAL OR PREVIOUS CALIBRATION:

CALIBRATION SCHEDULE: (circle one) DAILYMONTHLYYEARLY

MAINTENANCE SCHEDULE: (circle one) DAILYMONTHLYYEARLY

CURRENT CALIBRATION RECORD:

DATE: TIME:

CALIBRATION STANDARD(S) USED:

CONCENTRATION(S):

PROCEDURE (describe briefly):

DEFICIENCIES: (if any):

CALIBRATION PLOTS OR GRAPHS (attach, if any)

SIGNATURES:

Technician:____________________

Date: ____________ Laboratory Manager: ____________________

SYSTEMS OR PERFORMANCE AUDIT:

AUDIT REPORT:

SIGNATURE:

Auditor: __________________________ Date:____________________

QA Manager: __________________________ Date: ____________________

Table 11-1

ROUTINE PREVENTATIVE MAINTENANCE PROCEDURES AND SCHEDULES

Instrument	Maintenance Procedures/Schedule	Spare Parts in Stock
Gas Chromatograph/ Mass Spectrometry (GC/MS)	1. Replace pump oil as needed 2. Change septa weekly or as often as needed 3. Change gas line dryers as needed 4. Replace electron multiplier as often as needed 5. Replace glass jet spliter as needed 6. Replace GC injector glass liner weekly or as often as needed 7. Replace GC column as needed 8. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Syringes 2. Septa 3. Various Electronic components 4. glass jet spliter 5. GC column 6. glass liner
Gas Chromatograph	1. Replace pump oil as needed 2. Change septa weekly or as often as needed 3. Change gas line dryers as needed 4. Replace GC injector glass liner weekly or as needed 5. Replace GC column as needed 6. Clean/Replace GC detector as needed 7. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Syringes 2. Septa 3. detectors 4. glass liner 5. GC column
Purge and Trap Sample concentrator	1. Replace trap as needed 2. Decontaminate the system after running high concentration samples or as required by blank analysis 3. Check system leak daily or as often as needed 4. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Spare traps 2. Spare sparger 3. various electronic components /circuit boards 4. Plumbing supplies - tubing fitting.

TABLE 11-1
- Continued -

ROUTINE PREVENTATIVE MAINTENANCE PROCEDURES AND SCHEDULES

Instrument	**Maintenance Procedures/Schedule**	**Spare Parts in Stock**
Inductively Coupled Plasma Spectrometer (ICP)	1. Clean torch assembly as needed. 2. Clean nebulizer as needed. 3. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Spare torch & mixing chamber 2. Spare nebulizer.
Graphite Furnace Atomic Spectrophotomer (GFAA)	1. Change graphite contact rings as needed 2. Check optics as needed. 3. Clean quartz window as needed. 4. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Contact rings
Mercury Analyzer	1. Clean tubing and quartz cell weekly or as often as needed 2. Clean aspirator as necessary 3. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Quartz cells 2. Aspirator
Technicon Autoanalyzer II	1. Inspect pump tubes and replace as needed. 2. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Pump tubes

TABLE 11-1
- Continued -

ROUTINE PREVENTATIVE MAINTENANCE PROCEDURES AND SCHEDULES

Instrument	**Maintenance Procedures/Schedule**	**Spare Parts in Stock**
pH Meter	1. Check battery (if used in field); and replace if discharged 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. Immerse the lower third of the electrode in diluted HCL (1:9) solution for 10 minutes to remove any film formed. Rinse thoroughly with water. 3. Keep electrode properly filled with appropriate filling electrolyte solution.	1. Standard buffer solutions 2. Filling electrolyte solution 3. spare electrode
Specific Conductivity	1. Check battery (if used in field); and replace if discharged. 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. Immerse the lower third of the electrode in diluted HCL (1:9) solution for 10 minutes to remove any film formed. Rinse thoroughly with water. 3. Keep electrode properly filled with appropriate filling electrolyte solution	1. Standard solution 2. Filling electrolyte solution 3. Spare electrodes

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 Field Measurements

Field data will be assessed by the site Quality Control (QC) Officer. The site QC Officer will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSP. Accuracy of the field measurements will be assessed using daily instrument calibrations, calibration checks, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple readings of a single sample. **Data completeness** will be calculated using Equation 12-1.

$$\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100 \qquad (12\text{-}1)$$

12.2 Laboratory Data

Laboratory results will be assessed for compliance with required **precision, accuracy, completeness and sensitivity** as follows:

12.2.1 Precision

Precision of laboratory analysis will be assessed by comparing the analytical results between matrix spike/matrix spike duplicate (MS/MSD) for organic analysis, and laboratory duplicate analyses for inorganic analysis. The relative percent difference (%RPD) will be calculated for each pair of duplicate analysis using equation 12-2.

$$\% RPD = \frac{S - D}{(S + D)/2} x\ 100 \qquad (12\text{-}2)$$

Where:

S = First sample value (original or MS value)

D = Second sample value (duplicate or MSD value)

12.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria specified in the organic and inorganic SOWs. QC elements used for accuracy evaluations include MS/MSDs, LCSs and surrogate spikes. The percent recovery (%R) of matrix spike samples will be calculated using equation 12-3.

$$\% R = \frac{A - B}{C} x\ 100 \qquad (12\text{-}3)$$

Where:

A = The analyte concentration determined experimentally from the spiked sample;

B = The background level determined by a separate analysis of the unspiked sample and;

C = The amount of the spike added.

Accuracy calculations for surrogate spikes and LCSs are stated in Equation 12-4.

$$\%R = \frac{\text{Observed Concentration}}{\text{Spiked Concentration}} \text{ x } 100 \qquad (12\text{-}4)$$

12.2.3 Completeness

The **data completeness** of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation 12-1.

12.2.4 Sensitivity

The achievement of method detection limits depends on instrumental sensitivity and matrix effects. Therefore it is important to monitor the instrumental sensitivity to ensure the data quality through constant instrument performance. The instrumental sensitivity will be monitored through the analysis of method blanks, calibration check samples, and laboratory control samples, etc.

13.0 CORRECTIVE ACTIONS

Corrective actions may be required for two classes of problems: analytical and equipment problems and noncompliance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

13.1 Sample Collection/Field Measurements

Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document to the Field Manager. This Field Manager and Project QA Manager will be responsible for assessing the suspected problem's potential for impacting the quality of the data. If it is determined that the situation warrants a corrective action, then a nonconformance report will be initiated by the manager.

The manager will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- evaluating all reported nonconformances;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken;
- maintaining a log of nonconformances;
- reviewing nonconformance reports and corrective actions taken;
- ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the Field Manager will ensure that no additional work, dependent on the nonconforming activity, is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- Repeat the measurement to check the error;
- Check for all proper adjustments for ambient conditions such as temperature;
- Check the batteries;
- Re-Calibration;
- Check the calibration;
- Replace the instrument or measurement devices;
- Stop work (if necessary).

The Field Manager or Project Manager or his designee is responsible for all site activities. In this role, the RI Coordinator at times is required to adjust the site programs to accommodate site specific needs. When it becomes necessary to modify a program, the responsible person notifies the RI Coordinator of the anticipated change and implements the necessary changes after obtaining the approval of the RI Coordinator. The change in the program will be documented on the field change request (FCR) that will be signed by the initiators and the project manager. The FCR for each document will be numbered serially as required. The FCR shall be attached to the file copy of the affected document. The RI Coordinator must approve the change in writing or verbally prior to field implementation , if feasible. If unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices and action taken.

The RI Coordinator for the Tomah Landfill site is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties which include the U.S. EPA RPM. The RPM will be notified whenever program changes in the field are made.

13.2 Laboratory Analyses

Laboratory Corrective Actions- CLP or CRL RASs

For the CLP Routine Analytical Services (RASs), corrective action is implemented at several different levels. The laboratories performing CLP SOW analyses are required to have written SOPs specifying corrective actions to be taken when analytical errors are discovered or the analytical system is determined to be out of control. The SOPs require documentation of the corrective actions and notification by the analyst about the errors and corrective procedures.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

In addition to the audit reports submitted to the site manager in accordance with QAPP Section 12.0, a monthly progress report is submitted to the Dames & Moore Tomah Landfill Project Manager which addresses all Quality Assurance issues. The final RI and FS report will contain QA sections that summarize data quality information collected during the project.

14.1 Laboratory Quality Assurance Reports to Management

Two types of QA reports are issued by Enseco; internal reports to management and project reports to clients.

14.1.1 Internal QA Reports

On a monthly basis, the QA Manager prepares a report for Laboratory Management which provides management with a meaningful assessment of the quality of the Laboratory's products and services. This report includes the monthly assessments of: The results of any internal or external performance audits or clients visits; a description of any performance Evaluation (PE) samples, results received, and any corrective action responses, if applicable; performance on major contracts, certification changes; tracking and reporting of Key Resource Indicators (KRIs); and any additional comments or recommendations.

14.1.2 Project Reports

The Project Manager presents a QC report to the client representative at the completion of a sample and/or analytical project. The QC report may include LCSs, blanks, and any corresponding MS/MSD data if available. Any problems along with the corresponding corrective actions are documented in a QC Narrative.

APPENDIX A

CONTRACT LABORATORY QUALITY ASSURANCE PLAN

ENSECO-WADSWORTH/ALERT Laboratories
Division of Corning Lab Services Inc

Corporate and Laboratory:
4101 Shuffel Drive NW
North Canton OH 44720
216-497-9396
FAX 216-497-0772

REVISION NOTICE

This document is the Quality Assurance Program Plan (QAPP) for the Enseco-North Canton facility. The QAPP is intended to provide the user with a general overview of laboratory practices. This document summarizes laboratory management policies, objectives, organization, and general procedures. The contents and format of this document are updated annually to reflect current methodology and regulatory requirements. This QAPP (revised January 8,1993) is currently under revision. With continuous updates made to technical and regulatory requirements, it is critical for the user to contact the laboratory for any recent updates to the laboratory's program prior to initiating any project analysis.

Laboratories:
Pittsburgh, PA
412-826-5477

Tampa, FL
813-621-0784

A Corning Company

ENSECO-WADSWORTH/ALERT Laboratories
Division of Corning Lab Services Inc

Corporate and Laboratory:
4101 Shuffel Drive NW
North Canton OH 44720
[illegible]
[illegible]

QUALITY ASSURANCE PROGRAM PLAN

REVISED

January 8, 1993

Mark P. Nebiolo

Mark P. Nebiolo
Laboratory Manager

Kathleen R. Teuscher
QA/QC Manager

Laboratories:

Pittsburgh PA
412-826-5477

Tampa FL
813-621-0784

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NOTICE

This document is Enseco-Wadsworth/ALERT Laboratories' Quality Assurance Program Plan. It is a generic document summarizing the management policies, objectives, organization, and general procedures by which our laboratory achieves acceptable data quality. It is not intended for site-specific application. The contents and format of this document are as specified in EPA 600/4-83-004, "Interim Guidelines and Specification for Preparing Quality Assurance Project Plans," 1983.

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APPENDICES

1.0 INTRODUCTION, OBJECTIVES AND POLICIES

1.1 Introduction

Enseco-Wadsworth/ALERT Laboratories was founded as a metallurgical laboratory in 1938, but turned to environmental testing in the late 1970s and has concentrated on analysis of air, water, soil and hazardous and municipal waste ever since. With nearly 300 employees at the headquarters and principal laboratory in North Canton, Ohio and branch laboratories in Pittsburgh and Tampa, Enseco-Wadsworth/ALERT was one of the five largest independent environmental testing laboratories in the United States prior to its acquisition by Corning, Inc. in 1991 and affiliation with the Enseco network of environmental testing laboratories, the nation's largest such organization.

ANALYTICAL SERVICES

Enseco-Wadsworth/ALERT Laboratories provides a number of environmental analytical services which aid private industry, engineering consultants, and government agencies with technical aspects of environmental control and regulatory compliance. These analytical services are designed to fulfill the analytical requirements of major federal and state environmental regulations.

1.2 Objectives and Policies

The objective of Enseco-Wadsworth/ALERT Laboratories' Quality Assurance/ Quality Control Program is to provide legally and scientifically valid laboratory services. This QA/QC program directs organizational adherence to a system of mandatory operating practices and procedures which ensure that all generated laboratory data are scientifically correct, legally defensible, and fulfilling of applicable regulatory requirements. These component QA/QC operating procedures involve both technical and evidentiary aspects of all Enseco-Wadsworth/ALERT Laboratories sampling and analytical services, including mobile laboratory operations. These procedures are documented in the Laboratory Quality Control SOP Manual, which is available for inspection at the laboratory.

Enseco-Wadsworth/ALERT Laboratories' QA/QC program contains component Sampling and Analytical Quality Control Programs. The Sampling QC Program combines appropriate technical sample collection, preservation, and transport considerations with evidentiary documentation and chain-of-custody possession requirements. The Analytical QC Program provides a system of standard operating procedures which maintain high quality standards of operation throughout all laboratory analytical activities. In addition, this Analytical QC Program provides continuous, documented surveillance and evaluation of acceptable analytical method performance through the systematic insertion of various quality control samples into at least 10% of all laboratory analyses.

For the purpose of this document, the term Laboratory refers to Enseco-Wadsworth/ALERT Laboratories and Mobile Operations refers to the mobile on-site laboratories operated by Enseco-Wadsworth/ALERT Laboratories.

2.0 PROJECT DESCRIPTION - NOT USED

3.0 LABORATORY RESPONSIBILITY AND ORGANIZATION

The general responsibilities of key personnel with respect to QA/QC are as follows: (see Figure 3-1)

3.1 General Manager

The General Manager is responsible for the planning of the analytical growth and development of all laboratory sites. This person is involved in productivity assessments for each facility and determines the direction each will take to meet the analytical needs of the client. Additional responsibilities include ensuring that all analytical programs comply with regulatory needs.

3.2 Laboratory Manager

The Laboratory Manager's duties and responsibilities include the following:

- Direct the laboratory's analytical programs, including mobile laboratory activities.
- Coordinate projects and associated workloads.
- Execute laboratory administrative functions.
- Ensure compliance with appropriate analytical method and instrument performance specifications (see Chapters 8 and 9).

The Laboratory Manager reports to the General Manager.

3.3 Laboratory Business Development Director

The Laboratory Business Development Director is responsible for coordinating the Project Management and Marketing efforts of the Laboratory. This involves ensuring that the client's Data Quality Objectives and analytical needs are met. The Business Development Director reports to the General Manager.

3.4 Regional QA Director

The Regional QA Director is responsible for:

- Overseeing the implementation of the QA Plan within the Region to ensure compliance with the QA objectives.
- Assisting staff in maintaining regulatory analytical compliance.
- Directing and assisting the facility QA staff in meeting the responsibilities of the facility Quality Assurance Department at each facility in the Region as described below.
- Providing training opportunities relating to QA for both QA and laboratory staff.
- Conducting seminars on QA issues for Clients.
- Assisting facility QA Directors and managers in resolution of data quality inquiries.
- Serving as a member of the QA Committee.
- Serving as a channel of communications between the Vice President/General Manager and the facility QA groups.
- Meeting client requirements.

The Regional QA Manager reports to the General Manager.

3.5 QA/QC Manager

The Laboratory QA/QC Manager supervises QA functions pertaining to laboratory analytical operations. These responsibilities include ensuring that laboratory standard operating procedures meet current industry standards.

The Laboratory QA/QC Manager implements, supervises, and evaluates QC functions pertaining to all laboratory analytical operations, including mobile laboratory analyses. Primary duties include the following:

- Managing certification and approval programs.
- Maintaining precision and accuracy records for each analytical parameter.
- Conducting internal QC audits.
- Overseeing corrective action as indicated by internal QC data.
- Implementing, supervising, and evaluating Internal Quality Control Program (see Chapter 11).
- Administering and evaluating Performance and System Audits (see Chapter 12).
- Assessing data precision, accuracy, and completeness (see Chapter 14).
- The QA/QC Manager has the authority to stop work within the laboratory in the event of enforcing corrective action measures (see Chapter 15).

The QA/QC Manager reports to the Laboratory Manager. In addition, the QA/QC Manager reports to the Regional QA Director.

3.6 Organic Manager

The Organic Manager is responsible for:

- Directing the Organic Laboratory's analytical programs, including mobile laboratory activities.
- Coordinating projects and associated workloads.
- Executing departmental administrative functions.
- Ensuring compliance with appropriate analytical method and instrument performance specifications (see Chapters 8 and 9).
- Supervising all analytical activities in the organic department.
- Participate on the Organic Technical Committee.

The Organic Manager reports to the Laboratory Manager.

3.7 Inorganic Manager

The Inorganic Manager is responsible for:

- Directing the Inorganic Laboratory analytical programs, including mobile laboratory activities.
- Coordinating projects and associated workloads.
- Executing departmental administrative functions.
- Ensuring compliance with appropriate analytical method and instrument performance specifications (see Chapters 8 and 9).
- Supervising all analytical activities in the inorganic department.
- Participate on the Inorganic Technical Committee.

The Inorganic Manager reports to the Laboratory Manager.

3.8 Sample Custodians

The Sample Custodians' duties and responsibilities include the following:

- Ensuring that all submitted samples are properly accepted into the laboratory in accordance with documented sample acceptance procedures (see Chapter 6).
- Ensuring that associated sample acceptance data is entered into the laboratory data management systems (see Chapter 6).
- Arranging proper secure sample storage (see Chapter 6).

The Sample Custodians report to the Laboratory Manager.

3.9 Analytical Group Coordinators

The Analytical Group Coordinators' duties and responsibilities include the following:

- Implementing and supervising all analytical activities pertaining to their respective analytical groups (GC, GC/MS, Inorganics, etc.).
- Coordinating projects and workloads.
- Reviewing raw data and analytical results (see Chapters 8 and 9).

The Analytical Group Coordinators report to their respective Group Manager.

3.10 Analysts

An analyst's duties and responsibilities include the following:

- Equipment maintenance (see Chapter 13).
- Equipment calibration (see Chapter 8).
- Sample extraction and analysis (see Chapter 9).
- Raw data manipulation and reporting (see Chapter 10).
- Inclusion of appropriate QC samples and considerations into all laboratory operations (see Chapter 11).

Analysts report to their respective Analytical Group Coordinator.

3.11 Project Managers

The Project Managers are responsible for overseeing the timely completion of projects. They ensure that client quality assurance objectives are met and that project problems associated with any facet of the laboratory are addressed in a narrative to the client. The Project Managers report to the Laboratory Manager and coordinate activities with the Laboratory Business Development Director.

3.12 Personnel Training

3.12.1 New Laboratory Personnel

During the initial weeks of employment, new laboratory personnel are involved with several training sessions. These may include: quality control, health and safety, regulatory information, sample receiving procedures, and introduction to methods. Before performing analyses, analysts are trained in the laboratory by experienced analysts using the laboratory SOPs and under the guidance of the QA/QC Manager. This sequence of training is recorded in the employees' permanent records.

3.12.2 Instrumentation

All Laboratory analysts receive proper training in the operation of applicable instrumentation prior to actual sample analysis. This training may combine attendance at various instrument manufacturer's operator training classes and seminars with actual in-lab instruction and supervision by the group coordinator or his/her designee. This training is recorded in the employees permanent records.

3.12.3 Quality Control

The main purposes of the Quality Control training program are to introduce the Quality Control staff and to explain Laboratory Quality Control requirements. All laboratory analytical staff are required to complete the program. A brief outline of the program is as follows:

- Review the purposes and corrective actions for blanks, check samples, and spikes.
- Explain and show control limits and control charts - how and why they are used, what constitutes a trend, corrective action for trends.
- Emphasize documentation of laboratory data and any problems encountered.

- Explain QC reporting requirements.
- Offer assistance with problems encountered in the laboratory.

The training program is augmented and updated as appropriate.

3.12.4 Safety Program

All new employees must participate in an education and training program. The program commences prior to initial assignment.

For those employees currently working in areas where toxic substances are used on a routine basis, an education and training program is administered on an annual basis.

For those employees using toxic substances in non-routine situations, training is provided prior to handling the substance and is administered on an as needed basis as determined by the supervisor.

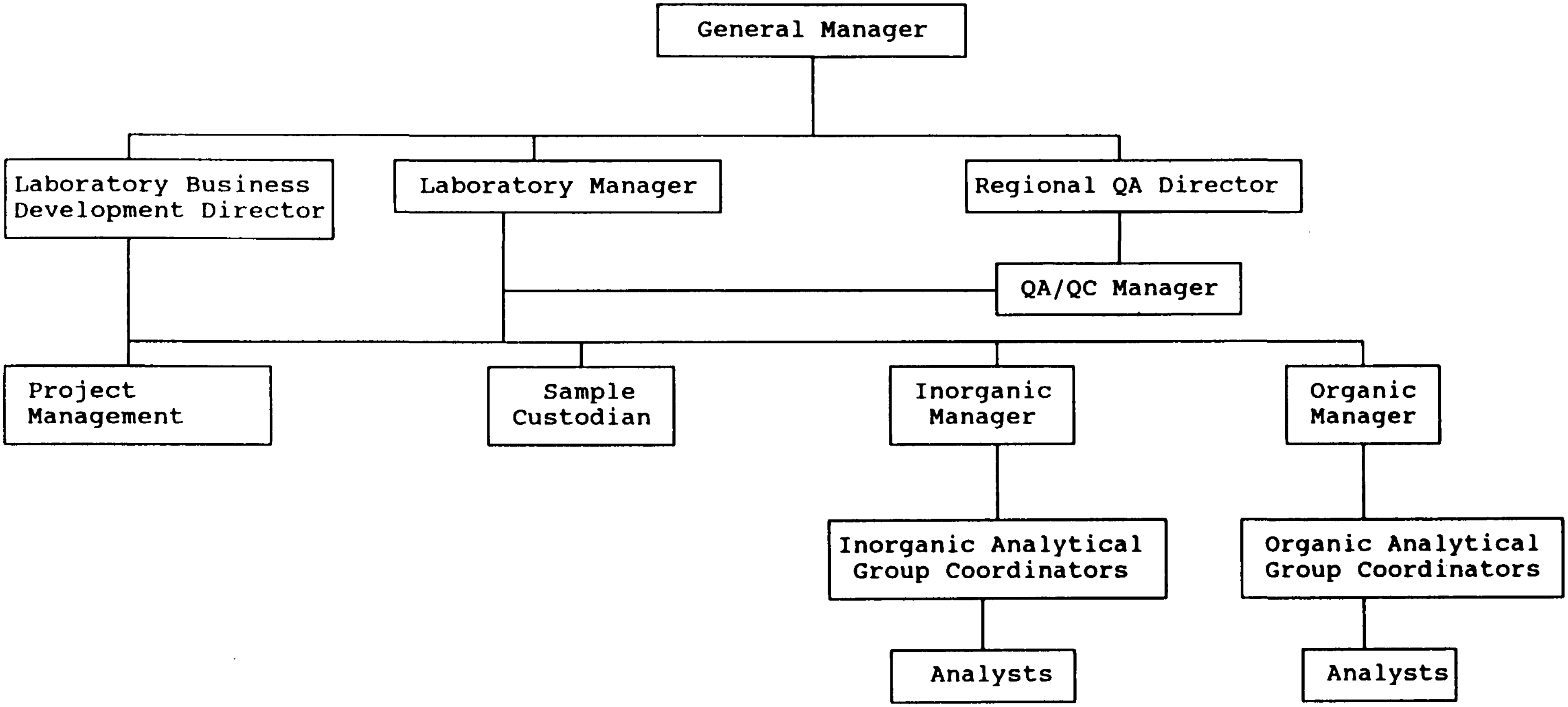
Group Coordinators are responsible for ensuring that all employees working in their group are using proper safety procedures at all times (as documented in the Safety & Health Manual). They are responsible for seeing that any new employee entering their group has received the proper safety training before work begins, and are responsible for implementing the Safety Committee's recommendations as quickly as possible. Group Coordinators should help employees develop good personal chemical hygiene habits.

The following protocols are used whenever handling toxic substances:

- Employees must confine any work done with toxic substances to a regulated area. A regulated area is defined as an area within the laboratory to which access is limited to persons who are aware of the hazards in use and the precautions that must be used. (Such areas would be fume hoods and specifically designated preparation areas.)

- The following protective apparel must be worn at all times when using/handling toxic substances:
  - Safety glasses
  - Laboratory coat
  - Gloves
  - A respirator must be immediately available
- The following personal hygiene must be used before leaving a regulated area:
  - Hands must be washed thoroughly
  - Gloves must be disposed of in a proper container
- All laboratory safety procedures must be followed whenever handling toxic substances. These safety procedures are listed in the Safety & Health Manual and include the following:
  - Labeling
  - Chemical Storage
  - Spills
  - Fire Safety
  - Disposal
  - Handling Procedures

Figure 3-1
Laboratory Organizational Chart



4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, AND COMPLETENESS

The objective of Enseco-Wadsworth/ALERT's Laboratory Quality Assurance Program is to provide legally and scientifically valid laboratory data which meet acceptable analytical accuracy, precision, and completeness criteria. These terms are defined below.

ACCURACY[1]	The degree of agreement of a measured value with the true or expected value. In-house generated accuracy limits are presented as an average recovery plus or minus three (3) standard deviations.
PRECISION[1]	The degree of mutual agreement characteristic of independent measurements as a result of repeated application of a process under specified conditions. In-house generated precision values are presented as the average percent relative standard deviation of a set of data.
COMPLETENESS[1]	The estimated amount of QC samples in control as a percentage of the total number of QC samples attempted.

The accuracy, precision, and completeness are based upon historical data and method validation studies using spikes, replicates and standards. EPA method control data is used if applicable. Advisory limits are presented for parameters which do not have a data base large enough to calculate a reliable value in a multi-analyst laboratory. Advisory limits are based on good laboratory practice and, in most cases, are as strict as or equal to those measured for similar compounds within the same method.

TABLE 4-1 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 501.1 - ANALYSIS OF TRIHALOMETHANES IN DRINKING WATER[10]

Matrix: Drinking Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Chloroform	10	83-119	95
Bromodichloromethane	10	85-115	95
Dibromochloromethane	10	85-112	95
Bromoform	10	81-129	95

TABLE 4-2 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 502.2 - VOLATILE ORGANIC COMPOUNDS IN WATER BY PURGE AND TRAP CAPILLARY COLUMN GAS CHROMATOGRAPHY WITH PHOTOIONIZATION AND ELECTROLYTIC CONDUCTIVITY DETECTORS IN SERIES[11]

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Benzene	9[6]	68-124[6]	95
Bromobenzene	10	96-106	95
Bromochloromethane	10	86-114	95
Bromodichloromethane	10	85-115	95
Bromoform	10	81-129	95
Bromomethane	10	88-112	95
n-Butylbenzene	10	78-138	95
sec-Butylbenzene	10	88-130	95
tert-Butylbenzene	10	92-116	95
Carbon tetrachloride	10	74-122	95
Chlorobenzene	8[6]	73-119[6]	95
Chloroethane	10	88-112	95
Chloroform	10	86-116	95
Chloromethane	16	56-164	95
2-Chlorotoluene	10	94-118	95
4-Chlorotoluene	10	76-118	95
Dibromochloromethane	10	85-112	95
1,2-Dibromo-3-chloropropane	22	39-195	95
1,2-Dibromoethane	10	86-116	95
Dibromomethane	10	85-115	95
1,2-Dichlorobenzene	10	91-121	95
1,3-Dichlorobenzene	10	85-127	95
1,4-Dichlorobenzene	10	86-116	95

TABLE 4-2 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 502.2 - VOLATILE ORGANIC COMPOUNDS IN WATER BY PURGE AND TRAP CAPILLARY COLUMN GAS CHROMATOGRAPHY WITH PHOTOIONIZATION AND ELECTROLYTIC CONDUCTIVITY DETECTOR IN SERIES[11] (Continued)

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Dichlorodifluoromethane	19	45-165	95
1,1-Dichloroethane	10	91-111	95
1,2-Dichloroethane	10	91-109	95
1,1-Dichloroethene	8[6]	67-115[6]	95
cis-1,2-Dichloroethene	10	94-106	95
trans-1,2-Dichloroethene	10	78-126	95
1,2-Dichloropropane	10	88-112	95
1,3-Dichloropropane	10	90-114	95
2,2-Dichloropropane	10	78-126	95
1,1-Dichloropropene	10	87-111	95
cis-1,3-Dichloropropene	10	89-113	95
trans-1,3-Dichloropropene	10	84-114	95
Ethylbenzene	10	92-112	95
Hexachlorobutadiene	10	81-125	95
Isopropylbenzene	10	89-119	95
p-Isopropyltoluene	10	73-133	95
Methylene chloride	11	60-132	95
Naphthalene	15	61-157	95
n-Propylbenzene	10	92-112	95
Styrene	11	69-135	95
1,1,1,2-Tetrachloroethane	10	83-111	95
1,1,2,2-Tetrachloroethane	10	82-112	95
Tetrachloroethene	10	85-121	95
Toluene	9[6]	67-120[6]	95
1,2,3-Trichlorobenzene	14	63-153	95
1,2,4-Trichlorobenzene	11	69-141	95
1,1,1-Trichloroethane	10	89-101	95
1,1,2-Trichloroethane	10	86-110	95
Trichloroethene	9[6]	72-122[6]	95
Trichlorofluoromethane	10	77-137	95
1,2,3-Trichloropropane	10	90-120	95
1,2,4-Trimethylbenzene	10	70-136	95
1,3,5-Trimethylbenzene	10	74-140	95

TABLE 4-2 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 502.2 - VOLATILE ORGANIC COMPOUNDS IN WATER BY PURGE AND TRAP CAPILLARY COLUMN GAS CHROMATOGRAPHY WITH PHOTOIONIZATION AND ELECTROLYTIC CONDUCTIVITY DETECTOR IN SERIES[11] (Continued)

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Vinyl chloride	12	70-154	95
o-Xylene	16	77-107	95
m-Xylene	10	79-133	95
p-Xylene	10	69-123	95

TABLE 4-3 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 509A - ORGANOCHLORINE PESTICIDES[12]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Endrin	20	56-121[6]	95
Lindane	20	56-123[6]	95
Methoxychlor	22[4]	53-159[4]	95
Toxaphene	14	41-126	95

TABLE 4-4 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 509B - CHLORINATED PHENOXY ACID HERBICIDES[12]

Matrix: Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
2,4-D	20	25-142	95
2,4,5-T	29	25-142	95
2,4,5-TP (Silvex)	19	25-142	95

TABLE 4-5 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 601 - PURGEABLE HALOCARBONS[2]

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Bromodichloromethane	10	85-115	95
Bromoform	10	81-129	95
Bromomethane	10	88-112	95
Carbon tetrachloride	10	74-122	95
Chlorobenzene	26[6]	74-128[6]	95
Chloroethane	10	88-112	95
2-Chloroethylvinyl ether	29[5]	14-186[5]	95
Chloroform	10	86-116	95
Chloromethane	16	56-164	95
Dibromochloromethane	10	100-112	95
1,2-Dichlorobenzene	10	91-121	95
1,3-Dichlorobenzene	10	85-127	95
1,4-Dichlorobenzene	10	86-116	95
1,1-Dichloroethane	10	91-111	95
1,2-Dichloroethane	10	91-109	95
1,1-Dichloroethene	32[6]	60-124[6]	95
trans-1,2-Dichloroethene	10	78-126	95
1,2-Dichloropropane	10	88-112	95
cis-1,3-Dichloropropene	10	89-113	95
trans-1,3-Dichloropropene	10	84-114	95
Methylene chloride	11	60-132	95
1,1,2,2-Tetrachloroethane	10	82-112	95
Tetrachloroethene	10	85-121	95
1,1,1-Trichloroethane	10	89-101	95
1,1,2-Trichloroethane	10	86-110	95
Trichloroethene	10	83-119	95
Trichlorofluoromethane	10	77-137	95
Vinyl chloride	12	70-154	95

TABLE 4-6 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 602 - PURGEABLE AROMATICS[2]

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Benzene	33[6]	65-119[6]	95
Chlorobenzene	26[6]	74-128[6]	95
1,2-Dichlorobenzene	10	82-124	95
1,3-Dichlorobenzene	10	88-126	95
1,4-Dichlorobenzene	10	82-118	95
Ethylbenzene	10	92-112	95
Toluene	23[6]	64-124[6]	95

TABLE 4-7 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 608 - ORGANOCHLORINE PESTICIDES AND PCBS[2]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Aldrin	28[6]	43-125[6]	95
a-BHC	19	37-134	95
b-BHC	26	17-147	95
g-BHC (Lindane)	28[6]	51-129[6]	95
d-BHC	20	32-127	95
Chlordane	15	45-119	95
4,4'-DDD	21	31-141	95
4,4'-DDE	22	30-146	95
4,4'-DDT	39[6]	60-162[6]	95
Dieldrin	32[6]	57-138[6]	95
Endosulfan I	18	45-153	95
Endosulfan II	33	D-202	95
Endosulfan sulfate	23	26-144	95
Endrin	28[6]	59-160[6]	95
Endrin aldehyde	20[4]	30-147[4]	95
Heptachlor	27[6]	57-161[6]	95
Heptachlor epoxide	20	37-142	95
Toxaphene	17	41-126	95
PCB-1016	13	50-114	95
PCB-1221	32	15-178	95
PCB-1232	30	10-215	95

TABLE 4-7 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 608 - ORGANOCHLORINE PESTICIDES AND PCBS[2] (Continued)

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
PCB-1242	20	39-150	95
PCB-1248	20	38-158	95
PCB-1254	21	29-131	95
PCB-1260	20	8-127	95

TABLE 4-8 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 624 - PURGEABLES[2]

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[5]	Completeness %[4]
Acrolein	40	D-170	95
Acrylonitrile	40	D-170	95
Benzene	8[6]	75-122[6]	95
Bromodichloromethane	16	52-142	95
Bromoform	10	68-100	95
Bromomethane	22	26-130	95
Carbon tetrachloride	15	58-158	95
Chlorobenzene	9[6]	89-112[6]	95
Chloroethane	20	30-132	95
2-Chloroethylvinyl ether	51	D- 74	95
Chloroform	19	45-167	95
Chloromethane	60	D-298	95
Dibromochloromethane	24	27-159	95
1,2-Dichlorobenzene	29[5]	18-190	95
1,3-Dichlorobenzene	16[5]	59-156	95
1,4-Dichlorobenzene	29[5]	18-190	95
1,1-Dichloroethane	45	D-260	95
1,2-Dichloroethane	40	D-247	95
1,1-Dichloroethene	10[6]	58-141[6]	95
trans-1,2-Dichloroethene	21	34-154	95
1,2-Dichloropropane	17	45-141	95
cis-1,3-Dichloropropene	26	15-117	95
trans-1,3-Dichloropropene	27	18-186	95
Ethylbenzene	33	D-225	95
Methylene chloride	12	88-178	95

TABLE 4-8 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 624 - PURGEABLES[2] (Continued)

Matrix: Water

Parameter	Precision %RSD[4]	Accuracy %R[5]	Completeness %[4]
1,1,2,2-Tetrachloroethane	20	34-148	95
Tetrachloroethene	19	59-173	95
Toluene	20[6]	84-116[6]	95
1,1,1-Trichloroethane	37	18-210	95
1,1,2-Trichloroethane	21	33-159	95
Trichloroethene	10[6]	76-118[6]	95
Trichlorofluoromethane	10	67-109	95
Vinyl chloride	42	D-153	95

TABLE 4-9 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 625 - BASE/NEUTRALS AND ACIDS[2]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Acenaphthene	28[6]	32-112[6]	95
Acenaphthylene	21	28-124	95
Anthracene	30	9-151	95
Benzidine	45	D- 15	95
Benzo(a)anthracene	26	16-136	95
Benzo(b)fluoranthene	35	D-153	95
Benzo(k)fluoranthene	31	6-156	95
Benzo(g,h,i)perylene	27	14-124	95
Benzo(a)pyrene	28	12-132	95
Bis(2-Chloroethoxy)methane	22	7-135	95
Bis(2-Chloroethyl)ether	19	30-108	95
Bis(2-Chloroisopropyl)ether	18	43- 91	95
Bis(2-Ethylhexyl)phthalate	26	16-136	95
4-Bromophenyl phenyl ether	28	12- 96	95
Butyl benzyl phthalate	30	7-145	95
2-Chloronaphthalene	25	14-120	95
4-Chlorophenyl phenyl ether	24	20-122	95
Chrysene	26	21-159	95
Dibenzo(a,h)anthracene	32	2-132	95
Di-n-butyl phthalate	28	12-132	95
1,2-Dichlorobenzene	39	D-122	95

TABLE 4-9 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 625 - BASE/NEUTRALS AND ACIDS[2] (Continued)

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
1,3-Dichlorobenzene	35	D-108	95
1,4-Dichlorobenzene	29[6]	30- 90[6]	95
3,3'-Dichlorobenzidine	57	D- 57	95
Diethyl phthalate	42	D-123	95
Dimethyl phthalate	70	D-133	95
2,4-Dinitrotoluene	47[6]	26-134[6]	95
2,6-Dinitrotoluene	50	D-154	95
Di-n-octylphthalate	36	D-156	95
Fluoranthene	30	7-145	95
Fluorene	24	21-135	95
Hexachlorobenzene	29	10-154	95
Hexachlorobutadiene	36	D-132	95
Hexachlorocyclopentadiene	36	D- 37	95
Hexachloroethane	30	5-113	95
Indeno(1,2,3-cd)pyrene	24	19-115	95
Isophorone	30	8-152	95
Naphthalene	29	9-141	95
Nitrobenzene	23	24-126	95
N-Nitrosodimethylamine	47	D-144	95
N-Nitrosodiphenylamine	23	22-124	95
N-Nitrosodi-n-propylamine	34[6]	19-123[6]	95
Phenanthrene	27	15-153	95
Pyrene	43[6]	21-145[6]	95
1,2,4-Trichlorobenzene	25[6]	13-136[6]	95
4-Chloro-3-methylphenol	37[6]	25-115[6]	95
2-Chlorophenol	26[6]	29- 97[6]	95
2,4-Dichlorophenol	17	31- 97	95
2,4-Dimethylphenol	42	D-123	95
2,4-Dinitrophenol	23	16- 88	95
2-Methyl-4,6-dinitrophenol	37	D-122	95
2-Nitrophenol	23	18-102	95
4-Nitrophenol	47[6]	10-143[6]	95
Pentachlorophenol	63[6]	10-154[6]	95
Phenol	33[6]	19-103[6]	95
2,4,6-Trichlorophenol	21	23-101	95

TABLE 4-10 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES
METHOD 8010 - HALOGENATED VOLATILE ORGANICS[3]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Benzyl chloride	20[4]	70-130[4]	95
Bromobenzene	20[4]	70-130[4]	95
Bromodichloromethane	20	42-172	95
Bromoform	28	13-159	95
Bromomethane	33	D-144	95
Carbon tetrachloride	18	43-143	95
Chlorobenzene	26[6]	74-128[6]	95
Chloroethane	17	46-137	95
Chloroform	15	49-133	95
1-Chlorohexane	20[4]	70-130[4]	95
2-Chloroethylvinyl ether	29	14-186	95
Chloromethane	33	D-193	95
Chlorotoluene	20[4]	70-130[4]	95
Dibromochloromethane	26	24-191	95
Dibromomethane	20[4]	70-130[4]	95
1,2-Dichlorobenzene	33	D-208	95
1,3-Dichlorobenzene	31	7-187	95
1,4-Dichlorobenzene	18	42-143	95
Dichlorodifluoromethane	20[4]	70-130[4]	95
1,1-Dichloroethane	16	47-132	95
1,2-Dichloroethane	16	51-147	95
1,1-Dichloroethene	32[6]	60-124[6]	95
trans-1,2-Dichloroethene	20	38-155	95
Dichloromethane	24	25-162	95
1,2-Dichloropropane	19	44-156	95
trans-1,3-Dichloropropene	26	22-178	95
1,1,1,2-Tetrachloroethane	20[4]	70-130[4]	95
1,1,2,2-Tetrachloroethane	30	8-184	95
Tetrachloroethene	24	26-162	95
1,1,1-Trichloroethane	18	41-138	95
1,1,2-Trichloroethane	18	39-136	95
Trichloroethene	32[6]	60-133[6]	95
Trichlorofluoromethane	25	21-156	95
Trichloropropane	20[4]	70-130[4]	95
Vinyl chloride	24	28-163	95

TABLE 4-11 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8010 - HALOGENATED VOLATILE ORGANICS[3]

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Benzyl chloride	20[4]	70-130[4]	95
Bromobenzene	20[4]	70-130[4]	95
Bromodichloromethane	20	42-172	95
Bromoform	28	13-159	95
Bromomethane	33	D-144	95
Carbon tetrachloride	18	43-143	95
Chlorobenzene	26[6]	60-128[6]	95
Chloroethane	17	46-137	95
Chloroform	15	49-133	95
1-Chlorohexane	20[4]	70-130[4]	95
2-Chloroethylvinyl ether	29	14-186	95
Chloromethane	33	D-193	95
Chlorotoluene	20[4]	70-130[4]	95
Dibromochloromethane	26	24-191	95
Dibromomethane	20[4]	70-130[4]	95
1,2-Dichlorobenzene	33[6]	D-208[6]	95
1,3-Dichlorobenzene	31	7-187	95
1,4-Dichlorobenzene	18	42-143	95
Dichlorodifluoromethane	20[4]	70-130[4]	95
1,1-Dichloroethane	16	47-132	95
1,2-Dichloroethane	16	51-147	95
1,1-Dichloroethene	32[6]	52-126[6]	95
trans-1,2-Dichloroethene	20	38-155	95
Dichloromethane	24	25-162	95
1,2-Dichloropropane	19	44-156	95
trans-1,3-Dichloropropene	26	22-178	95
1,1,1,2-Tetrachloroethane	20[4]	70-130[4]	95
1,1,2,2-Tetrachloroethane	30	8-184	95
Tetrachloroethene	24	26-162	95
1,1,1-Trichloroethane	18	41-138	95
1,1,2-Trichloroethane	18	39-136	95
Trichloroethene	31[6]	60-130[6]	95
Trichlorofluoromethane	25	21-156	95
Trichloropropane	20[4]	70-130[4]	95
Vinyl chloride	24	28-163	95

TABLE 4-12 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8020 - AROMATIC VOLATILE ORGANICS[3]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Benzene	33[6]	65-119[6]	95
Chlorobenzene	26[6]	74-128[6]	95
1,2-Dichlorobenzene	20	37-154	95
1,3-Dichlorobenzene	16	50-141	95
1,4-Dichlorobenzene	18	42-143	95
Ethylbenzene	22	32-160	95
Toluene	23[6]	64-124[6]	95
Xylenes	10	70-124	95

TABLE 4-13 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8020 - AROMATIC VOLATILE ORGANICS[3]

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Benzene	27[6]	55-132[6]	95
Chlorobenzene	26[6]	60-128[6]	95
1,2-Dichlorobenzene	20	37-154	95
1,3-Dichlorobenzene	16	50-141	95
1,4-Dichlorobenzene	18	42-143	95
Ethylbenzene	22	32-160	95
Toluene	24[6]	56-128[6]	95
Xylenes	10	70-124	95

TABLE 4-14 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS[3]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Aldrin	28[6]	43-125[6]	95
a-BHC	19	37-134	95
b-BHC	26	17-147	95
g-BHC (Lindane)	28[6]	51-129[6]	95
d-BHC	20	32-127	95
Chlordane	15	45-119	95

TABLE 4-14 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS[3] (Continued)

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
4,4'-DDD	21	31-141	95
4,4'-DDE	22	30-146	95
4,4'-DDT	39[6]	60-162[6]	95
Dieldrin	32[6]	57-138[6]	95
Endosulfan I	18	45-153	95
Endosulfan II	33	D-202	95
Endosulfan sulfate	23	26-144	95
Endrin	28[6]	59-160[6]	95
Endrin aldehyde	20[4]	30-147[4]	95
Heptachlor	27[6]	57-161[6]	95
Heptachlor epoxide	20	37-142	95
Methoxychlor	22[4]	53-159[4]	95
Toxaphene	17	41-126	95
PCB-1016	13	50-114	95
PCB-1221	32	15-178	95
PCB-1232	30	10-215	95
PCB-1242	20	39-150	95
PCB-1248	20	38-158	95
PCB-1254	21	29-131	95
PCB-1260	29	8-127	95

TABLE 4-15 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS[3]

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Aldrin	42[6]	32-131[6]	95
a-BHC	19	37-134	95
b-BHC	26	17-147	95
g-BHC (Lindane)	40[6]	45-143[6]	95
d-BHC	20	32-127	95
Chlordane	15	45-119	95
4,4'-DDD	21	31-141	95
4,4'-DDE	22	30-146	95

TABLE 4-15 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8080 - ORGANOCHLORINE PESTICIDES AND PCBS[3] (Continued)

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
4,4'-DDT	47[6]	37-163[6]	95
Dieldrin	43[6]	45-149[6]	95
Endosulfan I	18	45-153	95
Endosulfan II	33	D-202	95
Endosulfan sulfate	23	26-144	95
Endrin	46[6]	54-156[6]	95
Endrin aldehyde	20[4]	30-147[4]	95
Heptachlor	69[6]	32-192[6]	95
Heptachlor epoxide	20	37-142	95
Methoxychlor	22[4]	53-159[4]	95
Toxaphene	17	41-126	95
PCB-1016	13	50-114	95
PCB-1221	32	15-178	95
PCB-1232	30	10-215	95
PCB-1242	20	39-150	95
PCB-1248	20	38-158	95
PCB-1254	21	29-131	95
PCB-1260	29	8-127	95

TABLE 4-16 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8150 - CHLORINATED PHENOXY ACID HERBICIDES[3]

Matrix: Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
2,4-D	36	39-143	95
2,4,5-T	30	97-172	95
2,4,5-TP (Silvex)	43	27-141	95

TABLE 4-17 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8150 - CHLORINATED PHENOXY ACID HERBICIDES[3]

Matrix: Solid

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
2,4-D	39	44-124	95
2,4,5-T	33	77-168	95
2,4,5-TP (Silvex)	25	19-117	95

TABLE 4-18 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8240 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS[3]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Acetone	30[4]	70-130[4]	95
Acrolein	40[4]	D-170[4]	95
Acrylonitrile	40[4]	D-170[4]	95
Benzene	8[6]	75-122[6]	95
Bromodichloromethane	20	35-155	95
Bromoform	21	45-169	95
Bromomethane	33	D-242	95
2-Butanone	30[4]	70-130[4]	95
Carbon disulfide	30[4]	70-130[4]	95
Carbon tetrachloride	12	70-140	95
Chlorobenzene	9[6]	89-112[6]	95
Chloroethane	36	14-230	95
2-Chloroethylvinyl ether	51	D-305	95
Chloroform	14	51-138	95
Chloromethane	46	D-273	95
Dibromochloromethane	16	53-149	95
1,2-Dichlorobenzene	29	18-190	95
1,3-Dichlorobenzene	16	59-156	95
1,4-Dichlorobenzene	29	18-190	95
1,1-Dichloroethane	16	59-155	95
1,2-Dichloroethane	18	49-155	95
1,1-Dichloroethene	10[6]	58-141[6]	95
trans-1,2-Dichloroethene	17	54-156	95
1,2-Dichloropropane	35	D-210	95
cis-1,3-Dichloropropene	38	D-227	95
trans-1,3-Dichloropropene	28	17-183	95

TABLE 4-18 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES
METHOD 8240 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS[3] (Continued)

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Ethylbenzene	21	37-162	95
2-Hexanone	30[4]	70-130[4]	95
4-Methyl-2-pentanone	30[4]	70-130[4]	95
Methylene chloride	37	D-221	95
Styrene	30[4]	70-130[4]	95
1,1,2,2-Tetrachloroethane	18	46-157	95
Tetrachloroethene	14	64-148	95
Toluene	20[6]	84-116[6]	95
1,1,1-Trichloroethane	18	52-162	95
1,1,2-Trichloroethane	16	52-150	95
Trichloroethene	10[6]	76-118[6]	95
Trichlorofluoromethane	27	17-181	95
Vinyl acetate	30[4]	70-130[4]	95
Vinyl chloride	42	D-251	95
Total xylenes	30[4]	70-130[4]	95

TABLE 4-19 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES
METHOD 8240 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS[3]

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Acetone	30[4]	70-130[4]	95
Acrolein	40[4]	D-170[4]	95
Acrylonitrile	40[4]	D-170[4]	95
Benzene	19[6]	64-130[6]	95
Bromodichloromethane	20	35-155	95
Bromoform	21	45-169	95
Bromomethane	40	D-242	95
2-Butanone	30[4]	70-130[4]	95
Carbon disulfide	30[4]	70-130[4]	95
Carbon tetrachloride	12	70-140	95
Chlorobenzene	10[6]	61-128[6]	95
Chloroethane	36	14-230	95
2-Chloroethylvinyl ether	51	D-305	95
Chloroform	14	51-138	95
Chloromethane	46	D-273	95

TABLE 4-19 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8240 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR VOLATILE ORGANICS[3] (Continued)

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Dibromochloromethane	16	53-149	95
1,2-Dichlorobenzene	29	18-190	95
1,3-Dichlorobenzene	16	59-156	95
1,4-Dichlorobenzene	29	18-190	95
1,1-Dichloroethane	16	59-155	95
1,2-Dichloroethane	18	49-155	95
1,1-Dichloroethene	20[6]	49-140[6]	95
trans-1,2-Dichloroethene	17	54-156	95
1,2-Dichloropropane	35	D-210	95
cis-1,3-Dichloropropene	38	D-227	95
trans-1,3-Dichloropropene	28	17-183	95
Ethylbenzene	21	37-162	95
2-Hexanone	30[4]	70-130[4]	95
4-Methyl-2-pentanone	30[4]	70-130[4]	95
Methylene chloride	37	D-221	95
Styrene	30[4]	70-130[4]	95
1,1,2,2-Tetrachloroethane	18	46-157	95
Tetrachloroethene	14	64-148	95
Toluene	36[6]	78-121[6]	95
1,1,1-Trichloroethane	18	52-162	95
1,1,2-Trichloroethane	16	52-150	95
Trichloroethene	12[6]	65-124[6]	95
Trichlorofluoromethane	27	17-181	95
Vinyl acetate	30[4]	70-130[4]	95
Vinyl chloride	42	D-251	95
Total xylenes	30[4]	70-130[4]	95

TABLE 4-20 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8270 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR SEMIVOLATILE ORGANICS: CAPILLARY COLUMN TECHNIQUE[3]

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Acenaphthene	28[6]	32-112[6]	95
Acenaphthylene	19	33-145	95
Anthracene	18	27-133	95
Benzidine	45	D- 15	95
Benzo(a)anthracene	18	33-143	95
Benzo(b)fluoranthene	23	24-159	95
Benzo(k)fluoranthene	25	11-162	95
Benzo(g,h,i)perylene	36	D-219	95
Benzo(a)pyrene	24	17-163	95
Benzyl alcohol	30[4]	50-150[4]	95
Bis(2-Chloroethoxy)methane	25	33-184	95
Bis(2-Chloroethyl)ether	24	12-158	95
Bis(2-Chloroisopropyl)ether	22	36-166	95
Bis(2-Ethylhexyl)phthalate	25	8-158	95
4-Bromophenyl phenyl ether	12	53-127	95
Butyl benzyl phthalate	50[4]	D-152	95
2-Chloronaphthalene	10	60-118	95
4-Chlorophenyl phenyl ether	22	25-158	95
Chrysene	25	17-168	95
Dibenzo(a,h)anthracene	38	D-227	95
Di-n-butyl phthalate	20	1-118	95
1,2-Dichlorobenzene	16	32-129	95
1,3-Dichlorobenzene	29	D-172	95
1,4-Dichlorobenzene	29[6]	30- 90[6]	95
3,3'-Dichlorobenzidine	44	D-262	95
Diethyl phthalate	50[4]	D-114	95
Dimethyl phthalate	50[4]	D-112	95
2,4-Dinitrotoluene	47[6]	26-134[6]	95
2,6-Dinitrotoluene	18	50-158	95
Di-n-octylphthalate	24	4-146	95
Fluoranthene	18	26-137	95
Fluorene	10	59-121	95
Hexachlorobenzene	25	D-152	95
Hexachlorobutadiene	15	24-116	95
Hexachlorocyclopentadiene	36	D- 37	95
Hexachloroethane	12	40-113	95
Indeno(1,2,3-cd)pyrene	29	D-171	95

TABLE 4-20 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8270 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR SEMIVOLATILE ORGANICS: CAPILLARY COLUMN TECHNIQUE[3] (Continued)

Matrix: Water

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Isophorone	29	21-196	95
2-Methylnaphthalene	30[4]	50-150[4]	95
Naphthalene	19	21-133	95
2-Nitroaniline	30[4]	50-150[4]	95
3-Nitroaniline	30[4]	50-150[4]	95
4-Nitroaniline	30[4]	50-150[4]	95
Nitrobenzene	26	25-180	95
N-Nitrosodimethylamine	47	D-144	95
N-Nitrosodiphenylamine	23	22-124	95
N-Nitrosodi-n-propylamine	34[6]	19-123[6]	95
Phenanthrene	11	54-120	95
Pyrene	43[6]	21-145[6]	95
1,2,4-Trichlorobenzene	25[6]	13-136[6]	95
Benzoic acid	30[4]	50-150[4]	95
4-Chloro-3-methylphenol	37[6]	25-115[6]	95
2-Chlorophenol	26[6]	29- 97[6]	95
2,4-Dichlorophenol	16	39-135	95
2,4-Dimethylphenol	14	32-119	95
2,4-Dinitrophenol	32	D-191	95
2-Methyl-4,6-dinitrophenol	30	D-181	95
2-Methylphenol	30[4]	50-150[4]	95
4-Methylphenol	30[4]	50-150[4]	95
2-Nitrophenol	26	29-182	95
4-Nitrophenol	47[6]	10-143[6]	95
Pentachlorophenol	63[6]	10-154[6]	95
Phenol	33[6]	19-103[6]	95
2,4,5-Trichlorophenol	30[4]	50-150[4]	95
2,4,6-Trichlorophenol	18	37-144	95

TABLE 4-21 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8270 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR SEMIVOLATILE ORGANICS: CAPILLARY COLUMN TECHNIQUE[3]

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Acenaphthene	27[6]	37-116[6]	95
Acenaphthylene	19	33-145	95
Anthracene	18	27-133	95
Benzidine	45	D- 15	95
Benzo(a)anthracene	18	33-143	95
Benzo(b)fluoranthene	23	24-159	95
Benzo(k)fluoranthene	25	11-162	95
Benzo(g,h,i)perylene	36	D-219	95
Benzo(a)pyrene	24	17-163	95
Benzyl alcohol	30[4]	50-150[4]	95
Bis(2-Chloroethoxy)methane	25	33-184	95
Bis(2-Chloroethyl)ether	24	12-158	95
Bis(2-Chloroisopropyl)ether	22	36-166	95
Bis(2-Ethylhexyl)phthalate	25	8-158	95
4-Bromophenyl phenyl ether	12	53-127	95
Butyl benzyl phthalate	50[4]	D-152	95
2-Chloronaphthalene	10	60-118	95
4-Chlorophenyl phenyl ether	22	25-158	95
Chrysene	25	17-168	95
Dibenzo(a,h)anthracene	38	D-227	95
Di-n-butyl phthalate	20	1-118	95
1,2-Dichlorobenzene	16	32-129	95
1,3-Dichlorobenzene	29	D-172	95
1,4-Dichlorobenzene	21[6]	31- 99[6]	95
3,3'-Dichlorobenzidine	44	D-262	95
Diethyl phthalate	50[4]	D-114	95
Dimethyl phthalate	50[4]	D-112	95
2,4-Dinitrotoluene	46[6]	29-142[6]	95
2,6-Dinitrotoluene	18	50-158	95
Di-n-octylphthalate	24	4-146	95
Fluoranthene	18	26-137	95
Fluorene	10	59-121	95
Hexachlorobenzene	25	D-152	95
Hexachlorobutadiene	15	24-116	95
Hexachlorocyclopentadiene	36	D- 37	95
Hexachloroethane	12	40-113	95
Indeno(1,2,3-cd)pyrene	29	D-171	95

TABLE 4-21 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 8270 - GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR SEMIVOLATILE ORGANICS: CAPILLARY COLUMN TECHNIQUE[3] (Continued)

Matrix: Solid

Parameter	Precision %RSD[5]	Accuracy %R[5]	Completeness %[4]
Isophorone	29	21-196	95
2-Methylnaphthalene	30[4]	50-150[4]	95
Naphthalene	19	21-133	95
2-Nitroaniline	30[4]	50-150[4]	95
3-Nitroaniline	30[4]	50-150[4]	95
4-Nitroaniline	30[4]	50-150[4]	95
Nitrobenzene	26	25-180	95
N-Nitrosodimethylamine	47	D-144	95
N-Nitrosodiphenylamine	23	22-124	95
N-Nitrosodi-n-propylamine	27[6]	27-122[6]	95
Phenanthrene	11	54-120	95
Pyrene	55[6]	25-144[6]	95
1,2,4-Trichlorobenzene	22[6]	35- 98[6]	95
Benzoic acid	30[4]	50-150[4]	95
4-Chloro-3-methylphenol	24[6]	34-113[6]	95
2-Chlorophenol	20[6]	39- 99[6]	95
2,4-Dichlorophenol	16	39-135	95
2,4-Dimethylphenol	14	32-119	95
2,4-Dinitrophenol	32	D-191	95
2-Methyl-4,6-dinitrophenol	30	D-181	95
2-Methylphenol	30[4]	50-150[4]	95
4-Methylphenol	30[4]	50-150[4]	95
2-Nitrophenol	26	29-182	95
4-Nitrophenol	53[6]	10-146[6]	95
Pentachlorophenol	48[6]	11-172[6]	95
Phenol	25[6]	35-100[6]	95
2,4,5-Trichlorophenol	30[4]	50-150[4]	95
2,4,6-Trichlorophenol	18	37-144	95

TABLE 4-22 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS ORGANIC COMPOUNDS

Matrix: Water

Parameter	Method	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
1,2-Dibromoethane(EDB)	601M[7,2]	10	83-133	95
1,2-Dibromoethane(EDB)	8010M[7,2]	10	83-133	95
1-Methylnaphthalene	625[2]	29	91-141	95
1-Methylnaphthalene	8270[3]	19	21-133	95
2-Methylnaphthalene	625[2]	29	9-141	95
2-Methylnaphthalene	8270[3]	29	9-141	95
Methyl tert-butyl ether	602[2]	10	74-108	95
Methyl tert-butyl ether	8020[2]	10	74-108	95
Xylenes (Total)	602[2]	10	70-124	95

TABLE 4-23 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS ORGANIC COMPOUNDS

Matrix: Solid

Parameter	Method	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
1,2-Dibromoethane(EDB)	8010M[7,2]	10	83-133	95
1-Methylnaphthalene	8270[3]	19	21-133	95
2-Methylnaphthalene	8270[3]	29	9-141	95
Methyl tert-butyl ether	8020[2]	10	74-108	95

TABLE 4-24 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 6010/200.7 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRIC METHOD FOR TRACE ELEMENT ANALYSIS OF WATER AND WASTES[8]

Matrix: Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Aluminum	22	76-125	95
Antimony	11	84-110	95
Barium	13	82-110	95
Beryllium	9	83-113	95
Boron	20	68-116	95
Cadmium	12	77-112	95

TABLE 4-24 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 6010/200.7 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRIC METHOD FOR TRACE ELEMENT ANALYSIS OF WATER AND WASTES[8] (Continued)

Matrix: Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Calcium	61	85-114	95
Chromium	8	82-113	95
Cobalt	7	80-111	95
Copper	13	81-111	95
Iron	27	85-116	95
Lead	10	79-114	95
Magnesium	16	82-111	95
Manganese	15	81-112	95
Molybdenum	3	77-110	95
Nickel	11	81-110	95
Potassium	10	81-111	95
Silicon	20	57-148	95
Silver	7	82-111	95
Sodium	20	82-113	95
Strontium	20	75-117	95
Thallium	8	70-109	95
Tin	20	73-126	95
Titanium	20	71-122	95
Tungsten	20	58-110	95
Vanadium	9	83-115	95
Zinc	17	81-121	95

TABLE 4-25 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 200.7 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRIC METHOD FOR TRACE ELEMENT ANALYSIS OF WATER AND WASTES[8]

Matrix: Drinking Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Barium	14	90-106	95
Calcium	25	73-119	95
Copper	17	75-104	95
Iron	18	65-115	95
Magnesium	25	68-120	95
Manganese	24	62-121	95

TABLE 4-25 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 200.7 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRIC METHOD FOR TRACE ELEMENT ANALYSIS OF WATER AND WASTES[8] (Continued)

Matrix: Drinking Water

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Sodium	30	65-123	95
Zinc	21	63-113	95

TABLE 4-26 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 6010 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROSCOPY[3]

Matrix: Solid

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Aluminum	20	63-126	95
Antimony	52	76-111	95
Barium	65	78-110	95
Beryllium	11	74-110	95
Boron	20	64-110	95
Cadmium	19	75-109	95
Calcium	25	78-111	95
Chromium	26	76-114	95
Cobalt	8	74-111	95
Copper	27	78-107	95
Iron	20	72-131	95
Lead	56	75-116	95
Magnesium	59	76-107	95
Manganese	99	77-108	95
Molybdenum	20	70-119	95
Nickel	22	73-111	95
Potassium	25	81-110	95
Silicon	20	57-148	95
Silver	13	76-113	95
Sodium	8	77-112	95
Strontium	20	75-117	95

TABLE 4-26 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES METHOD 6010 - INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROSCOPY[3] (Continued)

Matrix: Solid

Parameter	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Thallium	20	69-106	95
Tin	20	77-117	95
Titanium	20	71-122	95
Tungsten	20	55-121	95
Vanadium	20	79-112	95
Zinc	20	71-123	95

TABLE 4-27 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS METALS

Matrix: Water

Parameter	Method	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Antimony	204.2[8]	20	75-125	95
Antimony	7041[3]	20	75-125	95
Arsenic	206.2[8]	23[6]	77-119[6]	95
Arsenic	7060[3]	23[6]	77-119[6]	95
Cadmium	213.2[8]	13[6]	69-107[6]	95
Cadmium	7131[3]	13[6]	69-107[6]	95
Chromium	218.2[8]	20[6]	78-119[6]	95
Chromium	7191[3]	20[6]	78-119[6]	95
Copper	220.2[8]	20	75-125	95
Lead	239.2[8]	17[6]	79-109[6]	95
Lead	7421[3]	17[6]	79-114[6]	95
Mercury	245.1[8]	10[6]	68-131[6]	95
Mercury	7470[3]	10[6]	68-131[6]	95
Selenium	270.2[8]	68[6]	62-125[6]	95
Selenium	7740[3]	68[6]	62-125[6]	95
Thallium	279.2[8]	20	75-125	95
Thallium	7841[3]	20	75-125	95

TABLE 4-28 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS METALS

Matrix: Drinking Water

Parameter	Method[8]	Precision %RSD[4]	Accuracy %R[6]	Completeness %[4]
Arsenic	206.2	20	66-134	95
Cadmium	213.2	20	61-132	95
Chromium	218.2	20	74-118	95
Lead	239.2	20	77-123	95
Mercury	245.1	20	64-138	95
Selenium	270.2	20	10-153	95
Silver	272.2	20	73-121	95

TABLE 4-29 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS METALS

Matrix: Solid

Parameter	Method[3]	Precision %RSD[4]	Accuracy %R[4]	Completeness %[4]
Antimony	7041	20	75-125	95
Arsenic	7060	20	67-122[6]	95
Cadmium	7131	20	68-114[6]	95
Chromium	7191	20	76-127[6]	95
Lead	7421	20	75-125	95
Mercury	7470	20	65-132[6]	95
Mercury	7471	20	65-132[6]	95
Selenium	7740	20	63-118[6]	95
Thallium	7841	20	75-125	95

TABLE 4-30 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS WET CHEMISTRY PARAMETERS

Matrix: Water

Parameter	Method	Precision %RSD[4]	Accuracy %R[6]	Completeness %[4]
Acidity	305.1[1]	18	87-112	95
Alkalinity	310.1[1]	8	90-110	95
Ammonia Nitrogen	350.2/350.3[1]	21	78-114	95
Bromide	320.1[1]	31	68-129	95

TABLE 4-30 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS WET CHEMISTRY PARAMETERS (Continued)

Matrix: Water

Parameter	Method	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Chemical Oxygen Demand	508B[12]/410.4[8]	21	79-128	95
Chloride	325.2[8]/9251[3]	9	90-113	95
Chloride-Pot. Water	325.28	10	90-111	95
Chromium (Cr^{+6})	307B[13]	18	75-116	95
Chromium (Cr^{+6})	7195[3]	18	75-116	95
Cyanide	335.2[8]/9010[3]	130	45-121	95
Fluoride	340.2[8]/314B[12]	11	86-110	95
Hardness	130.2[8]	38	80-121	95
Methylene Blue Active Substances	425.1[8]	44	82-116	95
Nitrate Nitrogen	353.3[8]/9200[3]	15	90-115	95
Nitrate-Potable Water	353.2[8]/418C[12]	10	88-110	95
Nitrite Nitrogen	353.3[8]	7	87-110	95
Petroleum Hydrocarbons Infrared	418.1[8]	30	61-139	95
Petroleum Hydrocarbons Gravimetric	418.1[8]/9071[3]	--	70-134	95
pH	150.1[8]/9040[3]	±0.1 units[4]	±0.2 units[4]	95
Phenols	420.1[8]	17	56-127	95
Phosphate	365.2[8]	50	71-119	95
Residue				
Filterable	160.1[8]	20[4]	78-120	95
Non-Filterable	160.2[8]	20[4]	63-114	95
Settleable	160.5[8]	20[4]	80-120[4]	95
Total	160.3[8]	20[4]	90-110	95
Volatile	160.4[8]	20[4]	70-130[4]	95
Specific Conductance	120.1[8]	±0.1 umhos[4]	±0.2 umhos[4]	95
Sulfate	375.4[8]/9035[3]	8	85-116	95
Sulfide	376.1[8]/9030[3]	17	48-115	95
Sulfite	377.1[8]	18	61-116	95
Total Kjeldahl Nitrogen	351.3[8]	10	87-110	95

TABLE 4-30 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS WET CHEMISTRY PARAMETERS (Continued)

Matrix: Water

Parameter	Method	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Total Organic Carbon	415.1[8]	11	82-117	95
Total Organic Carbon	9060[3]	11	82-117	95
Total Organic Halogen	450.1[8]	46	39-122	95
Total Organic Halogen	9020[3]	46	39-122	95
Total Organic Nitrogen	351.3[8]	29	78-120	95

TABLE 4-31 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES MISCELLANEOUS WET CHEMISTRY PARAMETERS

Matrix: Solid

Parameter	Method	Precision %RSD[6]	Accuracy %R[6]	Completeness %[4]
Ammonia Nitrogen	350.2[8]	17	88-110	95
Chloride	9251[3]	33	58-124	95
Chromium (Cr^{+6})	7195[3]	18	64-127	95
Cyanide	9012[3]	97	42-119	95
Nitrate Nitrogen	9200[3]	15	55-130	95
pH	9045[3]	±0.1 units[4]	±0.2 units[4]	95
Phenolics, Total	420.1[8]	100	31-145	95
Phosphorus, All	365.2[8]	63	27-164	95
Sulfate	9035[3]	41	67-127	95
Sulfide	9030[3]	13	45-120	95
Petroleum Hydrocarbons Infrared	9071[3]/418.1[8]	63	51-123	95
Total Kjeldahl Nitrogen	351.3[8]	48	79-122	95
Total Organic Nitrogen	351.3[8]	51	68-128	95

TABLE 4-32 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES TOXICITY CHARACTERISTIC LEACHEATE PROCEDURE (TCLP)

Marix: Extract

Parameter	Method[3]	EPA Hazardous Waste Number[14]	Accuracy %R[6]	Comp. %[4]
METALS				
Arsenic	7060	D004	80-111	95
Barium	6010	D005	57-157	95
Cadmium	6010	D006	77-109	95
Chromium	6010	D007	79-113	95
Lead	6010	D008	77-117	95
Mercury	7470	D009	71-126	95
Selenium	7740	D010	73-134	95
Silver	6010	D011	80-111	95
PESTICIDES				
Chlordane	8080	D020	10-185	95
Endrin	8080	D012	74-131	95
Heptachlor	8080	D031	57-166	95
Lindane	8080	D013	62-125	95
Methoxychlor	8080	D014	66-161	95
Toxaphene	8080	D015	38-155	95
HERBICIDES				
2,4-D	8150	D016	37-149	95
2,4,5-TP (Silvex)	8150	D017	22-140	95
VOLATILES				
Benzene	8240	D018	62-132	95
Carbon tetrachloride	8240	D019	55-131	95
Chlorobenzene	8240	D021	68-134	95
Chloroform	8240	D022	65-138	95
1,2-Dichloroethane	8240	D028	56-150	95
1,1-Dichloroethylene	8240	D029	50-140	95
Methyl ethyl ketone	8240	D035	45-132	95
Tetrachloroethylene	8240	D039	56-145	95
Trichloroethylene	8240	D040	59-138	95
Vinyl chloride	8240	D043	57-134	95

TABLE 4-32 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES TOXICITY CHARACTERISTIC LEACHEATE PROCEDURE (TCLP) (Continued)

Marix: Extract

Parameter	Method[3]	EPA Hazardous Waste Number[14]	Accuracy %R[6]	Comp. %[4]
SEMI-VOLATILES				
Cresols, Total	8270	D026	23-115	95
1,4-Dichlorobenzene	8270	D027	33- 89	95
2,4-Dinitrotoluene	8270	D030	10-118	95
Hexachlorobenzene	8270	D032	26-123	95
Hexachlorobutadiene	8270	D033	25- 93	95
Hexachloroethane	8270	D034	31- 88	95
Nitrobenzene	8270	D036	34-103	95
Pentachlorophenol	8270	D037	24-103	95
Pyridine	8270	D038	13-113	95
2,4,5-Trichlorophenol	8270	D041	24-111	95
2,4,6-Trichlorophenol	8270	D052	33-102	95

PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES NOTATIONS

1. Taylor, J.K, Quality Assurance of Chemical Measurements, Lewis Publishers, Inc. Chelsea, Michigan (1987).
2. 40 CFR Part 136, Appendix A, October 26, 1984.
3. SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, EPA, September 1986.
4. Advisory limit - Refer to Chapter 4.0 for the laboratory definition.
5. EPA method control data.
6. In-house data.
7. Method modification: EC detector is substituted for the Hall detector.
8. EPA Methods for Chemical Analysis of Water and Wastes 1983, EPA 600/4-79-020.
9. No objectives necessary - method is for screening only.
10. Analysis of Trihalomethanes in Drinking Water, November 29, 1979, EPA 600/D-80-020.
11. Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water, September 1986.
12. Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition.
13. Standard Methods for the Examination of Water and Wastewater, Fourteen Edition.
14. 55 Federal Register 11862, March 29, 1990, Final Rule.

5.0 SAMPLING PROCEDURES

5.1 Sample Collection Procedures

Enseco-Wadsworth/ALERT Laboratories uses USEPA approved and/or proposed sample collection methods and equipment outlined in the following technical publications:

- EPA/SW846, "Test Methods for Evaluating Solid Waste Physical/ Chemical Methods," Third Edition, USEPA, 1986.
- EPA/600/2-80-018, "Samples and Sampling Procedures for Hazardous Waste Streams".
- EPA 600/4-84-076, "Characterization of Hazardous Waste Sites -A Methods Manual, Volume II: Available Sampling Methods," December 1984.
- U.S. Army Corps of Engineers, "Interim Standard Air Monitoring Guide for Hazardous Waste Sites," June 1984.
- EPA/SW611, "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities".
- EPA 600/4-83-020, "Preparation of Solid Sampling Protocol: Techniques and Strategies," May 1983.
- EPA 600/4-82-029, "Handbook for Sampling and Sample Preservation of Water and Wastewater," September 1982.
- EPA Region IV Engineering Support Branch, "Standard Operating Procedures and Quality Assurance Manual," April 1986.

Specific guidelines for a project for sample site selection, selection of sampling equipment, types of samples to be collected, standard sample collection procedures, specific maintenance and calibration procedures for sampling equipment, and other considerations are based upon site-specific requirements.

5.2 Selection and Preparation of Sampling Equipment

The material of which sampling equipment is constructed can affect analytical results. The material selected for sampling certain parameters must not contaminate or alter the sample being collected, and must be easily cleaned so that samples are not cross-contaminated. Also, the action of the sampling device must not alter the sample being collected (e.g., using an air-lift pump for volatiles in water may purge the compounds of interest). Enseco-Wadsworth/ALERT sampling personnel select equipment based upon the medium and parameters being sampled following the guidance documents listed in Chapter 5.1. All sampling equipment is prepared following the specifications of the guidance documents in Chapter 5.1. Any deviation from standard procedures must be documented and reported to the Sample Procurement Manager.

5.3 Sample Containers, Preservations, and Holding Times

Enseco-Wadsworth/ALERT Laboratories recognize that proper containers and appropriate preservatives are necessary for the collection of valid samples. In addition, the sample must be analyzed within a prescribed time frame for each parameter. The Laboratory Sample Preservation Summary (Tables 5-1 and 5-2) details permissible sample containers, preservatives, holding times, and minimum volume of sample needed. The requirements of these tables correspond with the guidelines of the documents listed in Chapter 5.1.

5.4 Sample Documentation

Enseco-Wadsworth/ALERT Laboratories uses proper sample documentation measures to record pertinent field data and ensures the legal validity of all collected samples. These sample documentation measures provide a detailed, legal record of all sampling activities including: sample collection, preservation, chain-of-custody possession, transportation, and laboratory submittal. Key component sample documentation measures include use of the following record materials: Laboratory Field Sample Logbooks, Sample Labels, Sample Seals, Chain-of-Custody Forms, and Laboratory Sample Log. These are described in Chapter 6, Sample Custody.

5.5 Sample Collection Quality Control Procedures

5.5.1 Experience Requirements

All Enseco-Wadsworth/ALERT Laboratories field personnel must have at least six weeks field experience before conducting sampling programs without supervision. Each new field employee accompanies a qualified trainer on different types of field studies. During this training period, the employee receives instruction in sample site selection and preparation of equipment and materials, sample collection for various media, preservation, documentation, packing, and shipment.

5.5.2 Traceability Requirements

All sample collection activities are traceable, through field records, to the person collecting the sample and to the specific piece of sampling equipment used to collect that sample (where appropriate). In a similar fashion, all maintenance and calibration records for sampling equipment are kept so that they, too, are traceable.

5.5.3 Measurement of Sample Container and Sample Equipment Integrity

Only containers that have been properly prepared for specific types of samples are used for sample collection. To ensure the integrity of containers for volatile organic compounds, a representative container is filled with deionized water, preserved, carried into the field, and returned. VOC analysis is then performed. This quality assurance procedure is performed at least once per sampling event.

Preserved volatile organic compound (VOC) blanks are supplied for each investigation where VOCs are collected. These blanks are carried into the field, treated as regular VOC samples, and submitted for VOC analysis along with the required samples.

The sampler logs all sample container, preservative, and sample equipment blank data on field logsheets. Any problems noted with specific equipment, preservatives, or personnel are promptly reported to the Sample Procurement Manager so that corrective action can be instituted.

5.6 Sample Transportation and Shipment

Samples are delivered to the Laboratory for analysis as soon as possible. The samples are properly preserved, packaged for transport, and accompanied by chain-of-custody documentation prior to shipment or transport to the Laboratory. The samples are also submitted to the designated Sample Custodian for proper acceptance into the Laboratory.

5.6.1 Non-Hazardous Samples

Environmental samples are transported and/or shipped in the Laboratory's transport shippers or coolers. The shippers are designed and used exclusively by the Laboratory and are provided upon request to clients conducting their own sampling operations.

Laboratory transport shippers are 16" x 24" x 12" high-density polyethylene (HDPE) heavy transit cases form-fitted with high-density insulating foam. Each shipper contains packaging instructions, appropriate sample containers and preservatives, ice packs for refrigeration, various Laboratory sample documentation materials and Laboratory sample seals. Laboratory transport shippers are delivered or shipped via overnight carrier to the laboratory as soon as possible after collection.

5.6.2 Hazardous Samples

Hazardous samples as indicated in the DOT Hazardous Material Table (49 CFR 172.101) are transported as specified in the regulations. Preservatives for samples consist of either acids or caustics. Hydrochloric Acid (17%), Nitric Acid (18%), Sulfuric Acid (35%), and Sodium Hydroxide (4N) are packed and shipped as follows:

- 8 ml screw top vial is filled with 5 ml of acid or caustic and capped. The bottle is labeled as to its contents.
- Each vial is inserted in a four (4) mil thick polyethylene zip-lock bag.
- The bagged vials are packed in 250/500 ml polypropylene plastic intermediate containers.
- The plastic containers are then filled with vermiculite and capped/sealed.
- The intermediate containers are placed in a strong fiberboard box or cooler and sealed. A maximum of 500 ml of acid or caustic can be placed in a single outer package.

- The sealed box is labeled in accordance with DOT specifications (see 49 CFR 172.101).

Other potentially hazardous material samples are packaged and shipped as follows:

- Samples are placed in 32 oz. glass jars with TFE-lined lids or polyethylene bottles, as appropriate. All filled containers have sufficient air-space to allow for sample expansion and for volatilization. Samples to be analyzed for low level volatile organics are placed in 40 ml vials (no headspace) with appropriate septum lids.
- Sample containers are inserted and sealed in a four (4) mil thick polyethylene zip-lock bag (1 container/bag).
- Bagged containers are placed inside a 1 gallon metal paint can. Inert packing material (e.g. vermiculite) is then placed into the can to prevent breakage. The can is sealed and locked with lid clips.
- The can is placed in a DOT-12B fiberboard box or equivalent and sealed.
- The sealed box is labeled in accordance with DOT specifications (see 49 CFR 172.101).

5.6.3 Hazardous Materials Regulations (49 CFR Part 172)

The party offering hazardous material for transportation is responsible for ensuring compliance.

The Laboratory uses UPS or Federal Express to ship bottles or samples. Clients may pick up sample containers at the Laboratory's Sample Receiving Office. The Laboratory receives daily shipments of samples through UPS, Federal Express, Airborne Express, and Purolator Courier. Clients also may deliver their own samples to Sample Receiving. All bottles are shipped with instructions on sampling and the required preservatives as well as preservation procedures and material safety data sheets (MSDSs).

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES

Parameter	Container[1]	Preservative[2,10]	Recommended Holding Time[3]	Amount of Sample Required
Bacteriological				
Coliform, Fecal and Total	P,G	Cool, 4°C 0.008% $Na_2S_2O_3$[6]	6 hours	250 ml
Metals				
Chromium VI[4]	P,G	Cool, 4°C	24 hours	250 ml
Mercury	P,G	HNO_3 to pH <2	28 days	250 ml
Metals, except above[4]	P,G	HNO_3 to pH <2	6 months	1 l
Organics[5]				
Base Neutral Acid Extractables (GC/MS)	G, TFE Lined Cap	Cool, 4°C 0.008% $Na_2S_2O_3$[6]	7 days until extraction, 40 days after extraction	1 l
Polynuclear Aromatic Hydrocarbons	G, TFE Lined Cap	Cool, 4°C 0.008% $Na_2S_2O_3$[6] Store in Dark	7 days until extraction, 40 days after extraction	1 l
Pesticides/PCBs	G, TFE Lined Cap	Cool, 4°C pH 5-9[7]	7 days until extraction, 40 days after extraction	1 l
Herbicides	G, TFE Lined Cap	Cool, 4°C	7 days until extraction, 40 days after extraction	1 l

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES (Continued)

Parameter	Container[1]	Preservative[2,10]	Recommended Holding Time[3]	Amount of Sample Required
Purgeable Halocarbons (EPA 601,501.1)	G, TFE Lined Septum	Cool, 4°C 0.008% $Na_2S_2O_3$[6]	14 days	3x40 ml
Purgeable Aromatics (EPA 602,624, 502.2)	G, TFE Lined Septum	Cool, 4°C HCl to pH <2[8] 0.008% $Na_2S_2O_3$[6]	14 days	3x40 ml
Volatile Organics[9] No Residual Chlorine (SW 8010, 8020, 8240)	G, TFE Lined Septum	Cool, 4°C 4 drops Conc. HCl	14 days	3x40 ml
Residual Chlorine	G, TFE Lined Septum	Collect Sample in a 40 ml VOA Container Preserved with 4 drops of HCl. Add 4 drops of 10% $Na_2S_2O_3$. Cap Tightly & Mix, Cool, 4°C	14 days	3x40 ml
Total Petroleum Hydrocarbons (GC)	P,G	Cool, 4°C	28 days	2 l
<u>Physical Properties</u>				
Acidity	P,G	Cool, 4°C	14 days	250 ml
Alkalinity	P,G	Cool, 4°C	14 days	250 ml
Biochemical Oxygen Demand	P,G	Cool, 4°C	48 hours	1 l
Biochemical Oxygen Demand, Carbonaceous	P,G	Cool, 4°C	48 hours	1 l

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES (Continued)

Parameter	Container[1]	Preservative[2,10]	Recommended Holding Time[3]	Amount of Sample Required
Bromide	P,G	None Required	28 days	250 ml
Carbon, Total Organic	G	Cool, 4°C H_2SO_4 to pH <2	28 days	4x40 ml
Chemical Oxygen Demand	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days	250 ml
Chloride	P,G	None Required	28 days	250 ml
Chlorine, Total Residual	P,G	None Required	Analyze Immediately	250 ml
Color	P,G	Cool, 4°C	48 hours	500 ml
Conductivity	P,G	Cool, 4°C	28 days	250 ml
Cyanide, Total and Amenable to Chlorination	P,G	Cool, 4°C NaOH to pH >12 0.6 g ascorbic acid[6]	14 days[8]	1 l
Fluoride	P	None Required	28 days	300 ml
Halogens, Total Organic	P,G	Cool, 4°C H_2SO_4 to pH <2	14 days	2x250 ml
Hardness	P,G	HNO_3 to pH <2	6 months	150 ml
Hydrocarbons, Tot Recoverable Pet (IR)	G	Cool, 4°C HCl to pH <2	28 days	2 l
Ammonia	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days	250 ml

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES (Continued)

Parameter	Container[1]	Preservative[2,10]	Recommended Holding Time[3]	Amount of Sample Required
Kjeldahl Nitrogen	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days	1 l
Nitrate	P,G	Cool, 4°C	48 hours	250 ml
Nitrate-Nitrite	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days	250 ml
Nitrite	P,G	Cool, 4°C	48 hours	250 ml
Organic Nitrogen	P,G	Cool, 4°C $H2SO_4$ to pH <2	28 days	1 l
Oil and Grease	G	Cool, 4°C H_2SO_4 to pH <2	28 days	1 l
Oxygen, Dissolved Probe	G, Bottle and Top	None Required	Analyze Immediately	300 ml
Oxygen, Dissolved Winkler	G, Bottle and Top	Fix on Site and Store in Dark	8 hours	300 ml
Hydrogen Ion (pH)	P,G	None Required	Analyze Immediately	25 ml
Phenolics	G	Cool, 4°C H_2SO_4 to pH <2	28 days	1 l
Orthophosphate	P,G	Filter Immediately Cool, 4°C	48 hours	1 l
Phosphorus, Elemental	G	Cool, 4°C	48 hours	250 ml
Phosphorus, Total	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days	250 ml

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES (Continued)

Parameter	Container[1]	Preservative[2,10]	Recommended Holding Time[3]	Amount of Sample Required
Residue, Total Solids (TS)	P,G	Cool, 4°C	7 days	250 ml
Residue, Filterable Solids (TDS)	P,G	Cool, 4°C	7 days	250 ml
Residue, Non-Filterable Solids (TSS)	P,G	Cool, 4°C	7 days	250 ml
Residue, Settleable	P,G	Cool, 4°C	48 hours	250 ml
Residue, Volatile (TVS)	P,G	Cool, 4°C	7 days	250 ml
Silica	P	Cool, 4°C	28 days	250 ml
Sulfate	P,G	Cool, 4°C	28 days	250 ml
Sulfide	P,G	Cool, 4°C, Add Zinc Acetate plus Sodium Hydroxide to pH >9	7 days	500 ml
Sulfite	P,G	Cool, 4°C	Analyze Immediately	250 ml
Surfactants (MBAS)	P,G	Cool, 4°C	48 hours	1 l
Temperature	P,G	None Required	Analyze Immediately	1 l
Turbidity	P,G	Cool, 4°C	48 hours	500 ml
Radiological				
Alpha, Beta, and Radium	P,G	HNO_3 to pH <2	6 months	2 l

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES (Continued)

Parameter	Cont[1]	Preserv[2,10]	From TCLP Ext to Prep Extraction[3]	From Prep to Analysis	Min Sample Required
Toxicity Characteristic Leachate Procedure (TCLP)					
Metals (except Hg)	P,G	Cool 4°C	--	180 days	1 l
Mercury	P,G	Cool 4°C	--	28 days	1 l
Semivolatiles (BNA, HERB, PEST, PCB)	G, TFE	Cool 4°C	7 days	40 days	1 l
Volatiles, including Methanol	G, TFE	Cool 4°C	--	14 days	1 l

TABLE 5-1 LABORATORY SAMPLE PRESERVATION SUMMARY FOR AQUEOUS MATRICES

1. Polyethylene (P) or Glass (G). Although polyethylene or glass may be appropriate for many of the samples, where there is a choice the Laboratory will ship polyethylene containers due to the reduced cost of the containers and shipping. The following containers are available upon request: 1 liter glass with TFE liner; 500 ml glass with TFE liner; 40 ml VOA with TFE septum; 250 ml glass with septum; 1 liter plastic; 250 ml plastic; 500 ml plastic; and 125 ml plastic.

2. Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, the sample may be preserved by maintaining 4°C until compositing and sample splitting is completed.

3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period listed in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

4. Samples should be filtered immediately on-site before adding preservative for dissolved metals if dissolved metals are requested.

5. Guidance applies to samples to be analyzed by GC, LC or GC/MS for specific compounds.

6. Should only be used in the presence of residual chlorine.

7. The pH adjustment may be performed upon receipt at the laboratory and may be omitted if samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% sodium sulfate.

8. Maximum holding time is 24 hours when sulfide is present.

9. Samples for acrolein receiving no pH adjustment must be analyzed within three days of sampling.

10. When any sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation regulations.

TABLE 5-2 LABORATORY SAMPLE PRESERVATION SUMMARY FOR SOLID MATRICES

Parameter	Container[1]	Preservative[5]	Established Holding Time[2,3]	Minimum Amount of Sample Required
Metals				
Chromium VI	P,G	Cool, 4°C	24 hours	50 g
Mercury	P,G	Cool, 4°C	28 days	50 g
Metals, except above	P,G	Cool, 4°C	6 months	50 g
Organics[4]				
Base Neutral Acid Extractables (GC/MS)	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after extraction	50 g
Polynuclear Aromatic Hydrocarbons	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after extraction	50 g
Pesticides/PCBs	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after extraction	50 g
Herbicides	G, TFE Lined Cap	Cool, 4°C	14 days until extraction, 40 days after extraction	50 g
Volatile Organics	G, TFE Lined Septum	Cool, 4°C	14 days	50 g

TABLE 5-2 LABORATORY SAMPLE PRESERVATION SUMMARY FOR SOLID MATRICES (Continued)

Parameter	Container[1]	Preservative[5]	Established Holding Time[2,3]	Minimum Amount of Sample Required
Total Petroleum Hydrocarbons (GC)	G	Cool, 4°C	14 days until extraction, 40 days after extraction	100 g
Physical Properties				
Acidity	P,G	Cool, 4°C	14 days	50 g
Alkalinity	P,G	Cool, 4°C	14 days	50 g
Ammonia	P,G	Cool, 4°C	28 days	50 g
Bromide	P,G	None Required	28 days	50 g
Chloride	P,G	None Required	28 days	50 g
Cyanide, Total and Amenable to Chlorination	P,G	Cool, 4°C	14 days	50 g
Fluoride	P,G	None Required	28 days	50 g
Hydrocarbons, Tot Recoverable Pet (IR)	P,G	Cool, 4°C	14 days until extraction, 40 days after extraction	100 g
Hydrogen Ion (pH)	P,G	None Required	Analyze Immediately	50 g
Kjeldahl Nitrogen	P,G	Cool, 4°C	28 days	50 g
Nitrate	P,G	Cool, 4°C	48 hours	50 g
Nitrate-Nitrite	P,G	Cool, 4°C	28 days	50 g
Nitrite	P,G	Cool, 4°C	48 hours	50 g

TABLE 5-2 LABORATORY SAMPLE PRESERVATION SUMMARY FOR SOLID MATRICES (Continued)

Parameter	Container[1]	Preservative[5]	Established Holding Time[2,3]	Minimum Amount of Sample Required
Oil and Grease	G	Cool, 4°C	28 days	50 g
Organic Nitrogen	P,G	Cool, 4°C	28 days	50 g
Phenols	G	Cool, 4°C	28 days	50 g
Orthophosphate	P,G	Cool, 4°C	48 hours	50 g
Phosphorus, Elemental	G	Cool, 4°C	48 hours	50 g
Phosphorus, Total	P,G	Cool, 4°C	28 days	50 g
Silica	P	Cool, 4°C	28 days	50 g
Sulfate	P,G	Cool, 4°C	28 days	50 g
Sulfide	P,G	Cool, 4°C	28 days	50 g
Sulfite	P,G	Cool, 4°C	Analyze Immediately	50 g
Radiological				
Alpha, Beta, and Radium	P,G	Cool, 4°C	6 months	200 g

TABLE 5-2 LABORATORY SAMPLE PRESERVATION SUMMARY FOR SOLID MATRICES (Continued)

Parameter	Cont[1]	Preserv[2,10]	From TCLP Ext to Prep Extraction[3]	From Prep to Analysis	Min Sample Required
Toxicity Characteristic Leachate Procedure (TCLP)					
Metals (except Hg)	P,G	Cool 4°C	--	180 days	50 g
Mercury	P,G	Cool 4°C	--	28 days	50 g
Semivolatiles (BNA, HERB, PEST, PCB)	G, TFE	Cool 4°C	7 days	40 days	50 g
Volatiles, including Methanol	G, TFE	Cool 4°C	--	14 days	50 g

TABLE 5-2 LABORATORY SAMPLE PRESERVATION SUMMARY FOR SOLID MATRICES

1. Polyethylene (P) or Glass (G). Although polyethylene or glass may be appropriate for many of the samples, where there is a choice the Laboratory will ship polyethylene containers due to the reduced cost of the containers and shipping. The following containers are available upon request: 100 ml widemouth glass with TFE liner; 250 ml widemouth glass with TFE liner; and 500 ml widemouth glass with TFE liner.

2. Established holding times for which there is no specific guidance follows the guidelines for water holding times.

3. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period listed in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

4. Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

5. When any sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation regulations.

6.0 SAMPLE CUSTODY

A sample is physical evidence collected from a site or from the environment. As such, each sample must be documented in a manner that makes it legally defensible and which provides all data necessary for proper analysis. Enseco-Wadsworth/ALERT sampling personnel must complete all proper forms and documents for each sample taken. This documentation is described below.

6.1 Field Operations

6.1.1 Field Sample Logbook

Data from all samples taken by Laboratory personnel is entered in a hard-cover, bound Laboratory Field Sample Logbook consisting of consecutively numbered 8 1/2" x 11" pages. This Laboratory Field Sample Logbook contains entries which document pertinent field data for each sample including:

- Client
- Name and Address of Field Client
- Project or Sampling Location
- Exact Location of Sample Point
- Sampling Methodology
- Process Generating Sample (as applicable)
- Sample Container Numbers and Volumes
- Date and Time of Collection
- Field Sample Identification Number or Designation
- Field Observations and/or Measurements
- References such as Maps, Sketches, Photographs
- Preservation and Transport Statement
- Name(s) and Signature(s) of Sample Collector(s)

Location of sample points is referenced to an established system, or if this is not available, given in such a manner that it can be clearly identified.

6.1.2 Sample Labels

Permanent Laboratory Sample Labels are used to ensure proper identification and management of collected samples. These gummed labels are completed and affixed to each sample container at the time of collection. Entries on the sample label include:

- Field Sample Identification Number or Designation
- Exact Location of Sample Point
- Date and Time of Collection
- Name of Sample Collector(s)
- Additional Pertinent Field Information

All entries on the Laboratory Sample Label should correspond accordingly with the Laboratory Field Sample Logbook.

6.1.3 Sample Seals

Laboratory Sample Seals are used to detect unauthorized tampering of samples prior to laboratory acceptance. Laboratory Sample Seals are affixed to the sample transport container in a manner that requires seal breakage in order to open the container. Unauthorized seal breakage indicates possible tampering and will render a sample suspect.

6.1.4 Chain-of-Custody Forms

Chain-of-Custody documentation is necessary to track the possession of each sample from collection through analysis. This documentation is especially vital for legal concerns.

Samples submitted to the Laboratory are accompanied by Laboratory Chain-of-Custody Forms (Figure 6-1) to ensure adequate documentation. These forms are completed and sealed within the sample transport container to be opened and examined by the Laboratory Sample Custodian. Pertinent information includes:

- Client
- Project or Sampling Location
- Sample Identification Number or Designation

- Sample Description
- Sample Container Numbers and Volumes
- Purpose of Analysis
- Signatures of Persons Involved in Chain-of-Custody
- Date and Time of Possession

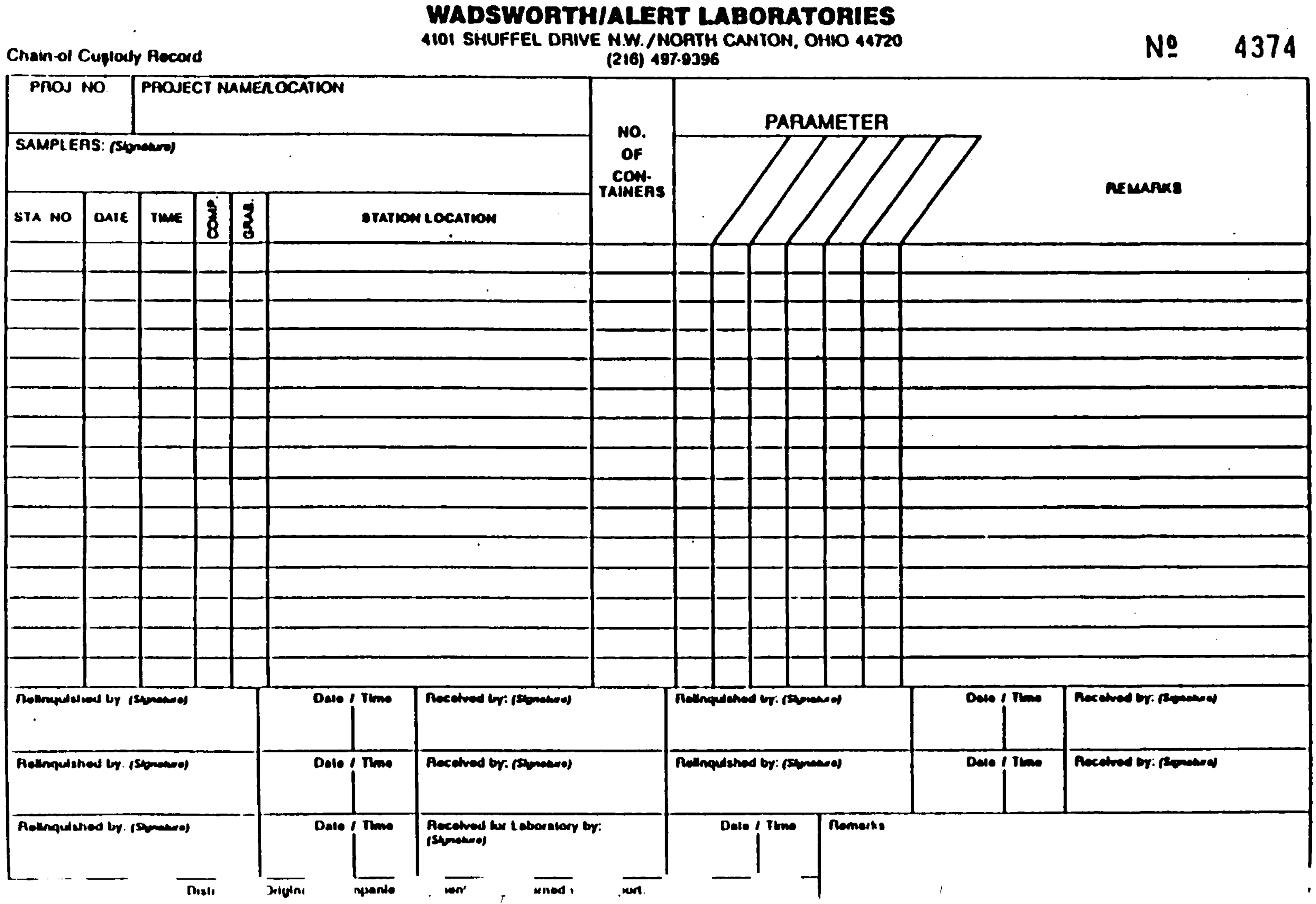
All entries on the Laboratory Chain-of-Custody Form correspond accordingly with the Laboratory Field Sample Logbook and Laboratory Sample Labels.

6.2 Laboratory Operations

Evidentiary documentation procedures continue with the Laboratory. The designated Laboratory Sample Custodian receives and documents all sample submittals into the Laboratory. The Laboratory Sample Custodian examines the condition, preservation, and accompanying documentation of all submitted samples prior to approval and formal acceptance into the Laboratory. Any sample, preservation, or documentation discrepancies (e.g. broken sample container, improper preservations, inadequate sample volume, poor documentation, etc.) are resolved before the sample is approved and actually accepted for analyses. All required acceptance data is then recorded and documented in the Laboratory Sample Log and Laboratory Computerized Data Management System. The sample is then labeled and placed in the secure sample storage area for distribution to the appropriate analyst(s).

Figure 6-1

Chain of Custody Forms



WADSWORTH/ALERT LABORATORIES
4101 SHUFFEL DRIVE N.W./NORTH CANTON, OHIO 44720
(216) 497-9396

Chain-of Custody Record

№ 4374

PROJ NO.

PROJECT NAME/LOCATION

SAMPLERS: *(Signature)*

STA NO	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	PARAMETER						REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

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7.0 MATERIAL PROCUREMENT AND CONTROL

7.1 Laboratory Material Purchasing

All materials purchased by Enseco-Wadsworth/ALERT Laboratories meet or exceed the specifications required by the methods used by the laboratory. Materials are also purchased to accommodate any project that requires specialized specifications.

7.2 Analytical Standards

Analytical standards (to include calibration standards, surrogate standards, matrix spiking standards, internal standards, and instrument performance evaluation standards) are prepared from materials purchased with a purity of 96% or better. These standards are prepared according to the procedures stated in the individual Analytical Methods. A record of each standard preparation is maintained in the Standards Preparation Log.

All analytical standards are traceable to reputable manufacturers who establish traceability. Working standards prepared in the laboratory are compared to primary standards obtained by reputable manufacturers.

7.3 Chemical Storage

7.3.1 Requirements for Storage

Every item stocked in a laboratory or storeroom is dated upon receipt. Large quantities of chemicals are not stocked in the laboratory. A current inventory of all chemicals with information on location, quantity, maximum shelf life, and potential hazard is maintained. Chemicals are not stocked in strict alphabetical order since this may result in the storage of incompatible chemicals. When storing, consideration is given to compatibility of chemicals.

7.3.2 Storage of Corrosives

- Caustic and corrosive materials are stored near the floor to minimize danger of bottles falling from shelves.
- Separate containers to facilitate handling. Organic (acetic acid and acetic anhydride) are stored separately away from strong oxidizing agents (sulfuric, nitric, or perchlorates) to prevent interaction of fumes and corrosion of storage cabinets.
- When transporting acid containers, acid bottle carriers are used.

7.3.3 Storage of Flammables

- In general, liquids having a flash point of 140°F or less are considered flammable.
- Quantities of greater than one gallon are stored in a safety can. If the liquid must be stored in glass for purity, the glass container should be coated in plastic to lessen the danger of breakage and possible ignition.
- Small quantities, no more than is required for work in progress, may be kept on shelves. However, quantities of five gallons or greater are not kept in any laboratory unless contained in a flammable liquids cabinet.
- Flammable liquids are not stored in confined spaces such as a refrigerator.
- Flammable liquids are not stored near strong oxidizing agents such as nitric acid, peroxides, dichromates, or perchlorates.

7.4 Laboratory Waste Disposal

Client samples are retained in a controlled access area for thirty (30) days after the analytical report date. If prior arrangements have been made with the client, the samples are returned to the project site or client by commercial carrier or Enseco-Wadsworth/ALERT Laboratories' company courier.

All samples slated for disposal are divided into three groups by matrix: aqueous, non-aqueous liquids, and solids. The aqueous samples (groundwaters, drinking waters, industrial effluents) are rinsed through the Laboratory neutralization sump. The non-aqueous liquids (oils, solvents) and the solid samples (soils, industrial waste) are consolidated into respective drums and shipped off-site for incineration as hazardous waste.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Laboratory Instruments

Enseco-Wadsworth/ALERT Laboratories uses specific procedures for the operation and calibration of all analytical instruments. Along with proper maintenance, these practices ensure optimum instrument performance and accuracy. These procedures include proper operator training and supervision; mandatory instrument performance specifications; and systematic instrument calibration, verification, and monitoring schedules.

The Laboratory uses mandatory instrument performance specifications to constantly ensure optimum instrumental performance. These performance criteria require acceptable instrument response to specific performance standards prior to initiating further instrument calibration and analyses. Acceptable instrument response criteria are based upon the manufacturer's or EPA's analytical method specifications.

Laboratory analysts record and document all instrumental runs in designated Laboratory instrument logbooks or Laboratory bench sheets. These logbooks or bench sheets identify instrument operating parameters, settings, and performance data associated with each instrumental run. Instrumental runs pursuant to establishing instrument performance criteria and calibrations are also recorded in these Laboratory instrument logbooks or bench sheets.

The Laboratory uses instrument calibration procedures to constantly ensure analytical accuracy. Initial instrument calibration curves are generated, verified, and routinely monitored throughout the duration of all instrumental analyses (see Table 8-1). Specific calibration procedures for laboratory instruments including the frequency and standards used are listed in Table 8-1 (Calibration Procedures).

8.2 Measurement Equipment, Glassware, Water, Reagents, and Industrial Gases

Enseco-Wadsworth/ALERT Laboratories adheres to proper standards of good laboratory practice in the use of measuring equipment, glassware, water, chemical reagents, and industrial gases. Adherence to proper standards relating to these laboratory elements validate analytical data. All laboratory glassware, balances, thermometers, and subsequent volume, mass, and temperature measurements are directly traceable to primary standards. Chemical reagents and industrial gases are purchased and used as appropriate for various laboratory applications.

All Laboratory volumetric glassware conforms to National Bureau of Standards (NBS) Class A standards. Kuderna-Danish concentrator tubes are also calibrated annually using gravimetric techniques. All calibrations are recorded and documented in designated Laboratory Calibration Logbooks. Written procedures (SOPs) for cleaning and storing glassware are posted at appropriate wash stations. (See Chapter 9.8)

Laboratory balances are annually serviced and calibrated. Additional balance performance evaluations are conducted daily by comparison against NBS Class S certified weights. Unacceptable performance requires service adjustments. Both balance service and daily calibrations are recorded and documented in designated Laboratory Balance Calibration Logbooks.

Laboratory thermometers are calibrated against a NBS certified thermometer and recorded in the designated Laboratory Thermometer Calibration Logbook. Laboratory drying ovens, incubators, refrigerators, etc. contain calibrated thermometers. Refrigerator readings are recorded twice a day in the Laboratory Temperature Logbook. Unacceptable deviation from desired temperatures requires immediate corrective action.

Laboratory pure water is generated by a commercial on-line water purification system consisting of mixed resin deionizing and carbon filtration cartridges. Cartridges are routinely replaced and serviced by the manufacturer or as indicated by an on-line resistivity indicator or laboratory method blank contamination. All water purity information is recorded in the manufacturer's service file. Daily checks are done on the water to prove it is of ASTM Type II quality.

The Laboratory uses various types and purities of chemical reagents, solvents, and industrial gases depending upon their intended use. Laboratory stock and working standards are derived from commercially available primary standards and solvents whenever possible. These stock and working standards are properly labeled (content, concentration, date, analyst) and routinely checked for degradation and/or impurities in accordance with the appropriate analytical method specifications. On-line molecular sieves and oxygen traps are used where appropriate to remove impurities from desired industrial gases. All chemical reagents, solvents, and industrial gases are stored only in designated areas in accordance with the Laboratory Health & Safety Program.

TABLE 8-1 CALIBRATION PROCEDURES

GC/MS VOCs and BNAs

- The Laboratory purchases standards from certified sources for quantitation of VOCs and BNAs.
- Every 12 or 24 hours as the method requires, the instrument is tuned to meet EPA established abundance criteria for DFTPP or BFB to assure that instrument response meets EPA specifications.
- Generation of three (3) or five (5) point calibration curves as the method requires for all method compounds. Recalibration is done when continuing calibration criteria is not met.
- Verification of system cleanliness by the analysis of an instrument or method blank.
- Addition of internal standards to each sample.
- Analytical Method SOPs detailing the calibration procedures to be used for each method are available at the laboratory.

GC VOCs

- The Laboratory purchases standards from certified sources for quantitation of GC volatiles.
- Generation of three (3) or five (5) point calibration curves as the method requires for all method compounds. Recalibration is done when continuing calibration does not meet criteria.
- Monitor consistency of instrument response through the analysis of a standard after every twenty (20) sample analyses.
- Demonstrate system cleanliness through the analysis of a reagent blank prior to any sample analysis.
- Maintain sample response within the limits of the response of the standards.
- The initial calibration curve must have an RSD of $\leq 20\%$ for Method 8010/8020, $\leq 15\%$ for Method 502.2, and $\leq 10\%$ for Method 601/602 with continuing calibrations of $\leq 15\%$, $\leq 20\%$, and $\leq 10\%$ respectively. (RSDs are calculated based on guidance found in SW846, Method 8000, Section 7.4.4.2.)

TABLE 8-1 CALIBRATION PROCEDURES CONT.

- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

Pesticides and PCBs

- The Laboratory uses certified standards for quantitation of pesticides and PCBs.
- The initial calibration curve must have an RSD of $\leq$20% with a continuing calibration of $\leq$15%. (RSDs are calculated based on guidance found in SW846, Method 8000, Section 7.4.4.2.)
- Generation of three (3) or five (5) point calibration curves for all analyzed compounds prior to any sample analysis, as stated in the analytical method. Recalibration is done when continuing calibration criteria is not met.
- Monitor consistency of instrument response through the analysis of a standard after every ten (10) sample analyses.
- Demonstrate system cleanliness through the analysis of an instrument or reagent blank.
- Maintain sample response within the limits of the response of the standards.
- An evaluation standard is analyzed prior to pesticide analysis of samples to verify degradation of <20% for Endrin and 4,4'-DDT.
- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

ICP

- The Laboratory purchases calibration standards from a certified source.
- Generation of a two (2) point calibration and frequent resloping of the curve per manufacturer's requirements.
- Verification of system cleanliness and baseline maintenance through the analysis of a reagent blank every ten (10) samples.

TABLE 8-1 CALIBRATION PROCEDURES CONT.

- Verification of instrument consistency through the analysis of a standard every ten (10) samples.

- Determination of instrument stability by the analysis of an interference check sample at the beginning and end of each sample set.

- Maintenance of sample response within the linear response of the instrument.

- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

AA Flame, Furnace, and Mercury Analyzer

- The Laboratory purchases calibration standards from certified sources.

- Construction of a three (3) to five (5) point calibration curve for an element prior to the analysis of each sample set.

- Verification of system cleanliness for each element through the analysis of a reagent blank every ten (10) samples.

- Monitoring of instrument performance by resloping the calibration curve every ten (10) samples.

- Bracketing of sample response between the limits of standard response.

- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

pH and Ion-Selective Electrode (Fluoride, Ammonia Nitrogen, and Bromide)

- The Laboratory purchases standards from certified sources.

- Construction of a three (3) point (2 point for pH) calibration curve weekly or prior to the analysis of any sample.

- Bracketing of sample response within the limits of standard response.

TABLE 8-1 CALIBRATION PROCEDURES CONT.

- Verification of cleanliness of the analytical system through the analysis of a reagent blank (where applicable).

- Verification of instrument consistency through the analysis of standards after the analysis of every ten (10) samples (where applicable).

- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

Spectrophotometer (Cyanide, Phosphate, Phenol and Methylene Blue Active Substances)

- The Laboratory purchases standards from certified sources.

- Construction of a five (5) point calibration curve prior to the analysis of any sample. The initial calibration curve must have an RSD of ≤20%.

- Monitor for the introduction of any interferents through the analysis of a reagent blank prior to any sample analysis.

- Bracket sample response within the standard response.

- Verification of the consistency of instrument response through the analysis of a standard after every ten (10) sample analyses.

- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

Traacs 800 (Chloride, Sulfate, Nitrate, and Nitrite)

- The Laboratory purchases standards from certified sources.

- The initial calibration curve must be linear with a correlation coefficient between 0.999 and 1.000.

- Construction of a three (3) point calibration curve prior to the analysis of any sample. The initial calibration curve must have an RSD of ≤20%.

- Monitor for the introduction of any interferents through the analysis of a reagent blank prior to any sample analysis.

TABLE 8-1 CALIBRATION PROCEDURES CONT.

- Bracket sample response within the standard response.
- Verification of the consistency of instrument response through the analysis of a standard after every ten (10) sample analyses.
- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

Miscellaneous

- Additional inorganic analyses use a single-point standard. The Laboratory purchases certified standards.
- Analytical Method SOPs, available at the Laboratory, detail the calibration procedures to be used for each method.

NOTE: Information on standards is documented in the Laboratory Standards Logbook (see Chapter 10).

9.0 ANALYTICAL PROCEDURES

9.1 Sample Receipt (see Chapter 6.0)

9.2 Sample Preparation

All samples are prepared in accordance with the methods outlined in Tables 9-1 and 9-2 (Methods Summary for Sample Preparation/Sample Extraction and Laboratory Analytical Methods Summary).

9.3 Equipment Startup and Performance Check (see Chapter 11).

9.4 Detection Limits

A summary of common Laboratory detection limits is outlined in Table 9-3 (Laboratory Detection Limits Summary). Detection limit studies are performed on an annual basis. Changes in laboratory detection limits resulting from these detection limit studies will be incorporated into Table 9-3.

9.5 Initial and Continuous Calibration (see Chapter 11).

9.6 Analytical Methods

A summary of common Laboratory analytical methods is outlined in Table 9-2 (Laboratory Analytical Methods Summary). Specific procedures and variances within the methods are detailed in the Analytical Methods SOPs. When the laboratory methods cited in Table 9-2 are changes, either by the issuing agency or through public notice in the Federal Register, WAL method SOPs will be updated accordingly. The Analytical Methods SOPs are kept on file in the laboratory, available to the analysts at all times.

9.7 Analyses of QC Samples (see Chapter 11).

9.8 Glassware Cleaning

The procedures used to clean laboratory glassware for use in organic, metals, and inorganic methods are outlined in Table 9-24 (Laboratory Glassware Washing Summary).

TABLE 9-1 METHODS SUMMARY FOR SAMPLE PREPARATION/SAMPLE EXTRACTION

Parameter	Matrix	Method
Metals (ICP) (Method 6010)	Water	3010[1]
Metals (GFAA) (Methods 7131, 7191, 7421, 7841)	Water	3020[1]
Metals (Methods 204.2, 208.2, 213.2, 218.2, 220.2, 239.2, 279.2)	Water	METALS[2] Paragraph 4.1
Metals (RCRA EP Toxicity)	Water/ Solid	1310[1]
Metals (Methods 6010, 7131, 7191, 7421, 7841)	Solid	3050[1]
Purgeables (Methods 8010, 8020)	Water/ Solid	5030[1]
Semivolatiles (Methods 8080, 8270)	Water	3510[1] 3520[1]
Semivolatiles (Methods 8080, 8270)	Oil	3580[1]
Semivolatiles (Methods 8080, 8270)	Solid	3540[1] 3550[1]
Metals, Semivolatiles, Volatiles (TCLP/ZHE-Volatiles)	Water/ Solid	1311[1]

1. SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, EPA, September 1986.

2. Methods for Chemical Analysis of Water and Wastes, March 1983, EPA-600/4-79-020.

TABLE 9-2 LABORATORY ANALYTICAL METHODS SUMMARY

Parameter	Methods		
	Water	Solid/Liquids Groundwaters	Drinking Water
Metals			
Aluminum	EPA 200.7	SW846 6010	EPA 200.7
Antimony	EPA 200.7, 204.2	SW846 6010	EPA 200.7, 204.2
Arsenic	EPA 206.2, 206.3	SW846 7060	EPA 206.2
Barium	EPA 200.7	SW846 6010	EPA 200.7
Beryllium	EPA 200.7, 210.2	SW846 6010	EPA 200.7, 210.2
Bismuth	EPA 200.7	SW846 6010	EPA 200.7
Boron	EPA 200.7	SW846 6010	EPA 200.7
Cadmium	EPA 200.7, 213.2	SW846 6010	EPA 213.2
Calcium	EPA 200.7	SW846 6010	EPA 200.7
Chromium	EPA 200.7	SW846 6010	EPA 218.2
Chromium +6	EPA 218.4, 218.5	SW846 7196	
Cobalt	EPA 200.7	SW846 6010	EPA 200.7
Copper	EPA 200.7	SW846 6010	EPA 200.7
Gold	EPA 200.7	SW846 6010	EPA 200.7
Iron	EPA 200.7, 236.2	SW846 6010	EPA 200.7, 236.2
Lead	EPA 200.7, 239.2	SW846 6010	EPA 239.2
Magnesium	EPA 200.7	SW846 6010	EPA 200.7
Manganese	EPA 200.7	SW846 6010	EPA 200.7
Mercury	EPA 245.1	SW846 7470, 7471	EPA 245.1
Molybdenum	EPA 200.7	SW846 6010	EPA 200.7
Nickel	EPA 200.7, 249.2	SW846 6010	EPA 200.7, 249.2
Osmium	EPA 200.7	SW846 6010	EPA 200.7
Potassium	EPA 200.7	SW846 6010	EPA 200.7
Selenium	EPA 270.2, 200.7	SW846 7740	EPA 270.2
Silver	EPA 272.2	SW846 6010	EPA 272.2
Sodium	EPA 200.7, 273.2	SW846 6010	EPA 200.7
Thallium	EPA 279.2	SW846 6010	EPA 279.2
Tin	EPA 200.7	SW846 6010	EPA 200.7
Titanium	EPA 200.7	SW846 6010	EPA 200.7
Tungsten	EPA 200.7	SW846 6010	EPA 200.7
Vanadium	EPA 200.7	SW846 6010	EPA 200.7

TABLE 9-2 LABORATORY ANALYTICAL METHODS SUMMARY (Continued)

Parameter	Methods		
	Water	Solid/Liquids Groundwaters	Drinking Water
Zinc	EPA 200.7	SW846 6010	EPA 200.7
Zirconium	EPA 200.7	SW846 6010	EPA 200.7
Organics			
Acrolein/Acrylonitrile	EPA 603	SW846 8030	
Base/Neutral & Acid Extractables	EPA 625	SW846 8270	
Chlorinated Herbicides	EPA 615	SW846 8150	EPA 515
Haloethers	EPA 611	EPA 611 (Mod)	
Nitroaromatics & Isophorone	EPA 625	SW846 8270	
Nitrosamines	EPA 625	SW846 8270	
Organochlorine Pesticides & PCBs	EPA 608	SW846 8080	EPA 808.4
Organohalide Pesticides		SW846 8080	
Organophosphorus Pesticides	EPA 625	SW846 8270	
Phenols	EPA 625	SW846 8270	
Phthalate Esters	EPA 625	SW846 8270	
Polynuclear Aromatic Hydrocarbons	EPA 625	SW846 8270	
Purgeable Halocarbons	EPA 601	SW846 8010	EPA 502.2/504
Purgeable Aromatics	EPA 602	SW846 8020	EPA 502.2/504
Volatile Organics	EPA 624	SW846 8240	
Physical Properties			
Acidity	EPA 305.1	SM 402	
Alkalinity	EPA 310.1	SM 403	EPA 310.1
Ash Content		ASTM D482-80	
Biochemical Oxygen Demand	EPA 405.1	SM 507	
Bromide	EPA 320.1		
BTU/lb		ASTM D2015-85/ D240-85	
Chemical Oxygen Demand	EPA 410.4	EPA 410.4/SM 508B	
Chloride	EPA 325.2	SW846 9251/9252 EPA 325.2	EPA 325.2

TABLE 9-2 LABORATORY ANALYTICAL METHODS SUMMARY (Continued)

Parameter	Methods		
	Water	Solid/Liquids Groundwaters	Drinking Water
Chlorine, Total Residual	SM 408 E		
Color	EPA 110.2		
Cyanide			
Amenable to Cl	EPA 335.1/335.3	SW846 9012	
Total	EPA 335.2/335.3	SW846 9012	
Flash Point (Open Cup)		ASTM D92-85	
Flash Point (Closed Cup)		SW846 1010/ ASTM D93-85	
Fluoride	EPA 340.2	EPA 340.2	EPA 340.2
Hardness	EPA 130.2	EPA 130.2	EPA 130.2
Methylene Blue Active Substances	EPA 425.1	EPA 425.1	
Nitrogen			
Ammonia	EPA 350.2/350.3	EPA 350.2/350.3	
Kjeldahl, Total	EPA 351.3	EPA 351.3	
Nitrate	EPA 353.2	EPA 353.2	EPA 353.2
Nitrate-Nitrite	EPA 353.2	EPA 353.2	EPA 353.2
Nitrite	EPA 353.2	EPA 353.2	EPA 353.2
Odor	EPA 140.1		
Oil and Grease, Total Recoverable	EPA 413.1/SM 503 A	SW846 9070/9071	
Organo Chlorine (Bombtox)		ASTM D2361-85/D808-81 EPA 325.3	
Organo Nitrogen	EPA 351.3/350.2	EPA 351.3/350.2	
Organo Phosphorus	EPA 365.2	EPA 365.2	
Organo Sulfur (Bombtos)		ASTM D3177-75/ D129-64	
Oxygen, Dissolved	EPA 360.2	EPA 360.2	
pH	EPA 150.1	SW846 9045/9040	EPA 150.1
Phenolics, Total	EPA 420.1/420.2	SW846 9065/9066	
Phosphorus, All Forms	EPA 365.2	EPA 365.2	
Residue			
Filterable	EPA 160.1		
Non-Filterable	EPA 160.2		
Settleable	EPA 160.5		
Total	EPA 160.3	EPA 160.3	
Volatile	EPA 160.4	EPA 160.4	
Silica, Dissolved	EPA 370.1	ASTM D859-80-8	
Specific Conductance	EPA 120.1	SW846 9050	

TABLE 9-2 LABORATORY ANALYTICAL METHODS SUMMARY (Continued)

Parameter	Methods		
	Water	Solid/Liquids Groundwaters	Drinking Water
Specific Gravity		ASTM D1298-85/D854-83	
Sulfate	EPA 375.2/375.4	SW846 9036/9038	
Sulfide	EPA 376.1	SW846 9030	
Sulfite	EPA 377.1		
Temperature	EPA 170.1	EPA 170.1	
Total Organic Carbon	EPA 415.1	SW846 9060	
Total Organic Halogen	EPA 450.1	SW846 9020	
Turbidity	EPA 180.1	EPA 180.1	
Viscosity, Brookfield	ASTM D-445		
Water %		ASTM E1064-85	
RCRA Corrosivity		SW846 9040	
RCRA Ignitability	SW846 1010		

REFERENCES:

- ASTM - American Society for Testing and Materials.
- EPA Methods - Methods for Organic Chemical Analysis of Municipal And Industrial Wastewater, EPA-600/4-82-057, July 1982.
- EPA - Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March 1983.
- SM - Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Sixteenth Edition.
- SW846 - Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, EPA, September 1986.
- Enseco-Wadsworth/ALERT Laboratories' Scheme for Waste Compatibility and Consolidation (See Appendix I).

TABLE 9-3 LABORATORY DETECTION LIMITS SUMMARY

Trihalomethanes in Drinking Water
EPA Method 501.1
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l
Chloroform	0.5
Bromodichloromethane	0.5
Dibromochloromethane	0.5
Bromoform	0.5

TABLE 9-4 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds in Water
EPA Method 502.2/EPA Method 504*
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l
Benzene	0.5
Bromobenzene	0.5
Bromochloromethane	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	0.5
n-Butylbenzene	0.5
sec-Butylbenzene	0.5
tert-Butylbenzene	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
2-Chlorotoluene	0.5
4-Chlorotoluene	0.5
Dibromochloromethane	0.5
1,2-Dibromo-3-chloropropane*	0.02
1,2-Dibromoethane*	0.02
Dibromomethane	0.5

TABLE 9-4 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds in Water (Continued)
EPA Method 502.2
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l
1,2-Dichlorobenzene	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
Dichlorodifluoromethane	0.5
1,1-Dichloroethane	0.5
1,2-Dichloroethane	0.5
1,1-Dichloroethene	0.5
cis-1,2-Dichloroethene	0.5
trans-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
1,3-Dichloropropane	0.5
2,2-Dichloropropane	0.5
1,1-Dichloropropene	0.5
cis-1,3-Dichloropropene	0.5
trans-1,3-Dichloropropene	0.5
Ethylbenzene	0.5
Hexachlorobutadiene	0.5
Isopropylbenzene	0.5
p-Isopropyltoluene	0.5
Methylene chloride	0.5
Naphthalene	0.5
n-Propylbenzene	0.5
Styrene	0.5
1,1,1,2-Tetrachloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
Tetrachloroethene	0.5
Toluene	0.5
1,2,3-Trichlorobenzene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-Trichloroethane	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
1,2,3-Trichloropropane	0.5
1,2,4-Trimethylbenzene	0.5
1,3,5-Trimethylbenzene	0.5

TABLE 9-4 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds in Water (Continued)
EPA Method 502.2
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l
Vinyl chloride	0.5
o-Xylene	0.5
m-Xylene	0.5
p-Xylene	0.5

TABLE 9-5 LABORATORY DETECTION LIMITS SUMMARY

Organochlorine Pesticides
EPA Method 509A
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

Compound	Water ug/l
Endrin	0.1
g-BHC (Lindane)	0.5
Methoxychlor	0.5
Toxaphene	1

TABLE 9-6 LABORATORY DETECTION LIMITS SUMMARY

Chlorinated Phenoxy Acid Herbicides
EPA Method 509B
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

Compound	Water ug/l
2,4-D	0.5
2,4,5-T	0.2
2,4,5-TP (Silvex)	0.1

TABLE 9-7 LABORATORY DETECTION LIMITS SUMMARY

Halogenated Volatile Organics
EPA Method 601
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l
Bromodichloromethane	1
Bromoform	1
Bromomethane	1
Carbon tetrachloride	1
Chlorobenzene	1
Chloroethane	1
Chloroform	1
2-Chloroethylvinyl ether	1
Chloromethane	1
Dibromochloromethane	1
1,2-Dichlorobenzene	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
Dichlorodifluoromethane	1
1,1-Dichloroethane	1
1,2-Dichloroethane	1
1,1-Dichloroethene	1
trans-1,2-Dichloroethene	1
Dichloromethane	1
1,2-Dichloropropane	1
trans-1,3-Dichloropropene	1
1,1,2,2-Tetrachloroethane	1
Tetrachloroethene	1
1,1,1-Trichloroethane	1
1,1,2-Trichloroethane	1
Trichloroethene	1
Trichlorofluoromethane	1
Vinyl chloride	1

TABLE 9-8 LABORATORY DETECTION LIMITS SUMMARY

Aromatic Volatile Organics
EPA Method 602
Gas Chromatograph - PID Detector

Routine Detection Limits[1]

Compound	Water ug/l
Benzene	1
Chlorobenzene	1
1,2-Dichlorobenzene	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
Ethylbenzene	1
Toluene	1

TABLE 9-9 LABORATORY DETECTION LIMITS SUMMARY

Organochlorine Pesticides and PCBs
EPA Method 608
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

Compound	Water ug/l
Aldrin	0.05
a-BHC	0.05
b-BHC	0.05
g-BHC (Lindane)	0.05
d-BHC	0.05
Chlordane	0.5
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
Dieldrin	0.1
Endosulfan I	0.05
Endosulfan II	0.1
Endosulfan sulfate	0.1
Endrin	0.1
Endrin aldehyde	0.1
Heptachlor	0.05

TABLE 9-9 LABORATORY DETECTION LIMITS SUMMARY

Organochlorine Pesticides and PCBs (Continued)
EPA Method 608
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

Compound	Water ug/l
Heptachlor epoxide	0.05
Methoxychlor	0.5
Toxaphene	1
PCB-1016	0.5
PCB-1221	0.5
PCB-1232	0.5
PCB-1242	0.5
PCB-1248	0.5
PCB-1254	1
PCB-1260	1

TABLE 9-10 LABORATORY DETECTION LIMITS SUMMARY

Polynuclear Aromatic Hydrocarbons
EPA Method 625
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Acenaphthene	10
Acenaphthylene	10
Anthracene	10
Benzo(a)anthracene	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Benzo(g,h,i)perylene	10
Benzo(a)pyrene	10
Chrysene	10
Dibenzo(a,h)anthracene	10
Fluoranthene	10
Fluorene	10

TABLE 9-10 LABORATORY DETECTION LIMITS SUMMARY

Polynuclear Aromatic Hydrocarbons (Continued)
EPA Method 625
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Indeno(1,2,3-cd)pyrene	10
1-Methylnaphthalene	10
2-Methylnaphthalene	10
Naphthalene	10
Phenanthrene	10
Pyrene	10

TABLE 9-11 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds
EPA Method 624
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Acrolein	50
Acrylonitrile	50
Benzene	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
Carbon tetrachloride	5
Chlorobenzene	5
Chloroethane	10
2-Chloroethylvinyl ether	10
Chloroform	5
Chloromethane	10
Dibromochloromethane	5
1,1-Dichloroethane	5
1,2-Dichloroethane	5

TABLE 9-11 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds (Continued)
EPA Method 624
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
1,1-Dichloroethene	5
1,2-Dichloroethene (Total)	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
trans-1,3-Dichloropropene	5
Ethylbenzene	5
Methylene chloride	5
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	5
Toluene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	5
Trichlorofluoromethane	5
Vinyl chloride	10

TABLE 9-12 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics
EPA Method 625
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Acenaphthene	10
Acenaphthylene	10
Anthracene	10
Benzidine	50
Benzo(a)anthracene	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10

TABLE 9-12 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics (Continued)
EPA Method 625
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Benzo(g,h,i)perylene	10
Benzo(a)pyrene	10
Bis(2-chloroethoxy)methane	10
Bis(2-chloroethyl)ether	10
Bis(2-chloroisopropyl)ether	10
Bis(2-ethylhexyl)phthalate	10
4-Bromophenyl phenyl ether	10
Butyl benzyl phthalate	10
2-Chloronaphthalene	10
4-Chlorophenyl phenyl ether	10
Chrysene	10
Dibenzo(a,h)anthracene	10
Di-n-butyl phthalate	10
1,2-Dichlorobenzene	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
3,3′-Dichlorobenzidine	50
Diethyl phthalate	10
Dimethyl phthalate	10
2,4-Dinitrotoluene	10
2,6-Dinitrotoluene	10
Di-n-octyl phthalate	10
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexachlorobutadiene	10
Hexachlorocylopentadiene	10
Hexachloroethane	10
Indeno(1,2,3-cd)pyrene	10
Isophorone	10
Naphthalene	10
Nitrobenzene	10
N-Nitrosodimethylamine	10
Nitrosodiphenylamine	10
N-Nitrosodi-n-propylamine	10

TABLE 9-12 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics (Continued)
EPA Method 625
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l
Phenanthrene	10
Pyrene	10
1,2,4-Trichlorobenzene	10
4-Chloro-3-methylphenol	10
2-Chlorophenol	10
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrophenol	50
2-Methyl-4,6-dinitrophenol	50
2-Nitrophenol	10
4-Nitrophenol	50
Pentachlorophenol	50
Phenol	10
2,4,6-Trichlorophenol	10

TABLE 9-13 LABORATORY DETECTION LIMITS SUMMARY

Halogenated Volatile Organics
SW846 Method 8010
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

	Water	Soil	
Compound	ug/l	Medium Level ug/kg[2]	Low Level ug/kg[2]
Benzyl chloride	1	330	2
Bromobenzene	1	330	2
Bromodichloromethane	1	330	2
Bromoform	1	330	2
Bromomethane	1	330	2
Carbon tetrachloride	1	330	2
Chlorobenzene	1	330	2

TABLE 9-13 LABORATORY DETECTION LIMITS SUMMARY

Halogenated Volatile Organics (Continued)
SW846 Method 8010
Gas Chromatograph - Hall Detector

Routine Detection Limits[1]

Compound	Water ug/l	Soil Medium Level ug/kg[2]	Soil Low Level ug/kg[2]
Chloroethane	1	330	2
Chloroform	1	330	2
1-Chlorohexane	1	330	2
2-Chloroethylvinyl ether	1	330	2
Chloromethane	1	330	2
Chlorotoluene	1	330	2
Dibromochloromethane	1	330	2
Dibromomethane	1	330	2
1,2-Dichlorobenzene	1	330	2
1,3-Dichlorobenzene	1	330	2
1,4-Dichlorobenzene	1	330	2
Dichlorodifluoromethane	1	330	2
1,1-Dichloroethane	1	330	2
1,2-Dichloroethane	1	330	2
1,1-Dichloroethene	1	330	2
trans-1,2-Dichloroethene	1	330	2
Dichloromethane	1	330	2
1,2-Dichloropropane	1	330	2
trans-1,3-Dichloropropene	1	330	2
1,1,1,2-Tetrachloroethane	1	330	2
1,1,2,2-Tetrachloroethane	1	330	2
Tetrachloroethene	1	330	2
1,1,1-Trichloroethane	1	330	2
1,1,2-Trichloroethane	1	330	2
Trichloroethene	1	330	2
Trichlorofluoromethane	1	330	2
Trichloropropane	1	330	2
Vinyl chloride	1	330	2

TABLE 9-14 LABORATORY DETECTION LIMITS SUMMARY

Aromatic Volatile Organics
SW846 Method 8020
Gas Chromatograph - PID Detector

Routine Detection Limits[1]

	Water	Soil	
		Medium Level	Low Level
Compound	ug/l	ug/kg[2]	ug/kg[2]
Benzene	1	330	2
Chlorobenzene	1	330	2
1,2-Dichlorobenzene	1	330	2
1,3-Dichlorobenzene	1	330	2
1,4-Dichlorobenzene	1	330	2
Ethylbenzene	1	330	2
Toluene	1	330	2
Xylenes	1	330	2

TABLE 9-15 LABORATORY DETECTION LIMITS SUMMARY

Organochlorine Pesticides and PCBs
SW846 Method 8080
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

	Water	Soil	
		Medium Level	Low Level
Compound	ug/l	ug/kg[2]	ug/kg[2]
Aldrin	0.05	0.05	8
a-BHC	0.05	0.05	8
b-BHC	0.05	0.05	8
g-BHC (Lindane)	0.05	0.05	8
d-BHC	0.05	0.05	8
Chlordane	0.5	0.5	80
4,4'-DDD	0.1	0.1	16
4,4'-DDE	0.1	0.1	16
4,4'-DDT	0.1	0.1	16
Dieldrin	0.1	0.1	16
Endosulfan I	0.05	0.05	8
Endosulfan II	0.1	0.1	16

TABLE 9-15 LABORATORY DETECTION LIMITS SUMMARY

Organochlorine Pesticides and PCBs (Continued)
SW846 Method 8080
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

	Water	Soil	
		Medium Level	Low Level
Compound	ug/l	ug/kg[2]	ug/kg[2]
Endosulfan sulfate	0.1	0.1	16
Endrin	0.1	0.1	16
Endrin aldehyde	0.1	0.1	16
Heptachlor	0.05	0.05	8
Heptachlor epoxide	0.05	0.05	8
Methoxychlor	0.5	0.5	80
Toxaphene	1	1	160
PCB-1016	0.5	0.5	80
PCB-1221	0.5	0.5	80
PCB-1232	0.5	0.5	80
PCB-1242	0.5	0.5	80
PCB-1248	0.5	0.5	80
PCB-1254	1	1	160
PCB-1260	1	1	160
PCB-1262	1	1	160

TABLE 9-16 LABORATORY DETECTION LIMITS SUMMARY

Polynuclear Aromatic Hydrocarbons
SW846 Method 8270
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

	Water	Soil	
		Medium Level	Low Level
Compound	ug/l	ug/kg[2]	ug/kg[2]
Acenaphthene	10	1	330
Acenaphthylene	10	1	330
Anthracene	10	1	330

TABLE 9-16 LABORATORY DETECTION LIMITS SUMMARY

Polynuclear Aromatic Hydrocarbons (Continued)
SW846 Method 8270
Gas Chromatograph/Mass Spectrometer Detector
GC/MS

Routine Detection Limits[1]

Compound	Water ug/l	Soil Medium Level ug/kg[2]	Soil Low Level ug/kg[2]
Benzo(a)anthracene	10	1	330
Benzo(b)fluoranthene	10	1	330
Benzo(k)fluoranthene	10	1	330
Benzo(g,h,i)perylene	10	1	330
Benzo(a)pyrene	10	1	330
Chrysene	10	1	330
Dibenzo(a,h)anthracene	10	1	330
Fluoranthene	10	1	330
Fluorene	10	1	330
Indeno(1,2,3-cd)pyrene	10	1	330
1-Methylnaphthalene	10	1	330
2-Methylnaphthalene	10	1	330
Naphthalene	10	1	330
Phenanthrene	10	1	330
Pyrene	10	1	330

TABLE 9-17 LABORATORY DETECTION LIMITS SUMMARY

Chlorinated Herbicides
SW846 Method 8150
Gas Chromatograph - ECD Detector

Routine Detection Limits[1]

Compound	Water ug/l	Soil mg/kg[2]
2,4-D	0.5	0.5
2,4,5-T	0.2	0.2
2,4,5-TP (Silvex)	0.1	0.1

TABLE 9-18 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds
SW846 Method 8240
Gas Chromatograph/Mass Spectrometer Detector
Target Compound List - GC/MS

Routine Detection Limits[1]

	Water	Soil	
		Medium Level	Low Level
Compound	ug/l	ug/kg[2]	ug/kg[2]
Acetone	50	6200	50
Acrolein	50	6200	50
Acrylonitrile	50	6200	50
Benzene	5	620	5
Bromodichloromethane	5	620	5
Bromoform	5	620	5
Bromomethane	10	1200	10
2-Butanone	50	6200	50
Carbon disulfide	5	620	5
Carbon tetrachloride	5	620	5
Chlorobenzene	5	620	5
Chloroethane	10	1200	10
2-Chloroethylvinyl ether	10	1200	10
Chloroform	5	620	5
Chloromethane	10	1200	10
Dibromochloromethane	5	620	5
1,1-Dichloroethane	5	620	5
1,2-Dichloroethane	5	620	5
1,1-Dichloroethene	5	620	5
1,2-Dichloroethene (Total)	5	620	5
1,2-Dichloropropane	5	620	5
cis-1,3-Dichloropropene	5	620	5
trans-1,3-Dichloropropene	5	620	5
Ethylbenzene	5	620	5
2-Hexanone	50	6200	50
4-Methyl-2-pentanone	50	6200	50
Methylene chloride	5	620	5
Styrene	5	620	5
1,1,2,2-Tetrachloroethane	5	620	5
Tetrachloroethene	5	620	5
Toluene	5	620	5
1,1,1-Trichloroethane	5	620	5
1,1,2-Trichloroethane	5	620	5

TABLE 9-18 LABORATORY DETECTION LIMITS SUMMARY

Volatile Organic Compounds (Continued)
SW846 Method 8240
Gas Chromatograph/Mass Spectrometer Detector
Target Compound List - GC/MS

Routine Detection Limits[1]

	Water	Soil	
Compound	ug/l	Medium Level ug/kg[2]	Low Level ug/kg[2]
Trichloroethene	5	620	5
Trichlorofluoromethane	5	620	5
Vinyl acetate	50	6200	50
Vinyl chloride	10	1200	10
Total Xylenes	5	620	5

TABLE 9-19 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics
SW846 Method 8270
Gas Chromatograph/Mass Spectrometer Detector
Target Compound List - GC/MS

Routine Detection Limits[1]

	Water	Soil	
Compound	ug/l	Medium Level ug/kg[2]	Low Level ug/kg[2]
Acenaphthene	10	1	330
Acenaphthylene	10	1	330
Anthracene	10	1	330
Benzidine	50	5	1600
Benzo(a)anthracene	10	1	330
Benzo(b)fluoranthene	10	1	330
Benzo(k)fluoranthene	10	1	330
Benzo(g,h,i)perylene	10	1	330
Benzo(a)pyrene	10	1	330
Benzyl alcohol	10	1	330
Bis(2-chloroethoxy)methane	10	1	330
Bis(2-chloroethyl)ether	10	1	330
Bis(2-chloroisopropyl) ether	10	1	330

TABLE 9-19 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics (Continued)
SW846 Method 8270
Gas Chromatograph/Mass Spectrometer Detector
Target Compound List - GC/MS

Routine Detection Limits[1]

Compound	Water ug/l	Soil Medium Level ug/kg[2]	Soil Low Level ug/kg[2]
Bis(2-ethylhexyl)phthalate	10	1	330
4-Bromophenyl phenyl ether	10	1	330
Butyl benzyl phthalate	10	1	330
2-Chloronaphthalene	10	1	300
4-Chlorophenyl phenyl ether	10	1	330
Chrysene	10	1	330
Dibenzo(a,h)anthracene	10	1	330
Di-n-butyl phthalate	10	1	330
1,2-Dichlorobenzene	10	1	330
1,3-Dichlorobenzene	10	1	330
1,4-Dichlorobenzene	10	1	330
3,3'-Dichlorobenzidine	20	5	660
Diethyl phthalate	10	1	330
Dimethyl phthalate	10	1	330
2,4-Dinitrotoluene	10	1	330
2,6-Dinitrotoluene	10	1	330
Di-n-octyl phthalate	10	1	330
Fluoranthene	10	1	330
Fluorene	10	1	330
Hexachlorobenzene	10	1	330
Hexachlorobutadiene	10	1	330
Hexachlorocyclopentadiene	10	1	330
Hexachloroethane	10	1	330
Indeno(1,2,3-cd)pyrene	10	1	330
Isophorone	10	1	330
2-Methylnaphthalene	10	1	330
Naphthalene	10	1	330
2-Nitroaniline	50	5	1600
3-Nitroaniline	50	5	1600
4-Nitroaniline	50	5	1600
Nitrobenzene	10	1	330
N-Nitrosodimethylamine	10	1	330
N-Nitrosodiphenylamine	10	1	330

TABLE 9-19 LABORATORY DETECTION LIMITS SUMMARY

Base/Neutral and Acid Extractable Organics (Continued)
SW846 Method 8270
Gas Chromatograph/Mass Spectrometer Detector
Target Compound List - GC/MS

Routine Detection Limits[1]

Compound	Water ug/l	Soil Medium Level ug/kg[2]	Soil Low Level ug/kg[2]
N-Nitrosodi-n-propylamine	10	1	330
Phenanthrene	10	1	330
Pyrene	10	1	330
1,2,4-Trichlorobenzene	10	1	330
Benzoic Acid	50	5	1600
4-Chloro-3-methylphenol	10	1	330
2-Chlorophenol	10	1	330
2,4-Dichlorophenol	10	1	330
2,4-Dimethylphenol	10	1	330
2,4-Dinitrophenol	50	5	1600
2-Methyl-4,6-dinitrophenol	50	5	1600
2-Methylphenol	10	1	330
4-Methylphenol	10	1	330
2-Nitrophenol	10	1	330
4-Nitrophenol	50	5	1600
Pentachlorophenol	50	5	1600
Phenol	10	1	330
2,4,5-Trichlorophenol	10	1	330
2,4,6-Trichlorophenol	10	1	330

TABLE 9-20 LABORATORY DETECTION LIMITS SUMMARY

Metals
EPA Method 200.7/SW846 Method 6010
Inductively Coupled Plasma-Atomic Emission Spectroscopy

Routine Detection Limits[1]

Parameter	Water	Solids[2] (and non-aqueous waste)
Aluminum	0.2 mg/l	20 mg/kg
Antimony	0.3 mg/l	30 mg/kg

TABLE 9-20 LABORATORY DETECTION LIMITS SUMMARY

Metals (Continued)
EPA Method 200.7/SW846 6010
Inductively Coupled Plasma-Atomic Emission Spectroscopy

Routine Detection Limits[1]

Parameter	Water	Solids[2] (and non-aqueous waste)
Barium	0.01 mg/l	5 mg/kg
Beryllium	0.005 mg/l	0.5 mg/kg
Bismuth	0.5 mg/l	50 mg/kg
Boron	0.1 mg/l	10 mg/kg
Cadmium	0.01 mg/l	1 mg/kg
Calcium	5 mg/l	500 mg/kg
Chromium	0.02 mg/l	2 mg/kg
Cobalt	0.05 mg/l	5 mg/kg
Copper	0.01 mg/l	2 mg/kg
Gold	0.25 mg/l	25 mg/kg
Iron	0.05 mg/l	10 mg/kg
Lead	0.1 mg/l	10 mg/kg
Magnesium	5 mg/l	500 mg/kg
Manganese	0.01 mg/l	1 mg/kg
Molybdenum	0.5 mg/l	50 mg/kg
Nickel	0.04 mg/l	4 mg/kg
Osmium	0.2 mg/l	20 mg/kg
Potassium	5 mg/l	500 mg/kg
Silicon	1 mg/l	100 mg/kg
Silver	0.01 mg/l	1 mg/kg
Sodium	5 mg/l	500 mg/kg
Strontium	0.01 mg/l	1 mg/kg
Thallium	0.5 mg/l	50 mg/kg
Tin	1 mg/l	100 mg/kg
Titanium	0.01 mg/l	1 mg/kg
Tungsten	0.5 mg/l	50 mg/kg
Vanadium	0.05 mg/l	5 mg/kg
Zinc	0.05 mg/l	5 mg/kg
Zirconium	0.05 mg/l	5 mg/kg

TABLE 9-21 LABORATORY DETECTION LIMITS SUMMARY

Miscellaneous Metals

Routine Detection Limits[1]

Parameter	EPA/SW846 Method	Water	Solids[2] (and non-aqueous waste)
Arsenic	206.2/7060	0.005 mg/l	0.5 mg/kg
Cadmium	213.2/7131	0.001 mg/l	0.1 mg/kg
Chromium	218.2/7191	0.005 mg/l	0.5 mg/kg
Chromium (Cr^{+6})	218.4/7196	0.02 mg/l	1 mg/kg
Lead	239.2/7421	0.003 mg/l	0.3 mg/kg
Mercury	245.1/7470	0.0002 mg/l	0.1 mg/kg
Selenium	270.2/7740	0.005 mg/l	0.5 mg/kg
Silver	272.2	0.005 mg/l	0.5 mg/kg
Thallium	279.2/7841	0.01 mg/l	1 mg/kg

TABLE 9-22 LABORATORY DETECTION LIMITS SUMMARY

Miscellaneous Wet Chemistry Parameters

Routine Detection Limits[1]

Parameter	Method	Water	Solids[2] (and non-aqueous waste)
Acidity	EPA 305.1	20 mg/l	400 mg/kg
Alkalinity	EPA 310.1	20 mg/l	400 mg/kg
Carbonate	SM 403	5 mg/l	100 mg/kg
Bicarbonate	SM 403	5 mg/l	100 mg/kg
Hydroxide	SM 403	5 mg/l	100 mg/kg
Phenolphthalein	EPA 310.1/SM 403	5 mg/l	100 mg/kg
Ammonia Nitrogen	EPA 350.2	1 mg/l	50 mg/kg
Ammonia Nitrogen	EPA 350.3	0.2 mg/l	----
Ash Content	ASTM D482-80	0.5 %	0.5 %
Biochemical Oxygen Demand	EPA 405.1	2 mg/l	----
Bromide	EPA 320.1	3 mg/l	60 mg/kg
BTU/lb	ASTM D2015-85/D240-85	1000 Btu/lb	1000 Btu/lb
Cation - Exchange	SW 9081	----	5 mg/l
Chemical Oxygen Demand	SM 508B/EPA 410.4	20 mg/l	----
Chloride	EPA 325.2/SW 9251	2 mg/l	40 mg/kg
Chlorine Total Residual	EPA 330.5	0.03 mg/l	----

TABLE 9-22 LABORATORY DETECTION LIMITS SUMMARY

Miscellaneous Wet Chemistry Parameters (Continued)

Routine Detection Limits[1]

Parameter	Method	Water	Solids[2] (and non-aqueous waste)
Chromium (Cr^{+6})	SM 307B	0.02 mg/l	1 mg/kg
Chromium (Cr^{+6})	SW 7195	0.02 mg/l	1 mg/kg
Color	EPA 110.3	5 cu	----
Compatibility		----	----
Corrosivity		0.5 mmpy	----
Cyanide	EPA 335.2/SW 9012	0.005 mg/l	0.25 mg/kg
Cyanide, Free	SM 412-H	0.005 mg/l	0.25 mg/kg
Cyanide, Spot Test	ASTM D5049-90	10 mg/l	10 mg/kg
Ferrous	EPA 315B	0.02 mg/l	0.4 mg/kg
Flash Point	SW 1010	----	----
Fluoride	EPA 340.2/SM 314B	0.1 mg/l	2 mg/kg
Formaldehyde	NIOSH 3500	0.05 mg/l	1 mg/kg
Hardness	EPA 130.2	5 mg/l	100 mg/kg
Ignitability	ASTM D39-85	----	----
Langier Index	SM 203	----	----
Methylene Blue Active Substances	EPA 425.1	0.1 mg/l	----
Moisture Content	CRL 445	----	----
Nitrate Nitrogen	EPA 353.3/SW 9200	0.1 mg/l	2 mg/kg
Nitrate - Potable Water	EPA 353.2/SM 418C	0.1 mg/l	----
Nitrate-Nitrite	EPA 353.3	0.1 mg/l	2 mg/kg
Nitrite Nitrogen	EPA 353.3	0.04 mg/l	0.8 mg/kg
Odor	EPA 140.1	----	----
Oil and Grease, Gravemetric	EPA 413.1/SW 9070	5 mg/l	250 mg/kg
Oil and Grease, Total Recoverable - IR	SW 9071	0.5 mg/l	10 mg/kg
Organo Chlorine	ASTM D2361-85/D808-81	0.1 %	1000 mg/kg
Organo Nitrogen	EPA 351.3/CRL 468	1.0 mg/l	50 mg/kg
Organo Phosphorus	EPA 365.2	0.1 mg/l	10 mg/kg
Organo Sulfur	ASTM D3177-75/D129-64	0.05 %	----
Oxygen, Dissolved	EPA 360.2	0.5 mg/l	----
Orthophosphate	EPA 365.2	0.1 mg/l	10 mg/kg
Paint Filter	SW 9095	----	----
pH	EPA 150.1/SW 9040/SW 9045	----	----
Phenolics, Total	EPA 420.1/SW 9066	0.02 mg/l	0.4 mg/kg

TABLE 9-22 LABORATORY DETECTION LIMITS SUMMARY

Miscellaneous Wet Chemistry Parameters (Continued)

Routine Detection Limits[1]

Parameter	Method	Water	Solids[2] (and non-aqueous waste)
Phosphorus	EPA 365.2	0.1 mg/l	10 mg/kg
Physical Description	ASTM D4979-89	----	----
Reactivity			
Cyanide	SW 9010/Sec 7	10 mg/kg	10 mg/kg
Sulfide	SW 9030/Sec 7	50 mg/kg	50 mg/kg
Redox	WAL	----	----
Residual			
Filterable	EPA 160.1	10 mg/l	----
Non-Filterable	EPA 160.2	10 mg/l	----
Settleable	EPA 160.5	0.5 mg/l/hr	----
Total	EPA 160.3	10 mg/l	0.5 %
Volatile	EPA 160.4	10 mg/l	0.5 %
Volatile Suspended	EPA 160.2/160.4	10 mg/l	----
Specific Conductance	EPA 120.1/SW 9050	0.2 umhos/cm	----
Specific Gravity	ASTM D854-83/D1298-85	----	----
Sulfate	EPA 375.4/SW 9035	5 mg/l	100 mg/kg
Sulfide	EPA 376.1/SW 9030	1 mg/l	50 mg/kg
Sulfide, Spot Test	ASTM D4978-89	10 mg/l	10 mg/kg
Sulfite	EPA 377.1	2 mg/l	40 mg/kg
Temperature	EPA 170.1	----	----
Petroleum Hydrocarbons, Infrared	EPA 418.1	0.5 mg/l	10 mg/kg
Petroleum, Hydrocarbons, Gravimetric	EPA 418.1/SW 9071	5 mg/l	250 mg/kg
Total Kjeldahl Nitrogen	EPA 351.3	1 mg/l	50 mg/kg
Total Organic Carbon	EPA 415.1/SW 9060	1 mg/l	----
Total Organic Halogen	EPA 450.1/SW 9020	10 ug/l	----
Turbidity	EPA 180.1	0.5 ntu	----
Vapor Pressure	ASTM D323-82	0.5 psi	----
Viscosity	ASTM D-445	0.5 mpa*s	----
Water, %	ASTM E1064-85	0.5 %	----
RCRA Corrosivity	SW 9040	0.5 mmpy	----
RCRA Ignitability	SW 1010	----	----

TABLE 9-23 LABORATORY DETECTION LIMITS SUMMARY

Toxicity Characteristic Leacheate Procedure (TCLP)[3]

EPA Hazardous Waste Number	Parameter	Regulatory Level (mg/l)	Detection Limit (mg/l)[1]
	METALS		
D004	Arsenic	5.0	0.5
D005	Barium	100.0	1.0
D006	Cadmium	1.0	0.1
D007	Chromium	5.0	0.1
D008	Lead	5.0	0.1
D009	Mercury	0.2	0.02
D010	Selenium	1.0	0.3
D011	Silver	5.0	0.1
	PESTICIDES		
D020	Chlordane	0.03	0.0005
D012	Endrin	0.02	0.0005
D031	Heptachlor (Epoxide)	0.008	0.0001
D013	Lindane	0.4	0.0001
D014	Methoxychlor	10.0	0.001
D015	Toxaphene	0.5	0.005
	HERBICIDES		
D016	2,4-D	10.0	0.5
D017	2,4,5-TP (Silvex)	1.0	0.1
	VOLATILES		
D018	Benzene	0.5	0.005
D019	Carbon tetrachloride	0.5	0.005
D021	Chlorobenzene	100.0	0.005
D022	Chloroform	6.0	0.005
D028	1,2-Dichloroethane	0.5	0.005
D029	1,1-Dichloroethylene	0.7	0.005
D035	Methyl ethyl ketone	200.0	0.05
D039	Tetrachloroethylene	0.7	0.005
D040	Trichloroethylene	0.5	0.005
D043	Vinyl chloride	0.2	0.01

TABLE 9-23 LABORATORY DETECTION LIMITS SUMMARY

Toxicity Characteristic Leacheate Procedure (TCLP)[3] (Continued)

EPA Hazardous Waste Number	Parameter	Regulatory Level (mg/l)	Detection Limit (mg/l)[1]
	SEMI-VOLATILES		
D023	o-Cresol	200.0	0.04
D024	m-Cresol	200.0	0.04
D025	p-Cresol	200.0	0.04
D026	Cresol	200.0	0.04
D027	1,4-Dichlorobenzene	7.5	0.04
D030	2,4-Dinitrotoluene	0.13	0.04
D032	Hexachlorobenzene	0.13	0.04
D033	Hexachloro-1,3-butadiene	0.5	0.04
D034	Hexachloroethane	3.0	0.04
D036	Nitrobenzene	2.0	0.04
D037	Pentachlorophenol	100.0	0.2
D038	Pyridine	5.0	0.04
D041	2,4,5-Trichlorophenol	400.0	0.04
D052	2,4,6-Trichlorophenol	2.0	0.04

LABORATORY DETECTION LIMITS SUMMARY NOTATIONS

1. Note that the detection limits listed are Practical Quantitation Limits (PQL). Actual quantitation limits may be higher due to matrix interference or a high concentration of a particular analyte.

2. Adjustment of PQLs for dry weight is available upon request. The quantitation limits calculated on a dry weight basis will be higher.

3. Source Note: 55 FR 11862, March 29, 1990, Final Rule.

TABLE 9-24 LABORATORY GLASSWARE WASHING SOP

	Metals	Organics	Wet Chemistry
Wash	Hot Water, Detergent Solution	Hot Water, Detergent Solution	Hot Water, Detergent Solution
Rinse	3 Times Tap Water 1 Time 1:1 Nitric Acid 3 Times Type II Water	3 Times Tap Water 3 Times Type II Water	3 Times Tap Water 1 Time 1:1 Hydrochloric Acid 3 Times Type II Water
Dry	Air	Muffle at 400°C for at least 2 hours	Air
Storage	Designated Cabinets		Designated Cabinets

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Management Systems

Enseco-Wadsworth/ALERT Laboratories uses the Laboratory Computerized Data Management System to record, document, and assimilate pertinent laboratory technical and administrative data. This Laboratory Computerized Data Management System provides data management functions for a number of component laboratory activities including: Laboratory Sample Acceptance, Sample Analytical Results, Sample Status and Tracking, Analytical QA/QC, Final Report Generation, and Client Invoicing. The data management system enhances efficient coordination among these component laboratory activities by providing a highly automated, standardized communication network for data transfer and correlation. This system is summarized below.

The Laboratory Computerized Data Management System assigns an individual and unique Laboratory Identification Number to each sample and records pertinent technical and administrative sample data. Pertinent technical sample data includes the client's sample identification, sample physical description, sampling date (if known), required analytical parameters, and requested completion data. Pertinent administrative data is necessary for final reporting and invoicing of results.

The data system assimilates the above data and generates Laboratory Worksheets for distribution to the appropriate analyst(s). These worksheets identify the appropriate analytical parameters and associated methods necessary to complete the requested sample analyses along with the turnaround time requirements. These turnaround requirements not only specify requested completion dates, but identify maximum allowable holding times for samples and/or extracts prior to analyses. The data management system also automatically generates appropriate worksheets for the analysis of systematic quality control samples in accordance with Laboratory QC procedures.

Laboratory personnel enter all completed sample analytical results and associated QC data into the Data Management System. The system's various data processing capabilities then automatically provide a number of component laboratory data management functions. These functions include generation of the following materials: QC data statistical evaluations and associated quality control charts (see Chapter 14 for the treatment of outliers), final sample analytical result reports, and sample tracking and status reports.

All analytical results are calculated using the equations specified in the appropriate EPA method (see Table 9-2).

10.2 Data Validation Criteria

The principle criteria used to validate data integrity during collection are the following:

- Reagent blank results
- Method preparation blank results (See Chapter 11)
- Calibration verification (See Chapter 8)
- Matrix spike/spike duplicate results (See Chapter 11)
- Quality Control check sample results (See Chapter 11)
- Surrogate spike recoveries (See Chapter 11)
- Sampling and field information, if the Laboratory was responsible for sampling.

These measurements are made by the analyst, using specific acceptance criteria. The analyst either proceeds with the analyses or takes corrective action (see Chapter 15). The analyst who generates the data has the prime responsibility for the correctness and completeness of the data. The data reduction and validation steps are documented, signed, and dated by the analyst. This initial review step, performed by the analyst, is designated Level I review.

All data is reviewed by the senior analyst or group coordinator whose function is to provide an independent review of the data package. The Level II review is structured so that all calibration and sample results are reviewed and ten percent (10%) of the analytical results are checked back to the bench.

An important element of Level II review is the documentation of any errors that have been identified during the review. Any errors found during a Level II review are immediately corrected. Additionally, the Level II reviewer along with the analyst who performed the Level I, review the reasons for the error to ensure that future errors are eliminated.

Organic analytical data generated from GC/MS Semi-Volatiles may include "B" and "J" flags. "B" denotes a contaminant that is common to both the blank and the sample, while "J" denotes the presence of a compound, but at a level less than the PQL. The Quality Control Narrative flags any problems that were encountered during sample extraction and/or analysis. The narrative contains information on recommended holding times, preservation techniques, container used, surrogates out of control, etc. that may affect the quality of the analytical data.

10.3 Data Documentation

Enseco-Wadsworth/ALERT Laboratories uses complete laboratory documentation measures to ensure the integrity and legal validity of all sample analytical results. These documentation measures encompass all analytical activities to create a traceable, legal history of each sample and subsequent analysis. All documented information is recorded in consecutively-numbered analytical logbooks, bench sheets, and/or computer data systems. Component analytical documentation measures include:

10.3.1 Laboratory Sample Logbook

Samples submitted to Enseco-Wadsworth/ ALERT for laboratory analysis are recorded and documented in the Laboratory Sample Logbook. Individual log entries include: client code, laboratory sample identification number, sample description, analytical requests, chain-of-custody possession statements, and additional information.

10.3.2 Laboratory Data

The analytical specifications and subsequent results of each sample submitted to the Laboratory are recorded on various Laboratory Worksheets or bench sheets. These worksheets are generated by the Laboratory Computerized Data Management System from sample information initially entered by the Laboratory Sample Custodian. Pertinent information on the worksheets include Laboratory Sample Identification, requested analytical parameters, maximum holding times and turnaround requests, and analytical results. These worksheets are retained by the Laboratory until all sample analytical results have been entered into the Laboratory Computerized Data Management System.

10.3.3 Laboratory Method Data

Laboratory analyses are entered into various Laboratory method logbooks or bench sheets which categorically record and document the raw data for each analytical parameter commonly determined by Enseco-Wadsworth/ ALERT Laboratories. Each analytical parameter and/or activity is assigned a particular Laboratory Method Logbook or bench sheet which records pertinent preparation, extraction, and instrumental data for each sample. This includes laboratory identification number, initial sample volume or weight, extraction volumes, dilution factors, instrument values, and the initials of the analyst(s). These logbooks or bench sheets also systematically include Enseco-Wadsworth/ALERT Laboratories ten percent (10%) Analytical Quality Control Program. Method Logbooks or bench sheets are maintained for ten years by Enseco-Wadsworth/ALERT Laboratories.

10.3.4 Laboratory Instrument Logbooks

All laboratory analyses requiring analytical instrumentation are recorded in various Laboratory Instrument Logbooks which categorically record and document analytical instrument settings and performance data. These logbooks record instrument calibration data, specific sample volumes, instrument parameters, and corresponding performance data for each sample. Instrumental information has been included and combined with Laboratory Method Logbooks whenever possible to consolidate data. Laboratory Instrument Logbooks are retained for ten years.

10.3.5 Laboratory Instrument Service Logbooks

The maintenance, repair, adjustment, and service of all instruments are recorded in appropriate Service Logbooks.

These logbooks, which are retained for ten years, record the service histories of various instruments.

10.3.6 Laboratory Equipment Calibration Logbooks

All Laboratory measuring equipment calibrations are recorded in various Laboratory Calibration Logbooks. These logbooks record the dates and primary standard for calibration of various Laboratory thermometers, balances, and glassware items. The Laboratory Calibration Logbooks are retained for ten years.

10.3.7 Laboratory Chromatography Data File

All chromatography data generated by Enseco-Wadsworth/ALERT are categorically filed with the corresponding project. The files include labeled, numbered chromatograms with corresponding integrator print-outs and raw data sheets. This file is retained for ten years.

10.3.8 Laboratory GC/MS/DS Data File

All chromatography data and corresponding quantitation lists generated by the Laboratory GC/MS/DS Systems are categorically filed with the corresponding project. This file is combined with appropriate Laboratory Chromatography Data Files for GC data. Processed GC/MS Data is filed on a daily basis in the appropriate Laboratory Processed Data File. In addition, all GC/MS/DS chromatography data, quantitation lists, and processed data are recorded on magnetic media. Both hardcopy data and magnetic computerized data are retained by the laboratory for ten years.

10.3.9 Analytical Quality Control Data

The corresponding department maintains documents of all data generated by the Analytical Quality Control Program. These files record the raw data and subsequent statistical calculations of various Laboratory quality control components including: continuous method performance evaluations, surrogate spike recovery evaluations, and method blank analyses. Laboratory QA/QC Data Summary Reports containing quality control data statistical summaries and associated quality control charts are routinely generated from this data file. QA/QC data files are retained for ten years by the laboratory.

10.3.10 Laboratory Standards Logbook

All laboratory primary standard data are maintained in a Laboratory Standards Logbook. These logbooks are retained for ten years.

10.4 Data Reporting

Subsequent to data entry, the senior analyst or group coordinator is responsible for comparing analytical worksheets with actual data entered in the Data Management System. The senior analyst or group coordinator also reviews the quality control report that accompanies the final report.

The Project Manager is then responsible for reviewing the final reports prior to release to the client. This review is labeled Level III. Reports are reviewed for:

- Completeness - results for all parameters requested are present; detection limits, units, dates, and sample descriptions are complete and correct.
- Consistency - all parameters are reviewed for internal consistency.

The final report is filed after the above review and kept for a minimum of five years.

10.4.1 Data Reporting Format

Laboratory Analytical Result Summary Final Reports may include appropriate introductory comments, analytical methods summaries, Quality Control Narratives, and invoices in addition to listing sample analytical results and associated QC data. Sample analytical result reports and associated QC data sheets are generated in the appropriate standardized form from the Laboratory Computerized Data Management System. The supporting materials previously mentioned are provided by administrative personnel as appropriate for inclusion in final reports. Additional technical narratives, along with supporting raw data may also be included as warranted by special circumstances (non-typical analyses, matrix interferences, etc.).

Preliminary analytical result summary final reports are provided for those projects requiring rapid analytical turnaround times. These abridged materials primarily contain analytical results. Additional supporting materials may be provided if prearranged. All preliminary reports are followed by final reports.

11.0 INTERNAL QUALITY CONTROL PROGRAM

Enseco-Wadsworth/ALERT Laboratories Sampling and Analytical Quality Assurance/ Quality Control Program is designed to ensure the scientific and legal validity of all samples and analytical results. The QA/QC Program consists primarily of a thorough, legal laboratory documentation network in combination with systematic inclusion of various analytical quality control practices into all component laboratory operations. These quality control practices provide constant, documented evaluation and surveillance of acceptable sampling and analytical method performance.

11.1 Internal Quality Control Program (Field)

Field personnel are responsible for collecting the appropriate field blanks as outlined in Chapter 5 as well as sufficient sample for matrix spiking purposes. These will be included in the Quality Control Program within the Laboratory and analyzed accordingly.

11.2 Internal Quality Control Program (Laboratory)

Analytical quality control checks are performed in both the on-site mobile laboratory and the off-site laboratory in identical manner. These procedures are based upon USEPA analytical methods guidance and generally accepted standards of good laboratory practice as outlined in Table 9-2. Key components of the Laboratory Analytical Quality Control Program include the following quality control practices and considerations:

- designation of a Laboratory Quality Assurance/Quality Control Manager (QA/QC) to implement the laboratory QA/QC program (Chapter 2).
- adherence to specified Laboratory Sample Acceptance Procedures to ensure proper handling, processing, and storage of submitted samples (Chapter 6).
- use of the Laboratory Computerized Data Management System to record, document, and assimilate pertinent laboratory technical and administrative data (Chapter 10).
- use of USEPA-approved Analytical Methods and Instrumentation (Chapter 8).

- adherence to mandatory procedures for Operation, Calibration, and Maintenance of Laboratory and Field Instrumentation (Chapters 8 and 13).
- use of proper Laboratory Measuring Equipment, Glassware, Water, Chemical Reagents, Industrial Gases (Chapter 8).
- constant surveillance and documentation of acceptable analytical method accuracy and precision through Initial Analytical Method Performance Evaluations and matrix spike/spike duplicate evaluations (Chapter 11).
- use of continuous Surrogate Spike Recovery Evaluations where appropriate to ensure acceptable method performance (Chapter 11).
- use of systematic Blank Evaluations to identify analytical system interferences and background contamination levels (Chapter 11).
- adherence to proper Laboratory Documentation measures to ensure the complete integrity and legal validity of all Laboratory analyses (Chapter 10).
- use of Voluntary Intralaboratory Performance Evaluations and participation in numerous Laboratory certifications, audits, and approval programs (Chapter 12).

11.3 Data Quality

The principle criteria for verification of data quality is the continuous monitoring of acceptable analytical accuracy, precision, and overall method performance through systematic analysis of quality control samples. Enseco-Wadsworth/ALERT Laboratories conducts both initial and continuous Analytical Method Performance Evaluations to ensure that all generated analytical data meet acceptable quality control method performance criteria established by the USEPA and the Laboratory. Each analytical method commonly used in the laboratory utilizes specific quality control procedures to continually monitor acceptable analytical method accuracy and precision. These method quality control procedures primarily involve the mandatory systematic insertion of quality control samples into 10% of all laboratory analyses, in addition to strict adherence to instrumental performance and calibration specifications. These specific quality control procedures are thoroughly detailed in the Analytical Methods Standard Operating Procedures and are based upon USEPA methods guidance (see Table 9-2).

11.4 Initial Demonstration of Method Proficiency

Prior to the introduction of any new method, the Laboratory conducts a demonstration of method proficiency to show the ability to achieve acceptable method accuracy and precision. This Initial Demonstration of Method Proficiency is summarized below.

A minimum of four (4) spiked samples are prepared using a representative sample matrix. These samples are spiked such that the parameter concentration(s) are within the working range of the method and at least two (2) times greater than the method's background level.

The matrix spike samples are analyzed in accordance with the method. The average percent recovery (R) and the standard deviation of the percent recoveries (s) is calculated from the analytical results. The Laboratory values of R are compared to the published EPA method performance value of average recovery (X). Unacceptable values require the Laboratory to review potential analytical problems and repeat the Initial Demonstration of Method Proficiency until acceptable values are obtained or the limitations of the method are demonstrated.

11.5 Matrix Spike/Spike Duplicate Evaluations

Mandatory matrix spike/spike duplicate samples are analyzed at a frequency of 5% in order to maintain continuous surveillance of acceptable method performance. Approximately fifty percent (50%) of all quality control samples are matrix spike samples. Percent Recovery determinations (R) from these results are monitored to provide a measure of the overall accuracy and precision of the method in addition to determining extraction efficiencies and sample matrix effects (see Chapter 14). For parameters in which matrix spikes are inappropriate duplicate analysis may be performed.

11.6 Method Blank Evaluations

Enseco-Wadsworth/ALERT Laboratories prepare and analyze method blanks for all applicable parameters to evaluate analytical system interferences and background contamination levels. Method blank analyses include all components (glassware, chemical reagents, environment, etc.) of actual, routine method analyses, substituting reagent water or another applicable clean matrix for the actual sample. Approximately twenty-five percent (25%) of all quality control samples are method blanks. Analyses of method blanks provides a safeguard against interfering and/or contaminated reagents, glassware, and laboratory environments. The results of all method blank analyses are recorded in the Laboratory Computer Data Management System. Unfavorable method blank performance renders associated data suspect and requires corrective action (see Chapter 15).

11.7 Surrogate Spike Recovery Evaluations

Enseco-Wadsworth/ALERT Laboratories conducts surrogate spike recovery evaluations to ensure acceptable method performance. Surrogate spikes consisting of method compound analogues are added to GC/MS analyses, GC volatile analyses, and GC pesticide and herbicide analyses to evaluate acceptable method performance. Surrogate spike recoveries must compare favorably to published USEPA method or statistically derived Laboratory performance limits in order for an analysis to be acceptable.

Unfavorable surrogate spike recoveries render associated data suspect and require corrective action (see Chapter 15).

11.8 Check Sample Evaluations

Enseco-Wadsworth/ALERT Laboratories prepare and analyze check samples on each batch of samples for all applicable parameters. The purpose of check samples is to continously evaluate method performance. Approximately twenty-five percent (25%) of all quality control samples are check samples. Percent recovery determinations from these check samples are monitored to provide a continuous measure of each method's accuracy. Laboratory quality control charts are constructed from this data in order to monitor and compare actual check sample data with established Laboratory method performance criteria.

11.9 Corrective Measures

Corrective action is based on percent recovery determinations of check samples and precision data of matrix spike/matrix duplicates.

Control limits are established by the laboratory on an annual basis. Current control limits are found in Chapter 4, Table 4-1. See Chapter 15 for additional corrective measures.

12.0 PERFORMANCE AND SYSTEMS AUDITS

Enseco-Wadsworth/ALERT Laboratories participates in a number of performance and systems audits, both internal and external, to monitor the capability and performance of the laboratory and its operations.

12.1 External Laboratory Certifications, Audits, and Approvals

Enseco-Wadsworth/ALERT Laboratories maintains an internal system of performance and systems audits to verify the quality of its measurement systems. These audits are conducted on a regular basis as a part of normal laboratory operations. Enseco-Wadsworth/ALERT has been an active participant in the USEPA Contract Laboratory Program (CLP) since 1985. In addition, the laboratory participates in a number of other federal, state, and private Laboratory Certification, Audit and/or Approval Programs in order to demonstrate its analytical capabilities and expertise. Participation in these programs require the Laboratory to demonstrate acceptable laboratory performance through satisfactory completion of routine systems and/or performance audits. As a part of its certification by these various federal, state, and private agencies, Enseco-Wadsworth/ALERT Laboratories submits to on-site external systems audits. The inspection audits evaluate the adequacy of laboratory personnel, equipment, documentation, and QA/QC. Performance audits require satisfactory blind analyses of unknown intralaboratory performance evaluation samples. A listing of Laboratory Certifications, Audits, and/or Approvals currently maintained by the Laboratory is available upon request.

12.2 Voluntary Intralaboratory Performance Evaluations

Enseco-Wadsworth/ALERT Laboratories participates in Intralaboratory Performance Evaluations administered by the Laboratory QA/QC Manager. The QA/QC Manager periodically submits single blind performance evaluation samples into the laboratory to assess analytical performance. These single blind performance evaluation samples are generated in-lab by the QA/QC Manager or obtained from various commercial and regulatory sources. When internal criteria are not met with these Performance Evaluation samples, the

Laboratory Manager and appropriate Group Coordinators are notified. They must determine what caused the out-of-control situation and respond to the QA/QC Manager in writing with the corrective action taken. Additional samples of known concentration may then be submitted to determine whether or not the corrective action taken was sufficient.

12.3 Internal Audits

The Quality Assurance/Quality Control department conducts data audits of randomly selected projects. This data review is referred to as a Level IV review.

The Level IV review involves verification of the presence and correctness of the Levels I, II, and III reviews as well as checking twenty percent (20%) of the sample data back to bench-level for each project audited. If no problems are found with the data package, the review is complete. If any problems are found, an additional ten percent (10%) of the sample data in that project is checked. The process continues until no errors are found or until the data package has been reviewed in its entirety. A report is compiled of the data package errors and corrective action plans are implemented to eliminate repetition of these errors. An ongoing tally of the types of errors is used to address problem areas with additional training and education. The frequency of the level IV review is determined by the error rate found.

On a semiannual basis, the QA/QC Manager audits the laboratory facilities. The audits include logbook review, chromatogram review, equipment inspection, and compliance with Laboratory Quality Control SOPs. Audit reports are submitted to the General Manager, Regional QA Director, Laboratory Manager, and Group Coordinators. The Group Coordinators are required to respond in writing to the QA/QC Manager with the corrective actions taken. Depending on the nature of the problems found, follow-up audits are conducted to determine that corrective actions were sufficient and appropriate.

13.0 PREVENTIVE MAINTENANCE

Enseco-Wadsworth/ALERT Laboratories maintains a routine training and laboratory equipment maintenance program for all major instrumentation. Laboratory Instrument Service Logbooks are assigned to each instrument to document the service of all equipment included within this program.

13.1 Field Instruments and Equipment

The parameters measured in the field include temperature, pH, and specific conductivity. All field equipment are calibrated per the manufacturer's specifications prior to use.

13.2 Laboratory Instruments and Equipment

All laboratory analysts receive proper training in the operation of applicable instruments prior to actual sample analyses. This training may include attendance at instrument manufacturer's operator training classes and seminars with in-lab instruction and supervision by the group coordinators. This training is augmented and updated as appropriate.

Enseco-Wadsworth/ALERT Laboratories maintains a routine laboratory equipment maintenance program for all major instrumentation. For GC and GC/MS instruments, selected operators have been trained to perform routine maintenance procedures (e.g. changing oven fans, replacing electronic control boards, changing vacuum pump oil, cleaning, etc.). Additionally, the laboratory maintains service contracts with the manufacturers for some of the major instrumentation. For the other instrumentation, operators perform routine maintenance (e.g. changing electrodes, changing bulbs, etc.). This program ensures minimal downtime, as well as proper performance. Laboratory Instrument Service Logbooks are assigned to document the service of all equipment included within this program. A substantial spare parts inventory is also maintained to assure timely repair of instruments. When routine maintenance procedures do not correct a problem with instrumentation, outside repair services are available on a next day basis. The laboratory does not maintain test equipment used in the maintenance of instrumentation. Service representatives bring the necessary test equipment for the service call. Additional specific preventive maintenance procedures for laboratory instruments are listed below.

13.2.1 GC and GC/MS

- Use of high-quality industrial operating gases combined with on-line installation of molecular sieves to remove impurities.
- "Bake off" or conditioning of new GC and GC/MS columns and detectors to cleanse system.
- Periodic cleaning and reconditioning of detectors as indicated by instrumental performance.
- Monitoring of detector response and overall instrument performance through calibration and verification.
- Periodic cleaning/changing of cooling fans and air filters to ensure proper temperature maintenance.
- Periodic changing of septa and injector liners. Cutting and replacing of columns as needed.

13.2.2 AA

- AA lamps are warmed up for 15 minutes prior to any analysis.
- Weekly cleaning of furnace housing and injector tip.
- Periodic cleaning of windows with alcohol to assure optimal light transmission.
- Periodic aspiration of 50 ml of deionized water through the flame assembly or the vapor generation assembly after analyses are complete.
- Periodic washing of the burner assembly and spray chamber in hot water as indicated by instrument response.
- Frequent replacement of pyrolitic graphite furnace tubes as indicated by instrumental performance.
- Utilization of high quality industrial operating gases.

- Monitoring of detector response and instrument performance through calibration and verification.

13.2.3 ICP

- Use of high quality operating gases.
- Periodic changing of vacuum pump oil and circulated cooling water.
- Monitoring of detector response and instrument performance through calibration and verification.
- Daily replacement of peristaltic pump tubing.
- Periodic cleaning of nebulizer and spray chamber.

13.2.4 pH and Ion-Selective Electrodes

- Rinse probe with deionized water after every analysis and carefully blot off remaining deionized water prior to next analysis.
- Soaking of probe in a suitable solution when instrument is not operating.
- Periodic replacement of the electrodes as indicated by the consistency, repeatability, and stability of the response.

13.2.5 Spectrophotometer

- Rinse cuvette with deionized water between analyses.
- Periodic cleaning of windows with alcohol to assure optimal light transmission.
- Periodic replacement of lamps as indicated by the consistency, stability, and repeatability of the response.
- Warm up lamp for 10 minutes prior to any analysis.

13.3 Routine Maintenance Procedures for Mobile Laboratory

All laboratory equipment is available for use in mobile laboratory sites by making arrangements with Project Management personnel. While on site, the equipment is maintained as it is in the Laboratory (13.2).

13.4 Instrument Downtime

Routine maintenance procedures allow the laboratory workload to be scheduled around planned downtime. In the event of unscheduled downtime, samples are diverted to alternate, qualified laboratories. A substantial spare parts inventory is maintained to assure timely repair of instruments and minimize the likelihood of having to send samples out of the laboratory.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Enseco-Wadsworth/ALERT Laboratories uses specific routine procedures to assess the precision, accuracy, and completeness of its analytical data. These measures include the validation and internal quality control procedures discussed in Chapters 9 and 11.

Specific procedures for assessing data accuracy and precision include calculation of percent recoveries for all check samples and relative percent differences for all duplicate spike sample analyses. These calculations are summarized below.

a. $$\text{Accuracy} = \underset{(\text{R\%})}{\text{Percent Recovery}} = \frac{(\text{Observed Conc.})}{(\text{Expected Conc.})} \times 100$$

b. $$\text{Precision} = \underset{(\text{RPD})}{\text{Relative Percent Difference}} = \frac{(C1 - C2)}{(C1 + C2)/2} \times 100$$

(Where C1 and C2 are concentrations of duplicate spikes.)

c. $$\text{Completeness} = \frac{\text{\# of QC samples in control}}{\text{\# of QC samples attempted}} \times 100$$

NOTE: Refer to the definitions of accuracy, precision, and completeness in Chapter 4.

Analytical control limits are derived from statistical manipulation of each data category using the Grubbs tests for the rejection of statistical outliers. The limits are outlined below.

	Accuracy	Precision
Upper Control Limit (UCL)	$\overline{\%R} + 3S$	$\overline{RPD} + 3S$
Lower Control Limit (LCL)	$\overline{\%R} - 3S$	$\overline{RPD} - 3S$

(Where S is Standard Deviation)

Percent Recovery determinations (%R) are entered into the Laboratory computer Data Management System. This Laboratory Computer Data Management System formally records the percent recovery data and calculates the mean,standard deviation and the relative percent difference of each pair, and generates continuous R-S quality control charts of the accuracy for each method commonly used in the Laboratory.

Laboratory method performance criteria are utilized to evaluate quality control data in the absence of published USEPA method performance criteria. Laboratory method performance criteria are statistically derived from matrix spike or check sample quality control data as follows:

Warning Limit (WL) = ± 2s
Control Limit (CL) = ± 3s

s = standard deviation of the method percent recoveries

Fifty (50) matrix spike or check sample percent recoveries are used to determine trends and one hundred (100) matrix spike or check sample percent recoveries are used to calculate control limits. A minimum of seven (7) matrix spike or check sample percent recovery determinations are required to establish the above-stated performance limits. These Laboratory method performance limits are continually redefined as quality control information accumulates.

The mean value percent recovery (R) and standard deviation(s) determinations calculated from the matrix spike or check sample quality control results are used to generate Laboratory Method Accuracy Statements for each analytical method commonly used in the Laboratory. Method Accuracy Statements are defined as R ± 3s and are based upon a minimum of seven (7) matrix spike or check sample determinations. These statements are updated annually as calculated from previously accumulated quality control data. All laboratory Method Accuracy Statements are maintained in the Laboratory Quality Control SOP Manual and should be within the recommended EPA criteria.

15.0 CORRECTIVE ACTION

15.1 Laboratory

Enseco-Wadsworth/ALERT Laboratories routinely uses its quality control data to determine the need for corrective action. Frequent review of data permits rapid identification of an analytical or sampling error and implementation of corrective action.

15.1.1 Determination of the Need for Corrective Action

Percent recovery determinations from the systematic matrix spike and quality control check samples must compare favorably to the published USEPA or laboratory method performance criteria outlined previously in order to validate and approve a corresponding batch of sample analyses. The method analyses are out of control and therefore unacceptable if:

- One data point recovery value is outside of published USEPA performance limits or laboratory established control limits (CL) for any quality control check sample.
- The Relative Percent Difference (RPD) for any parameter is outside of published USEPA performance limits or laboratory established control limits for any matrix spike/matrix spike duplicate.

Refer to Chapter 4 for check sample and RPD control limits.

Unacceptable values render the sample analyses suspect, as do unacceptable results for method blank analyses, until corrective action demonstrates the return of acceptable method performance.

15.1.2 Procedures for Corrective Action

The analyst who reviews and compiles raw data from sample analysis and associated matrix blank, matrix spike, and check samples must immediately notify the group coordinator of the deviation from accepted standards. In addition, the group coordinator reviews all QC data during Level II review to monitor the performance of the analytical system. If any values are outside of QC limits, corrective action is instituted at once.

Corrective action may also be implemented as a result of external performance and systems audits, intralaboratory comparisons, QA project audits, or other QA/QC activities.

These corrective actions may involve any phase of the analytical or sampling method including: reagent quality, sample extraction, equipment cleaning, instrument calibration and/or performance, calculations, etc. Specific procedures for corrective action are detailed in the Laboratory Quality Control SOP Manual. For further information on the Internal Quality Control Program, refer to Chapter 11.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Two types of Quality Assurance reports are issued by Enseco-Wadsworth/ALERT Laboratories; internal reports to management and project reports to clients.

16.1 Internal QA Reports

On a monthly basis, the QA/QC Manager prepares a Quality Assurance Report for Laboratory Management. This report includes the monthly assessments of: the results of any internal or external systems and performance audits; a description of any significant QA problems and suggested corrective actions; and the outcome of any corrective actions taken.

16.2 Project Reports

When requested, the Project Manager presents a QC report to the client representative at the completion of a sampling and/or analytical project. In most cases, this will be a portion of the Analytical Result Summary Final Report. The QC report includes check samples, blanks, and any corresponding matrix spike data if available. Any quality control problems are documented in a QC Narrative.

APPENDIX I

Waste Compatibility and Consolidation Scheme

Enseco-Wadsworth/ALERT Laboratories developed the following analytical scheme for the purpose of determining the compatibility and ultimate consolidation of unknown waste streams. It incorporates the use of commercial test strips and standard analytical methods and drum consolidation protocols as outlined in this section.

Waste Compatibility and Consolidation Scheme

Compatibility and Consolidation Groups
(See Flowchart)

1. Radioactive
2. PCB Solid
3. Flammable Solid
4. Nonflammable Solid
5. Oxidizer
6. Peroxide
7. Reactive
8. Water Reactive
9. PCB Liquid
10. Sulfide Liquid
11. Cyanide Liquid
12. Flammable Nonhalogenated Organic Liquid
13. Nonflammable Nonhalogenated Organic Liquid
14. Flammable Halogenated Organic Liquid
15. Nonflammable Halogenated Organic Liquid
16. Flammable Aqueous Acid
17. Nonflammable Aqueous Acid
18. Flammable Aqueous Neutral
19. Nonflammable Aqueous Neutral
20. Flammable Aqueous Base
21. Nonflammable Aqueous Base

ANALYTICAL METHODS

Radioactivity - National Conference on Management of Uncontrolled Hazardous Wastes Sites (USEPA Hazardous Materials Control Research Institute), October 1981 110

Peroxide - Ether Peroxide Test Strips
* - Drum Consolidation Protocol (DRAFT) USEPA, August 1981 15.5.11

Oxidizer - Potassium Iodide - Starch Test Strips
* - Drum Consolidation Protocol (DRAFT) USEPA, August 1981 15.5.11

Water Reactivity & Solubility - Drum Consolidation Protocol (DRAFT) USEPA, August 1981 15.5.11

Flammability - Open Flame Test

pH - pH Indicator Strips

Cyanide - Standard Methods for Examinaiton of Water & Wstewater, 14th Edition, 1979 413-I
* - Standard Methods for Examination of Water & Wastewater, 14th Edition, 1979 412-E

Sulfide - Lead Acetate Test Strips
* - Drum Consolidation Protocol (DRAFT) USEPA August 1981 15.5.5

Halides - The Systematic Identification of Organic Compounds, Shriner et al, 5th Edition, Jon Wily & Sons, New York, NY, 1964
* - Drum Consolidation Protocol (DRAFT) USEPA August 1981 15.5.6

PCBs - Drum Consolidation Protocol (DRAFT) USEPA August 1981 15.5.8

* - Confirmation Test

ATTACHMENT D

DATA MANAGEMENT PLAN

ATTACHMENT D
DATA MANAGEMENT PLAN
TOMAH MUNICIPAL SANITARY LANDFILL
TOMAH, WISCONSIN

March 10, 1994

Dames & Moore No. 27504-002

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1.0 INTRODUCTION

To achieve the objectives of the Remedial Investigation (RI/FS) at the Tomah Municipal Sanitary Landfill (TMSL) site, field and analytical data will be used to identify contaminant concentrations with respect to the established clean-up criteria and support the remedial activities. To generate and maintain functional data, the PRPs have developed this Data Management Plan (DMP) and other various project plans (e.g., work plan, field sampling plan, and quality assurance plan). The project plans are designed to provide guidance to project personnel and to produce a framework for the successful completion of this project. The information within these plans will furnish the direction necessary to; (1) carefully plan project activities, (2) execute the field work, (3) control data quality, and (4) manage data generated by field and laboratory activities.

The DMP provides policies and procedures regarding data documentation, control, and management. These policies and procedures are intended to maintain high quality data which are easily accessible to project participants and which can be used as long-term records of site activities as well as up-to-date reports. As the project evolves, it may become necessary to add, delete, or modify selected elements of this plan.

2.0 DATA MANAGEMENT RESOURCES

Data management is the process of organizing, maintaining, and applying a variety of data to provide a useful and coherent view of the site conditions. The data management resources will include staff to review and maintain project data, a computerized data management system, and a documentation filing system.

2.1 Data Management Staff

The Data Management Staff will provide support for the TMSL project, including the following:

- Set-up and oversee the operation of a database management system.
- Set-up and oversee the data transfer mechanism for transfer of data from the laboratory liaison to the Project Manager.
- Work with the Project Manager to set-up the project filing system.
- Work with primary data users to develop suitable data output.
- Develop a data validation process with the Quality Assurance/Quality Control Manager.
- Provide for data security.
- Assure timely and reliable data output for authorized users.
- Resolve potential conflicts regarding data use and reporting formats.
- Provide information required by the Quality Assurance Manger for data quality auditing purposes.

- Receive field data from the Field Manager, task managers, field technicians, and subcontractors.

- Receive laboratory data from the laboratory liaisons.

- Maintain communications with the laboratory liaisons regarding the availability of data and data transfer problems.

- Add data to the database management system.

- Provide hard copies of field and laboratory data to the Project Manager for project file storage.

- Provide data reports and graphics to task managers and others.

- Collect samples from field investigators at appropriate intervals (either daily or semi-daily, depending upon weather conditions, number of samples generated, required analyses, etc.).

- Review the field portion of each chain-of-custody record when samples are received from the field.

- Check that the information recorded on field data records, sample labels, and chain-of-custody records is consistent.

- Provide chain-of-custody records to the field manager for completion of the analytical request section.

- Transfer samples to the laboratory at appropriate intervals.

2.2 Database Management System

The TMSL project will generate large of amounts of environmental data. To effectively store, manipulate, and report such data, the Project Manager will utilize a project database management system (DBMS) which has the capability to:

- Maintain the relationship between sampling locations, samples collected, and laboratory analytical results;
- Filter the data to create selected subsets of appropriate information; and,
- Efficiently report large quantities of data in both graphical and tabular formats.

2.3 Document Filing System

To promote data security, the document filing system for the project will limit access to original data and will minimize document transfers. The project documentation will include three general categories of information:

- Category 1 data includes general administrative documents (e.g., project memos, records of conversations, etc.);
- Category 2 data includes technical documentation which is not directly associated with sampling, and laboratory analyses (e.g., field logbooks, field memos, QA/QC evaluation sheets, computation forms, project deliverables, and miscellaneous communications); and,
- Category 3 data includes technical documentation which is directly associated with sampling, and laboratory analyses (e.g., survey documentation, field data records, chain-of-custody records, laboratory analytical results, and QA/QC data).

All documents will be managed by the Project Manager. Documents will be transferred to the Data Management Staff and will be maintained in the data management files throughout the duration of the project. To promote the security of these documents, the data management filing system will incorporate the data protection procedures described in Section 5.0.

3.0 DATA IDENTIFICATION STRATEGY

To promote the generation and use of high quality data, the DMP includes a strategy to provide standard methodologies for the identification of collected data. These methodologies are described in the following subsections.

3.1 Sample Numbering System

A site-specific sample numbering system will be used to identify each sample, including all samples sent for chemical analysis, duplicates, and blanks. The sample number will consist of alphanumeric characters. The site manager or his designee will be responsible for maintaining a listing of the sample identification numbers in a project log book.

The sample identification number will begin with the letters TMSL to indicate that the samples were obtained at the Tomah Municipal Sanitary Landfill. This will be followed by the month and year that the sample is collected (i.e. 0894 for a sample collected in August of 1994). This will be followed by a letter code corresponding to the sample type as follows: SW-surface water; SC-Sediment Core; GW-groundwater; SB-subsurface soil sample; GP-gas probe (field reading only); FB-field blank; TB-trip blank; DP-duplicate sample. The letter code will be followed by a pre-established numeric location code (e.g., monitoring well number or boring number and sample interval depth).

Field blanks will have the FB designation plus an additional letter code and number identifying the type and number of the field blank (e.g., a groundwater blank will be designated FBGW). Duplicate samples will be given a separate identification number in the field to allow for blind duplicate analyses.

Example: TMSL0794GWMW01

- the first four letter characters designate the site the samples are collected from;
- the second set of four numbers designate that the sample was collected in July 1994. This number will also establish the sampling round;
- the next two characters (GW) indicates that the sample is a groundwater sample;
- the last four characters indicates that the sample was obtained from monitoring well MW-1.

A duplicate sample collected from this well would be labeled **TMSL0794DPMW01.** A field blank collected after sampling this well would be designated **TMSL0794FBMW01.**

4.0 DOCUMENTATION

Data will be generated from survey, environmental sampling, and laboratory analysis activities. To appropriately manage the data generated by these tasks, the DMP includes specific provisions for data documentation. The project documentation establishes procedures and identifies written records which will:

- Enhance and facilitate sample tracking and the interpretation of sampling and analytical data;
- Standardize data entry for input into the DBMS for efficient retrieval and data manipulation; and,
- Identify and establish the authenticity of data collected for possible remedial measures.

The project documentation is designed to address the need to view sampling and analysis results as a function of data quality and application. Knowledge of the circumstances under which project samples were collected, handled, preserved, transported, and analyzed will play an important role in how the analytical data are used and interpreted. In addition, the documentation will address the need for uniformity in data recording, as a number of sampling teams may be involved in sample collecting and data gathering. As such, a consistent, standardized documentation program is essential for developing an effective and efficient data management system. Finally, the project documentation will be provided in a format which can provide a clear and concise record for possible legal use.

The DMP includes provisions for field, and laboratory documentation. This documentation will provide the following:

- Essential and required information that is consistently acquired and preserved for current use and future reference.

- Timely, correct, and complete analysis for parameters requested from the laboratory;

- Satisfaction of quality assurance requirements; and,

- Chain-of-custody records for samples.

The following subsections describe the project documentation.

4.1 Field Documentation

Field data will be generated primarily by surveying and sampling activities. To document these activities project personnel will be required to annotate appropriate details of the activities in Survey Records, Logbooks, Field Data Records, and Chain-of-Custody Records. A description of each of these items is provided in the following subsections.

4.1.1 Survey Records

To accurately locate field data with respect to previous site features and for future reference, appropriate field activities will be located with field surveying equipment. This information will then be used to plot the locations on the project base map. Survey records will be completed by the project surveyor and transmitted directly to the Project Manager.

Because the project surveyor has not yet been selected, an example survey record cannot be provided in this plan. However, the surveying contract will specify that surveying data will be transmitted to the Project Manager in two forms: (1) printed hard copy, and (2) computer floppy disk. The printed copy will serve as the certified surveying report and will include appropriate information. The electronic copy will be provided to minimize the data entry efforts required and to reduce the potential for data entry errors.

4.1.2 Logbooks

Field logbooks will be used to document observations, measurements, and significant events that have occurred during field activities. In addition, the logbooks will be used to describe any modifications to the procedures outlined in the work plan, field sampling plan, quality assurance plan, or health & safety plan, with justifications for such modifications. Unusual occurrences and circumstances will be documented in the logbooks and can be used for reference in determining the possible causes for data anomalies discovered during data analysis. Information in the logbooks should be able to convey to the reader an understanding of the activities which occurred.

These logbooks will be assigned to, and maintained by, individuals working in the field. The field logbooks will be permanently bound and will contain sequentially numbered pages. Once completed, the logbooks will be transferred from the field personnel to the Project Manager and will be maintained as part of the project files.

Entries for each new day will begin at the top of a new page and all pages will be marked with the date. All entries in the logbooks will be identified by time of recording, legibly written in permanent black or blue ink, and contain accurate and objective documentation. Entries which include conjecture or opinion will be clearly marked and will be prefaced by the words "I believe" or "In my opinion". Entry errors will be marked out using a single line drawn through the error and will be initialed and dated by the person making the correction.

Lines below the last entry on each page will be crossed with a diagonal line and signed by the author. All pages will remain in the logbook regardless of whether the page is used or not. All unused pages will be crossed with a single diagonal line and signed by the author.

4.1.3 Field Data Records

Field data records will be used to document details of the various field activities. These records will document information regarding subsurface conditions, well construction, hydrogeologic data, and sampling. The field data records include the following:

- Soil logs;
- Well construction summaries;
- Well development/purging data sheets;
- Water level data sheets; and,
- Field Sample Forms.

All entries in the field data records will be legibly written in permanent black or blue ink, and contain accurate and objective documentation. Entry errors will be marked out using a single line drawn through the error and will be initialed and dated by the person making the correction.

The purpose and content of each of these records are described below.

Soil Logs

Soil logs will be utilized to document subsurface conditions encountered during the completion of borings, hand auger holes, and test pits. The soil logs will be completed in the field at the time of investigation. Each log will be submitted to the field manager after completion of the boring. After the field manager has reviewed each form for completeness and legibility, it will be transmitted to the Project Manager.

Well Construction Summaries

Well construction summaries will be utilized to document construction details of groundwater and vapor monitoring/recovery/injection wells. The well construction summaries will be completed in the field at the time of construction, and will be submitted to the field manager at the end of each day. After the field manager has reviewed each summary for completeness and legibility, it will be transmitted to the Project Manager.

Well Development/Purging Data Sheets

Well development/purging data sheets will be utilized to document information regarding the removal of groundwater during well development and well purging. The well development/purging data sheet will be completed in the field at the time of development/purging. Each data sheet will be submitted to the field manager at the end of each day. After the field manager has reviewed each data sheet for completeness and legibility, it will be transmitted to the Project Manager.

Water Level Data Sheets

Water level data sheets will be utilized to document information regarding water level and floating product elevations encountered in groundwater monitoring wells. The water level data sheet will be completed in the field at the time of water level measurement. Each data sheet will be submitted to the field manager at the end of each day. After the field manager has reviewed each data sheet for completeness and legibility, it will be transmitted to the Project Manager.

Field Sample Forms

Field Sample Forms will be utilized to document the who, what, when, where, and how of site sampling activities. The field sample forms will be completed in the field at the time of sampling. Each form will be submitted to the field manager at the end of each day. After the field manager has reviewed each record for completeness and legibility, it will be transmitted to the Project Manager.

4.1.4 Sample Labels

To identify and manage samples obtained in the field, a sample label will be affixed to each sample container. The labels will be partially pre-printed on an adhesive material and permanently affixed to the unused sample containers prior to shipment from the laboratory to the Project Manager. The pre-printed information may include the laboratory name, the project identification, special sampling instructions, requested analyses, and preservation requirements. When the sample container is used, the sampling team will add the following information to each label:

- Sample ID;
- Sampler's Initials;
- Sample Location;
- Date; and,
- Time.

4.1.5 Chain-Of-Custody Records

Chain-of-custody records will be utilized to document sample transfers from field personnel to the laboratory. These documents will provide the information required to trace sample possession from the point of origination to final disposition. The chain-of-custody record will be completed (except for the analytical requests) in the field at the time that custody of the samples is transferred from the field investigator to the sample custodian. After receipt of the samples, the sample custodian will review each record for completeness, accuracy, and legibility. Prior to shipment of the samples to the analytical laboratory, these records will be submitted to the field manager. The field manager will then complete the analytical request section and return the record to the sample custodian for shipment to the laboratory. In no case will samples be transmitted to the laboratory without a chain-of-custody record. If the field manager is unable to identify the analytical requests prior to the sample shipment, the chain-of-custody record will indicate that analytical requests will follow (see Subsection 4.1.6). When the samples are transmitted to the laboratory, one copy of each record with the final data will be forwarded to the Project Manager.

When sample shipments are sent to the laboratory via third party carriers the sample custodian will enter the carrier name and weigh bill number on the chain-of-custody record and a copy of the weigh bill will be attached to the chain-of-custody record retained by the Project Manager.

4.1.6 Laboratory Analysis Request Forms

Laboratory analysis request forms will be utilized to document analytical requests which were not transmitted as part of the chain-of-custody record (e.g., situations where the laboratory was instructed to "hold" the sample or if new information indicates the potential presence of a previously unsuspected contaminant). The laboratory analysis request forms will be completed by the field manager or by the appropriate task manager.

4.2 Laboratory Documentation

To document the laboratory data generated during this project, participating laboratories will be required to annotate appropriate details of the activities in chain-of-custody records, internal laboratory documentation, analytical result records, and quality assurance/quality control records. A description of each of these items is provided in the following subsections.

4.2.1 Chain-of-Custody Records

To document the receipt of samples received from the field a representative of the laboratory will sign the accompanying chain-of-custody and immediately transmit a copy of the signed record to the Project Manager.

4.2.2 Internal Laboratory Documentation

Internal laboratory documentation generated during this project will be maintained by the laboratory and will not be addressed by this DMP. However, access to the data should be available to the Data Management and QA/QC Staff for reference and future use.

4.2.3 Analytical Results

Analytical results from the laboratory will be provided to the Project Manager in an easy-to-use, consistent format. Although the format may change slightly depending upon the sample media and laboratory analyses performed, the format will remain essentially the same throughout the project. These results will include the sample identification and description, the applicable detection limit, the analytical result, and a QA/QC qualifier (if applicable).

4.2.4 Quality Assurance/Quality Control Results

Each package of analytical results will include appropriate QA/QC results. The QA/QC results included may change from one laboratory package to another, depending upon the type of analyses performed and the end use of the data. Specific details of the QA/QC data required is provided in the QAPP.

4.2.5 Data Transfer

The analytical results including QA/QC data generated at project laboratories will be transferred to the Project Manager in two forms: (1) printed hard copy, and (2) computer floppy disk. The printed copy will serve as the certified laboratory report and will include appropriate information. The electronic copy will be provided to minimize the data entry efforts required and to reduce the potential for data entry errors. Data transfers will be effected at the earliest possible date by courier to the Project Manager.

Each transfer of laboratory analytical data will be accompanied by a transmittal cover letter which includes the following information:

- Laboratory name;
- Laboratory report number;
- Samples included;
- Analyses performed; and,
- A description of which data have been revised (if applicable).

Electronic data transmitted from the laboratory to the Project Manager will be contained on 3 1/2 inch high density (1.44 MB) floppy diskettes and will be provided in a file format which is compatible with the dBASE III+ standard. The specific structure of these files will be developed as required during the project. However, each data package from the laboratory will be accompanied by a data dictionary which describes each of the data files and the associated data structures on the diskette. Each diskette will be clearly and indelibly identified with a unique laboratory report number, the name of the laboratory, and the date of the transfer. The transmitted diskettes will be retained by the Project Manager for project storage.

5.0 CONTROL

To achieve the goals of this project, data obtained from the field and from the laboratory must meet high standards of quality. In addition, high quality must be maintained throughout the project. To maintain data quality specific guidelines and procedures have been developed to control the project data. Document control is a systematic procedure for ensuring that all sampling/monitoring documents are identified and accounted for during and after the project. Generally, document control procedures include serialized documents, document inventory records, and document storage. The document control guidelines and procedures for this project are described in the following subsections.

5.1 Data Entry

Without current data, the efficiency and success of this project may be limited. Therefore data entry efforts will be given a top priority. These efforts will include entry of the following items:

- Field Documentation; and,
- Laboratory Documentation.

The project documentation described in Section 4.0 will consist of both; (1) paper documentation only, and (2) paper documentation with associated electronic data. To maintain the quality of the documented data, the Data Management Staff will adhere to the following data entry procedures.

5.1.1 Paper Documentation

Documentation which is received by the Data Management Staff in paper form only (e.g. field data records, chain-of-custody records, etc.) will be subjected to the following data entry procedure.

- Upon receipt by the Data Management Staff each data sheet will be stamped as "Received" with the appropriate date and initialed by the Data Management Staff. Where appropriate the data sheets will be assigned a tracking number.

- Enter data into a temporary data file. Each data sheet will be stamped as "Entered" with the appropriate date and initials of the data entry personnel.

- Print and check the data in the temporary file to verify correct data entry. Where required entry discrepancies will be resolved and the incorrect data will be modified. Each data sheet will be stamped as "Checked" with the appropriate date and initialed by the Data Management Staff. If data discrepancies have been modified the data sheet will also be stamped as "Revised" with the appropriate date and initialed by the Data Management Staff.

- Append the temporary data file to the permanent data file. Each data sheet will be stamped as "Appended" with the appropriate date and initialed by the Data Management Staff.

- File each data sheet according to appropriate procedures.

After proper completion of the data entry process each data sheet should contain the following information:

"Received" + date + initials
"Entered" + date + initials
"Checked" + date + initials
"Revised" + date + initials (if appropriate)
"Appended" + date + initials

5.1.2 Paper/Electronic Documentation

Documentation which is received by the Data Management Staff in both paper form and electronic form (e.g. laboratory analytical data) will be subjected to the following data entry procedure.

- Upon receipt by the Data Management Staff each data sheet and the electronic disk will be stamped as "Received" with the appropriate date and initialed by the Data Management Staff.

- Transfer data from the electronic disk to a temporary data file using the analytical data transfer program. Each data sheet will be stamped as "Transferred" with the appropriate date and initialed by the Data Management Staff.

- Data from the temporary data file will be checked against the original hard copy report to verify correct data transfer. Where required transfer discrepancies will be resolved and the incorrect data will be modified. Each data sheet will be stamped as "Checked" with the appropriate date and initialed by the Data Management Staff. If data discrepancies have been modified the data sheet will also be stamped as "Revised" with the appropriate date and initialed by the Data Management Staff.

- Append the temporary data file to the permanent data file. Each data sheet will be stamped as "Appended" with the appropriate date and initialed by the Data Management Staff.

- File each data sheet according to appropriate procedures.

Initially 100% of the electronic data will be checked against the hardcopy. When the Data Management Staff consider that the electronic data accurately represent the data reported by the laboratory, the frequency of the checked data will be reduced to a randomly selected level of approximately 10%.

After proper completion of the data entry process each data sheet should contain the following information:

"Received" + date + initials
"Transferred" + date + initials
"Checked" + date + initials (if appropriate)
"Revised" + date + initials (if appropriate)
"Appended" + date + initials

5.2 Data Security

Data generated during remedial projects are both sensitive and confidential. To maintain the security of this data, the Project Manager will maintain the data in secure areas, limit access to original data, and restrict access to the DBMS.

All original copies of data documentation will be kept in a secure area in cabinets under control of the Data Management Staff or the Project Manager. Access to original data will be limited and in controlled situations. When access to these documents is required in areas outside of the direct control of either the Data Management Staff or the Project Manager, copies will be provided. These copies will be clearly stamped "COPY".

To reduce the potential for data modifications, the project DBMS will be provided with a password security system. This system will include provisions for the following:

- Unauthorized personnel will be prevented from operating the data management computer; and,

- Only personnel directly authorized by the Data Manager will be permitted to add, modify, or delete data from the database.

To minimize the effects of potential computer problems and data corruptibility, the project database will be subjected to a strict data back-up procedure. The procedure will consist of a backup of all modified data files on a daily basis. All files (modified and not modified) will be backed up on a weekly basis.

ATTACHMENT B

HEALTH AND SAFETY PLAN

ATTACHMENT E
TOMAH LANDFILL
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
HEALTH & SAFETY PLAN

March 10, 1994

Dames & Moore No. 27504-002

DAMES & MOORE

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Project Name and Number:	Tomah Landfill: Remedial Investigation & Feasibility Study No. 27504-002
Project Site Location:	Monroe County, Wisconsin
Project Manager:	Jeffrey Steiner
Site Safety Coordinator:	Mark McColloch
Plan Preparer:	Michelle M. Schwoch
Plan Reviewer:	Timothy Stratton
Preparation Date:	12/22/93

APPROVED:

Tom Covilli
Regional Health and Safety Manager

(Date)

Timothy Stratton
Office Health and Safety Coordinator

(Date)

David P. Trainor
Manager, Madison Office

(Date)

Jeffrey Steiner
Project Manager

(Date)

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1.0 PURPOSE

The purpose of this Site-Specific Health and Safety Plan (HSP) is to assign responsibilities, establish personnel protection standards and mandatory safety practices and procedures, and provide for contingencies that may arise during site operations.

2.0 APPLICABILITY

The provisions of the plan are mandatory for all on-site Dames & Moore employees who are engaged in hazardous material management activities including, but not limited to, initial site reconnaissance, preliminary field investigations, mobilization, project operations, and demobilization. This plan has been developed under U.S. Environmental Protection Agency (EPA) guidelines and complies with applicable regulations, including Occupational Safety and Health Administration (OSHA) standards [29 Code of Federal Regulations (CFR) 1910 and 1926].

Dames & Moore will insist on the following health and safety requirements from its subcontractors:

- Subcontractor employees must have appropriate training [i.e., either a 40-hour or 24-hour OSHA-required (29 CFR 1910.120) health and safety course for hazardous waste work, or certified equivalent training].

- Personnel working at hazardous waste sites must have had an annual physical (or physician's waiver for biennial physical) and be certified "fit for duty" and "fit for respirator use," if necessary, by a qualified physician.

- Subcontractor shall provide Dames & Moore with a completed Subcontractor Statement of Compliance as proof of both training and a physical before site work may begin.

- Personnel must have appropriate personal protective equipment (PPE) for the specific job. At a minimum, personnel should have the following equipment, which will be inspected by Dames & Moore:

    - Hard hat
    - Safety shoes
    - Gloves
    - Goggles/safety glasses
    - Hearing protection, if appropriate
    - Respiratory protection, if appropriate (with fit test)
    - Other equipment as specified by the HSP.

- Drilling equipment and field operations must meet applicable safety standards and satisfy Dames & Moore's field inspection. Unsafe equipment or operations will necessitate shut down of the job at a cost to the subcontractor.

Before field activities begin, the Dames & Moore subcontractors and the remediation contractor shall provide a Health & Safety plan for its employees covering exposure to hazardous materials and shall complete all work in accordance with that plan. Dames & Moore reserves the right to review the contractor's plan at any time. Dames & Moore will provide a copy of its health and safety plan, but this is not a substitute for an independent plan by the subcontractor. If the subcontractor has not developed a site-specific health and safety plan, Dames & Moore will assist the subcontractor in preparing its own separate, site-specific HSP for implementation by the subcontractor. The subcontractor must agree to comply with at least the minimum requirements of its own site-specific HSP, be responsible for the health and safety of its own employees, and sign the Subcontractor Statement of Compliance for all on-site employees before site work begins. The subcontractor also must agree that it will take any additional measures it deems necessary to meet at least minimum applicable health and safety standards if unforeseen circumstances arise.

The subcontractor will provide at least minimum safety equipment as required by the site-specific HSP. When respirators are necessary, the subcontractor will provide a respirator fit test certificate and a physician's "fit for respirator use" declaration.

Subcontractor
Statement of Compliance

This is to confirm that the employees listed below are qualified by virtue of training and experience to engage in field activities at ______________________ ______________ ______________ in connection with the Contract/Subcontract Agreement between Dames & Moore and ______________, dated ______________, 19____. Further, all said employees have been determined to be properly trained and medically fit to perform those activities prescribed by said contract and to use the respiratory protective equipment necessary to perform the job safely in accordance with 29 CFR 1910 and 1926 and any other Federal, State, or local requirements.

Employee Names

1. ____________________	6. ____________________
2. ____________________	7. ____________________
3. ____________________	8. ____________________
4. ____________________	9. ____________________
5. ____________________	10. ____________________

____
Authorized Subcontractor Representative

____
Printed Name

3.0 SITE CHARACTERIZATION AND ANALYSIS

3.1 General Information

Site Location: The site is located in the SW 1/4 of the NE 1/4 of Section 32, Township 18 North, Range 1 West, City of Tomah, Monroe County, Wisconsin. See Figure 3.1, Site Location Map.

The objectives include: advancement of soil borings, installation of gas probes, installation and sampling of water table observation wells and piezometers, development of wells, determination of hydraulic conductivity by means of slug tests, and sampling of surface water/sediment.

Waste Types: Liquid: X Solid: X Sludge: X Gas: X

Proposed Date of Investigation: April 1994 to July 1994.

Characteristics: Corrosive: Ignitable:X Radioactive:
Volatile:X Toxic:X Reactive: Unknown:

Unusual Site Features: Wet, marshy conditions exist along the Deer Creek, which flows through the northwest corner of the landfill property.

Status:
Background Review: Complete:X Preliminary:
Summary (Overall Hazard): Serious: Moderate: Low:X Unknown:

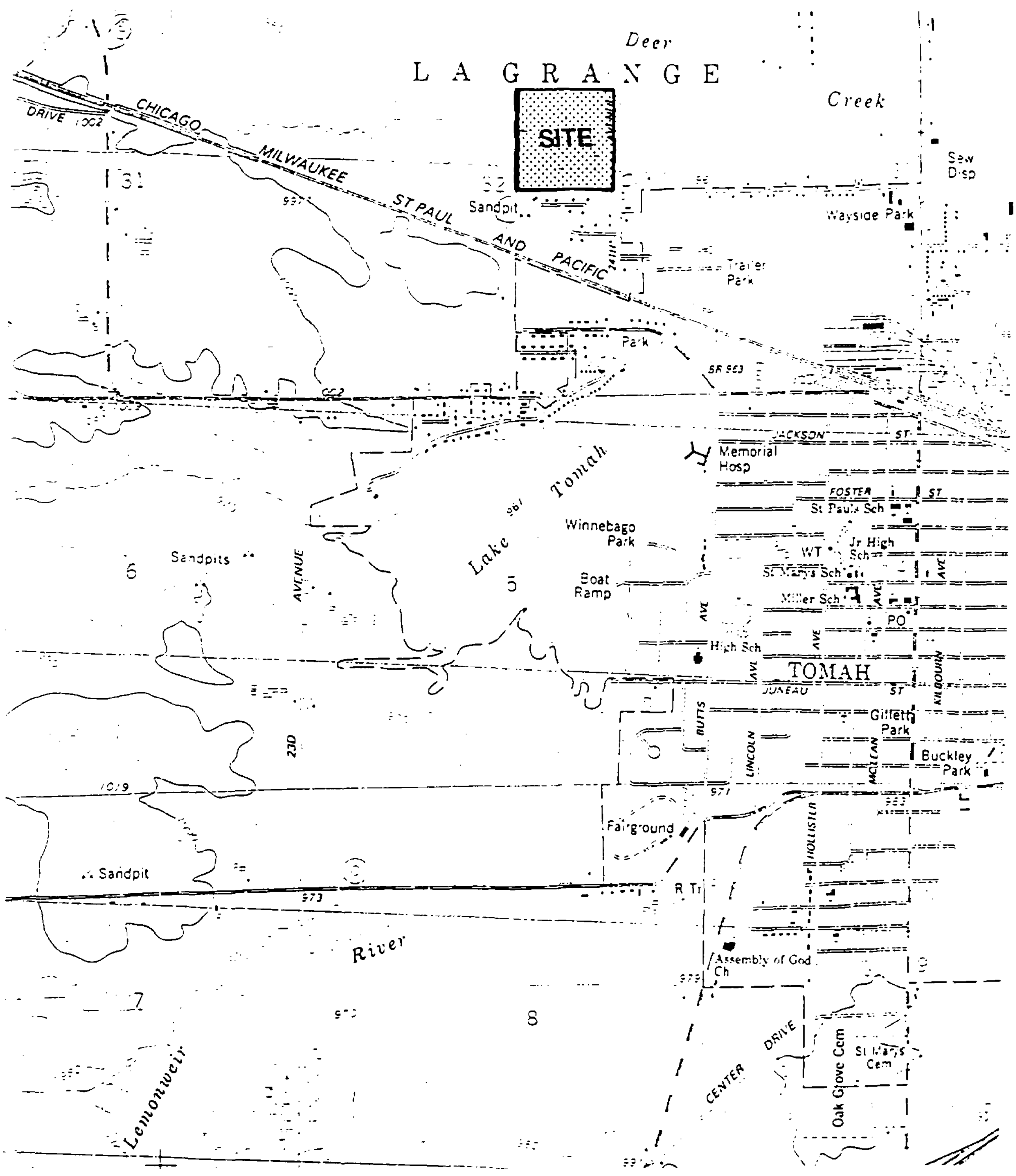
3.2 Site Description

The Tomah Landfill is a solid waste disposal facility located northwest of Tomah, immediately west of 24th Avenue and to the north of the Chicago Milwaukee St.Paul and Pacific railroad tracks. An unknown quantity of residential, commercial, and industrial wastes were disposed in a waste containment area of 17 acres of the 40 acre landfill property. Wastes were placed in shallow trenches excavated in the sandy subsoils over the southern half of the site, and covered with native soils.

Deer Creek passes through the northwest corner of the landfill property. The land to the south and southeast of the landfill is a moderately populated residential area. The land to the north and west of the landfill is open fields, while the land to the east is forested.

3.3 Description of Work and Hazard Evaluation

The work covered by this HSP includes advancement of soil borings, installation of gas probes, installation and sampling of water table observation wells and piezometers, development of wells, determination of hydraulic conductivity by means of slug tests, and sampling of surface water/sediment. This work is proposed to begin April 1994 and be concluded July 1994.



BASE MAP SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, TOMAH AND TUNNEL CITY, WISCONSIN, DATED 1983.

QUADRANGLE LOCATION

NORTH
SCALE: 1"=2000'

TOMAH MUNICIPAL SANITARY LANDFILL
TOMAH, WISCONSIN

FIGURE 3-1
SITE LOCATION MAP

DRN. BY MMS	PROJ. NO. 27504-001
DATE DECEMBER 1993	DAMES & MOORE

FILE: C:\DWG\SUE\TOMAHSITE.DWG

One of the objectives of this RI/FS is to evaluate the chemical characteristics of the wastes in the landfill and its effect on groundwater. The EPA has already performed the investigation for the Hazard Ranking System (HRS). The HRS is a scoring system developed by the EPA to rank sites to determine if a site should be placed on the National Priority List. In the July 1986 evaluation of the HRS, conducted by Ayer Associates, the following substances were identified in the groundwater:

benzene
1,1-dichloroethane
trans-1,2-dichloroethene
trichloroethene
vinyl chloride

It is anticipated that the substances found in the groundwater will be indicative of the substances to be found in the landfill wastes because the water table is located within the waste. Groundwater is believed to be less than ten feet below ground surface.

The exposure limits, recognition qualities, acute and chronic effects, as well as first aid treatment for chemical hazards of concern are presented in Tables 3.1 and 3.2. Continuous air monitoring with the Photo-Ionization Detector (PID) for volatile compounds and the Combustible Gas Indicator (CGI) for methane gas will be performed as indicated in Table 5.1.

The properties of the chemicals indicated in Tables 3.1 and 3.2 were used to determined the level of Personal Protective Equipment (PPE) required. Due to the chemicals of concern anticipated to be found at the landfill site, a minimum of Level D PPE (see Table 6.1) with upgrade to Level C, if necessary, will be required for work on-site when waste is expected to be encountered. Level C PPE will include full-face respirators with organic vapor cartridges and HEPA filters, along with tyvek coveralls. The use of PPE may be reduced in accordance with Table 5.1 once exposure levels have been established. Use of non-sparking tools is recommended. No smoking signs will be posted at the perimeter of the work area.

The physical hazards of concern related to the drilling operations are outlined in Section 10.0 of this document. Heavy machinery will be encountered at various times on-site, and therefore requires that general safety practices be implemented at all times.

3.4 Field Personnel

The project team will consist of the following persons:

Project Manager:	Jeffrey Steiner
Site Safety Coordinator:	Mark McColloch
Field Team Members:	Other Dames & Moore employees, as needed.

3.5 Emergency Information

3.5.1 Emergency Contacts

Contact	Person or Agency	Telephone No.
Security	Tomah Police Dept.	911 608/372-4141
Police	Tomah Police Dept.	911 608/372-4141
Fire	Tomah Fire Dept.	911 608/372-4141
Ambulance	Tomah Fire Dept.	911 608/372-4141
Hospital	Tomah Memorial Hospital	911 608/372-2181
Poison Control	Tomah Memorial Hospital	911 608/372-2181
Client Contact	Ken Patterson City of Tomah, Public Works	608/273-3223
D&M Project Manager	Jeffrey Steiner	608/244-1788 Madison
D&M Office Managing Principal-in-Charge (MPIC)	David P. Trainor	608/244-1788 Madison
Office H&S Manager	Timothy Stratton	608/244-1788 Madison
Regional H&S Manager	Tom Covilli	314/993-4599 St. Louis
Firmwide H&S Director	Dr. Gary Krieger	303/294-9100 Denver

3.5.2 Location of Site Resources

Water Supply: Telephone:	Location of water supply and telephone will be determined by the SSO prior to commencement of site activities, and will be discussed during on-site safety briefing.

3.5.3 Location of Hospital/Clinic

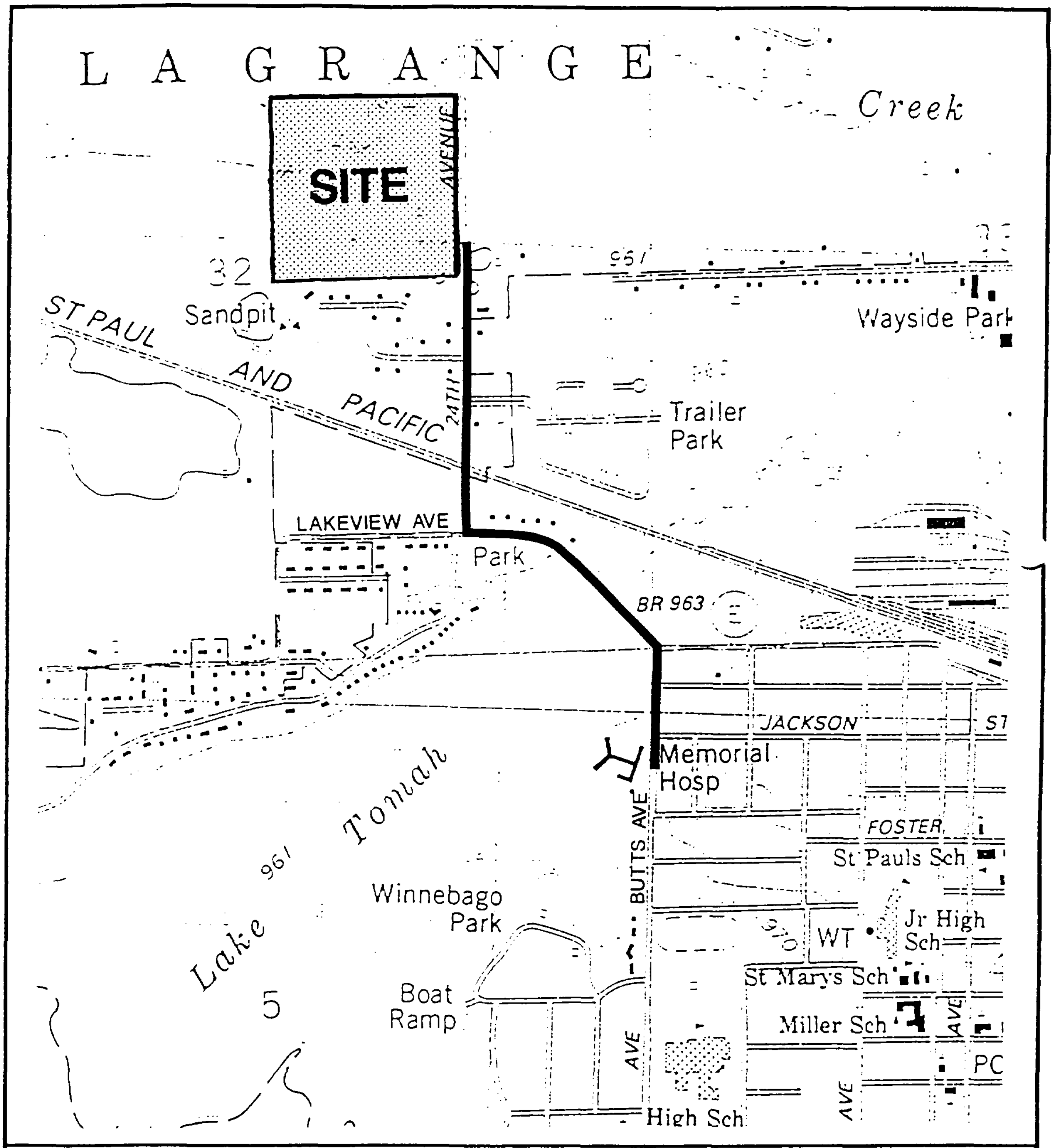
All evacuation will be coordinated through on-site personnel noted in Section 3.5.1. The hospital location is 321 Butts Avenue. To get to the hospital from the landfill, exit the landfill and go south on 24th Avenue. Turn left on Lakeview Drive. (Lakeview Drive turns into Butts Avenue) Go approximately 1 mile. Hospital is on the right.

See Figure 3.2 for Hospital Route Map.

3.6 Chemical and Physical Properties of Hazardous Substances

The exposure limits, recognition qualities, acute and chronic effects, and first aid treatments for hazardous chemicals expected to be found at the site are presented in Tables 3.1 (Exposure Limits and Recognition Qualities) and 3.2 (Health Hazards and First Aid). Site specific compounds are shaded and additional compounds are included for reference if needed. These tables were compiled from the following sources:

- OSHA 29 CFR Part 1910.1000 *et seq.*, "Air Contaminants," U.S. Department of Labor, Washington, DC, July 1, 1990.
- *National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards*, Department of Health and Human Services (DHHS) Publication No. 90-117, June 1990.
- *Threshold Limit Values and Biological Exposure Indices for 1990-91*, American Conference of Governmental Industrial Hygienists (ACGIH).
- Amoore, John E., and Earl Hautala, 1983. "Odor as an Aid to Chemical Safety," *Journal of Applied Toxicology*, Vol. 3, No. 6.



BASE MAP SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE, TOMAH AND TUNNEL CITY, WISCONSIN, DATED 1983.

QUADRANGLE LOCATION

NORTH
SCALE: 1"=2000'

TOMAH MUNICIPAL SANITARY LANDFILL
TOMAH, WISCONSIN

FIGURE 3-2
ROUTE TO HOSPITAL

DRN. BY MMS	PROJ. NO. 27504-001
DATE DECEMBER 1993	DAMES & MOORE

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TABLE 3.1
Exposure Limits and Recognition Qualities

	Exposure Standards				Recognition Qualities		
Compound	TLV/PEL[a] (ppm)	STEL[b] (ppm)	IDLH[c] (ppm)	Skin Designation	Odor/ Threshold (ppm)	LEL[d] (%)	Ionization Potential (ev)
1,2 Dichlorobenzene	--	50[1]	1000	Yes	0.3	2.20	9.06
1,1 Dichloroethane	100.0	--	4000	Yes	Chloroform-like	5.6	11.06
1,2 Dichloroethane	1.0	2	1000	--	88	6.20	11.05
1,2 Dichloroethylene	200.0	--	4000	--	17	5.60	9.65
1,4 Dichlorobenzene	75.0	110	1000	--	0.18	--	8.98
2-4-6 Trinitrotolulene	0.1[2]	--	--	Yes	odorless	--	10.59
Acetone	750.0	1000	20000	--	13	2.50	9.69
Aluminum	2.0[2]	--	--	--	--	--	--
Ammonia	25.0	35	500	--	5.2	15.00	10.18
Ammonium chloride	10.0[2]	20[2]	--	--	--	--	--
Aniline	2.0	--	100	Yes	1.1	1.30	7.70
Antimony	0.5[2]	--	80[2]	--	--	--	--
Asbestos	0.2[3]	1[4]	carcinogenic	--	--	--	--
Barium	0.5[2]	--	1100[2]	--	varies	--	--
Baygon	0.5[2]	--	--	--	--	--	--
Benzene	1.0	--	3000	--	12	1.30	9.24
Cadmium	0.01[2]	--	50[2]	--	--	--	--
Carbaryl (Sevin)	5.0[2]	--	600[2]	--	odorless	--	--
Carbon Tetrachloride	2.0	--	300	Yes	96	--	11.47
Chlordane	0.5[2]	--	500	Yes	chlorine like	--	--
Chlorobenzene	10.0	--	2400	--	0.68	1.30	9.07

	Exposure Standards				Recognition Qualities		
Compound	TLV/PEL[a] (ppm)	STEL[b] (ppm)	IDLH[c] (ppm)	Skin Designation	Odor/ Threshold (ppm)	LEL[d] (%)	Ionization Potential (ev)
Chloroform	2.0	--	1000	--	85	--	11.42
Chromium (III)	0.5[2]	--	--	--	varies	--	--
Chromium (VI)	0.05[2]	--	carcinogenic	--	varies	--	--
Coal tar pitch volatiles	0.2[2]	--	700	--	varies	--	--
Copper	1.0[2]	--	--	--	--	--	--
Cresols	5.0	--	250	Yes	0.00028	1.10	8.93
Cumene	50.0	--	8000	Yes	0.088	0.90	8.75
Cyanides	5.0[2]	--	50[2]	--	faint almond	--	--
DDT	1.0[2]	--	carcinogen	Yes	aromatic	--	--
Diazinon	0.1[2]	--	--	Yes	--	--	--
Dioxin (2,3,7,8 TCDD)	2.0E-07[5]	--	--	Yes	--	--	--
Dursban (Chlorpyrifos)	0.2[2]	--	--	Yes	--	--	--
Endrin	0.1[2]	--	2000	Yes	mild	--	--
Ethanol	1000.0	--	--	--	84	3.30	--
Ethyl benzene	100.0	125	2000	--	2.3	1.00	8.76
Ethyl chloride	1000.0	--	20000	--	ether like	3.80	10.97
Ethyl ether	400.0	500	19000	--	8.9	1.90	9.53
Gasoline	300.0	500	--	--	--	1.40	--
Glacial acetic acid	10.0	15	1000	--	0.48	4.00	10.66
Heptanes	400.0	500	5000	--	150	1.10	9.90
Hexanes	500.0	1000	5000	--	mild gasoline like	1.10	10.18
Hydrochloric acid	5.0[2]	--	100	--	0.77	--	12.74

Table 3.1
Exposure Limits and Recognition Qualities
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	Exposure Standards				Recognition Qualities		
Compound	TLV/PEL[a] (ppm)	STEL[b] (ppm)	IDLH[c] (ppm)	Skin Designation	Odor/ Threshold (ppm)	LEL[d] (%)	Ionization Potential (ev)
Hydrofluoric acid	3.0	6	30	Yes	strong, irritating	--	15.98
Isobutane	800.0	--	--	--	2700	--	--
Lead	0.05[2]	--	700	--	varies	--	--
Malathion	10.0[2]	--	5000[2]	Yes	garlic like	--	--
Manganese compounds	5.0[5]	--	--	--	--	--	--
Mercury	0.05[2]	--	28[2]	Yes	--	--	--
Methane	--	--	--	--	odorless	5.30	--
Methyl Chloride	50.0	100.0	10,000	Yes	faint, sweet	8.1	11.28
Methyl ethyl ketone (MEK)	200.0	300	3000	--	mint or acetone like	1.40	9.54
Methylene chloride	50.0	--	5000	--	chloroform like	14.00	11.32
Mineral spirits	100.0	--	29500	--	kerosene like	0.80	--
N-Hexane	50.0	--	--	--	130	--	--
Naphthalene	10.0	15	500	--	0.084	0.90	8.12
Nickel	0.05[2]	--	carcinogenic	--	varies	--	--
Nitric acid	2.0	--	100	Yes	acrid, suffocating	--	11.95
Nitroaniline	3.0[2]	--	300[2]	Yes	faint ammonia-like	--	8.85
Octane	300.0	375	5000	--	150	1.00	9.90
PCBs	0.5[2]	--	5[2]	Yes	mild hydrocarbon	--	--
Pentachlorophenol	0.5[2]	--	150[2]	Yes	Benzene like	--	--
Pentane	600.0	750	15000	--	1000	1.50	10.35
Perchloroethylene	25.0	200	500	--	27	--	9.32
Phenol	5.0	--	250	Yes	0.040	1.80	8.50

Table 3.1
Exposure Limits and Recognition Qualities
Page 4

	Exposure Standards				Recognition Qualities		
Compound	**TLV/PEL[a] (ppm)**	**STEL[b] (ppm)**	**IDLH[c] (ppm)**	**Skin Designation**	**Odor/ Threshold (ppm)**	**LEL[d] (%)**	**Ionization Potential (ev)**
Phosphorous trichloride	0.2	--	50	--	hydrochloric acid	--	9.91
Selenium	0.2[2]	--	--	--	--	--	--
Silver	0.01[2]	--	--	--	--	--	--
Sodium hydroxide	2.0[5]	--	250[2]	--	odorless	--	--
Styrene	50.0	100	5000	--	0.32	1.10	8.40
Sulfuric acid	1.0[2]	3[2]	80[2]	--	odorless	--	--
Tetrachloroethylene	25.0	200	500	--	27	--	9.32
Tetraethyl lead	0.08[2]	--	40[2]	Yes	musty	--	11.10
Tetramethyl lead	0.08[2]	--	40[2]	Yes	musty	--	9.30
Toluene	100.0	150	2000	--	2.9	1.20	8.82
Trichloroethylene	50.0	200	1000	--	28	8.00	9.45
Trichlorofluoromethane	1000.0	--	10,000	Yes			11.77
Vanadium	0.05[2]	--	70[2]	--	--	--	--
Vinyl chloride	1.0	5[1]	carcinogenic	--	3000	3.60	9.99
Xylenes	100.0	150	1000	--	1.1	1.00	8.56
Zinc oxide	5.0[2]	--	--	--	--	--	--

Notes:

[a] The more stringent of either the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) or the American Conference Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV).

[b] Short Term Exposure Limit - 15 minute exposure.

[c] Immediately Dangerous to Life and Health.

[d] Lower Explosive Limit.

[1] Ceiling.

[2] mg/m3.

[3] f/cc.

[4] 1 f/cc over 30 minutes.

[5] Recommended Exposure Limit (Leung, 1988).

TABLE 3.2
Health Hazards and First Aid

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
1,2 Dichlorobenzene	Ingestion Absorption Contact Inhalation	Yes	Irritated nose, livery & kidney damage, skin blisters	Liver, kidneys, skin, eyes
1,1 Dichloroethane	Inhalation Contact Ingestion		Central nervous system depression, skin irritant, liver & kidney damage	Skin, liver, kidneys
1,2 Dichloroethane	Ingestion Absorption Contact Inhalation	Yes	Central nervous system depressant, nausea, vomiting, dermatitis, corneal opacity, carcinogenic	Kidneys, liver, eyes, skin, central nervous system
1,2 Dichloroethylene	Ingestion Inhalation Contact	Yes	Irritated respiratory system, central nervous system depression	Respiratory system, eyes, central nervous system
1,4 Dichlorobenzene	Ingestion Contact Inhalation	Yes	Headache, profuse rhinitis, anorexia, nausea, vomiting, low weight, jaundice, cirrhosis, carcinogenic	Liver, respiratory system, eyes, kidneys, skin
2-4-6 Trinitrotolulene	Ingestion Absorption Contact Inhalation	Yes	Liver damage, jaundice, cyanosis, sneezing, coughing, sore throat, peripheral neuropathy, muscular pain, kidney damage, cataracts, sensitization dermatitis, cardiac irregularity, anemia	Blood, liver, eyes, cardiovascular system, central nervous system, kidneys, skin
Acetone	Ingestion Contact Inhalation	Yes	Irritated nose & throat, headache, dizziness, dermatitis	Respiratory system, skin
Ammonia	Ingestion Contact Inhalation	Yes	Irritated nose & throat, dyspepsia, bronchial spasms, chest pain, pulmonary edema, skin burns	Respiratory systems, eyes

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Aniline	Ingestion Absorption Contact Inhalation	Yes	Headache, weakness, dizziness, cyanosis, ataxia, dyspnea on effort, tachycardia, carcinogenic	blood, cardiovascular system, liver, kidneys
Antimony	Ingestion Contact Inhalation		Irritated nose, throat & mouth, coughing, dizziness, headache, nausea, vomiting, diarrhea, stomach cramps, insomnia, irritated skin	Respiratory system, cardiovascular system, skin, eyes
Asbestos	Ingestion Inhalation		Dyspepsia, interstitial fibrosis, restricted pulmonary function, finger clubbing, carcinogenic	Lungs
Barium	Ingestion Contact Inhalation	Yes	Upper respiratory irritant, gastroenteritis, muscle spasms, slow pulse, extrasystoles, hypokalemia, irritated skin, skin burns	Heart, central nervous system, skin, respiratory system, eyes
Baygon	Ingestion Contact Inhalation		Skin irritant, poison via ingestion, subcutaneous, intraperitoneal, intravenous and intramuscular routes, moderately toxic by inhalation and skin contact	Central nervous system
Benzene	Ingestion Absorption Contact Inhalation	Yes	Irritated nose & respiratory system, giddiness, headache, nausea, staggering gait, fatigue, anorexia, lassitude, dermatitis, bone marrow depression, carcinogenic	Blood, central nervous system, skin, bone marrow, eyes, respiratory system
Cadmium	Ingestion Inhalation		Pulmonary edema, dyspepsia, coughing, tight chest, headache, chills, muscle ache, nausea, vomiting, diarrhea, mild anemia	Respiratory system, kidneys, prostate, blood
Carbaryl (Sevin)	Ingestion Absorption Contact Inhalation		Miosis, blurred vision, tearing, nasal discharge, salivation, sweating, skin irritant, abdominal cramps, nausea, vomiting, diarrhea, tremors, cyanosis, convulsions	Respiratory system, central nervous system, cardiovascular system, skin

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Carbon tetrachloride	Ingestion Absorption Contact Inhalation		Central nervous system depression, nausea, vomiting, liver & kidney damage, skin irritation, carcinogenic	Central nervous system, eyes, lungs, liver, kidneys, skin
Chlordane	Ingestion Absorption Contact Inhalation		Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, tremors, convulsions, lung, liver & kidney damage	Central nervous system, eyes, lungs, liver, kidneys, skin
Chlorobenzene	Ingestion Contact Inhalation	Yes	Irritated skin & nose, drowsiness, incoherence	Respiratory system, eyes, skin, central nervous system, liver
Chloroform	Ingestion Contact Inhalation	Yes	Dizziness, mental dullness, nausea, disorientation, headache, fatigue, hepatomegaly, irritated skin, carcinogenic	Liver, kidneys, heart, eyes, skin
Chromium (III)	Contact Inhalation		Dermatitis	Skin
Chromium (VI)	Ingestion Inhalation		Histologic fibrosis of the lungs	Respiratory system
Coal tar pitch volatiles	Ingestion Inhalation		Dermatitis, bronchitis, carcinogenic	Respiratory system, bladder, kidneys, skin
Copper	Ingestion Contact Inhalation	Yes	Irritated nasal mucous membranes & pharynx, nasal perforation, metallic taste, dermatitis	Respiratory system, skin, liver, kidneys
Cresols	Ingestion Absorption Contact Inhalation	Yes	Central nervous system effects, confusion, depression, respiratory failure, dyspepsia, irregular rapid respiration, weak pulse, skin & eye burns, dermatitis	Central nervous system, respiratory system, liver, kidneys, skin, eyes

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Cumene	Ingestion Absorption Contact Inhalation	Yes	Irritated mucous membranes, headache, dermatitis, coma	Eyes, upper respiratory system, skin, central nervous system
Cyanides	Ingestion Absorption Contact Inhalation	Yes	Asphyxia & death can occur, weakness, headache, confusion, nausea, vomiting, slow gasping respiration, skin irritation	Cardiovascular system, central nervous system, liver, kidneys, skin
DDT	Ingestion Absorption Contact Inhalation	Yes	Tremors, dizziness, confusion, headache, fatigue, convulsions, vomiting, irritated skin, carcinogenic	Central nervous system, kidneys, liver, skin, peripheral nervous system
Diazinon	Ingestion Absorption Contact Inhalation		Headache, nervousness, blurred vision, weakness, nausea, cramps, diarrhea, vomiting, chest discomfort, sweating, miosis, tearing, salivation, cyanosis, convulsions	Central nervous system
Dioxin (2,3,7,8 TCDD)	Ingestion Absorption Contact	Yes	Chemical burns of the skin, mucous membranes and eyes, nausea, vomiting, severe muscle pains, chloracne, polyneuropathy, liver damage, conjunctivitis, dyspnea	Cardiovascular system, central nervous system, liver, skin
Dursban (Chlorpyrifos)	Ingestion Absorption Contact Inhalation		Excessive sweating, headache, weakness, giddiness, nausea, vomiting, stomach pains, blurred vision, slurred speech, muscle twitching, convulsions, coma	Central nervous system
Endrin	Ingestion Absorption Contact Inhalation		Convulsions, stupor, headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, confusion, lethargy, weakness, anorexia	Central nervous system, liver

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Ethanol	Ingestion Contact Inhalation	Yes	Nose & throat irritant, distorted perceptions, convulsions, motor activity changes, ataxia, coma, headache, pulmonary changes, nausea, vomiting	Liver
Ethyl benzene	Ingestion Contact Inhalation	Yes	Irritated mucous membranes, headache, dermatitis, narcosis, coma	Eyes, upper respiratory system, skin, central nervous system
Ethyl chloride	Ingestion Absorption Contact Inhalation		Incoherence, inebriation, abdominal cramps, cardiac arrhythmia, cardiac arrest, liver & kidney damage	Liver, kidneys, respiratory system, cardiovascular system
Ethyl ether	Ingestion Contact Inhalation	Yes	Dizziness, drowsiness, headache, excitability, narcosis, nausea, vomiting	Central nervous system, skin, respiratory system, eyes
Glacial acetic acid	Inhalation	Yes	Conjunctivitis, irritated nose & throat, edema, chronic bronchitis, eye & skin burns, dental erosion, black skin, hyperkeratosis	Respiratory system, skin, eyes, teeth
Heptane	Ingestion Contact Inhalation		Lightheadedness, giddiness, stupor, no appetite, nausea, dermatitis, chemical pneumonia, unconsciousness	Skin, respiratory system, peripheral nervous system
Hexanes	Ingestion Contact Inhalation	Yes	Lightheadedness, nausea, headache, numbness, muscle weakness, irritated nose, dermatitis, chemical pneumonia, giddiness	Skin, eyes, respiratory system, lungs
Hydrochloric acid	Ingestion Contact Inhalation	Yes	Nasal & throat inflammation, coughing, choking, burning eyes & skin, dermatitis	Respiratory system, skin, eyes
Hydrofluoric acid	Ingestion Absorption Contact Inhalation	Yes	Irritated eyes, nose & throat, pulmonary edema, skin & eye burns, nasal congestion, bronchitis	Eyes, respiratory system, skin

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Lead	Ingestion Contact Inhalation	Yes	Weakness, lassitude, insomnia, facial pallor, anorexia, low weight, malnutrition, constipation, abdominal pain, colic, anemia, tremors, encephalopathy, hypotension	Gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue
Malathion	Ingestion Absorption Contact Inhalation	Yes	Miosis, aching eyes, blurred vision, lacrimation, skin irritation, salivation, nausea, anorexia, vomiting, rhinitis, abdominal cramps, diarrhea, giddiness, confusion, ataxia	Respiratory system, liver, blood cholinesterase, central nervous system, cardiovascular system, gastrointestinal tract
Manganese compounds	Ingestion Inhalation		Parkinson's, asthenia, insomnia, mental confusion, metal fume fever, dry throat, coughing, tight chest, dyspepsia, rales, flu-like fever, back pain, vomiting	Respiratory system, central nervous system, blood, kidneys
Mercury	Ingestion Absorption Contact Inhalation		Coughing, chest pain, dyspepsia, bronchitis, pneumonitis, tremors, insomnia, headache, fatigue, weakness, gastrointestinal disturbance, irritated skin	Skin, respiratory system, central nervous system, kidneys, eyes
Methane	Inhalation		Rapid respiration, diminished mental alertness, impaired muscular coordination, faulty judgement, sensory depression, fatigue, nausea, vomiting	Simple asphyxiant
Methyl ethyl ketone (MEK)	Ingestion Contact Inhalation	Yes	Irritated nose, headache, dizziness, vomiting	Central nervous system, lungs
Methyl chloride	Inhalation Contact	Yes	Dizziness, nausea, vomiting, visual disturbance, staggering gait, slurred speech, convulsions, coma, liver & kidney damage, frostbite, carcinogenic	Central nervous system, liver, kidneys, skin

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Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Methylene chloride	Ingestion Contact Inhalation	Yes	Fatigue, weakness, sleepiness, lightheadedness, numb limbs, tingling, nausea, irritated skin, carcinogenic	Skin, cardiovascular system, eyes, central nervous system
Mineral spirits	Ingestion Contact Inhalation	Yes	Irritated nose & throat, dizziness, dermatitis	Skin, eyes, respiratory system, central nervous system
N-Hexane	Ingestion Inhalation	Yes	Lightheadedness, nausea, numb extremities, muscular weakness, eye & nose irritation, dermatitis, chemical pneumonia, giddiness	Skin, eyes, respiratory system
Naphthalene	Ingestion Absorption Contact Inhalation	Yes	Headache, confusion, excitement, malnutrition, nausea, vomiting, abdominal pain, irritated bladder, profuse sweating, jaundice, renal shutdown, dermatitis	Eyes, blood, liver, kidneys, skin, red blood cells, central nervous system
Nickel	Ingestion Contact Inhalation		Headache, vertigo, nausea, vomiting, epigastric pain, substernal pain, coughing, hyperpnea, cyanosis, weakness, pneuitis, delirium, convulsions, carcinogenic	Lungs, paranasal sinus, central nervous system
Nitric acid	Ingestion Contact Inhalation	Yes	Irritated eyes, mucous membranes, skin, delayed pulmonary edema, pneuitis, bronchitis, dental erosion	Eyes, respiratory system, skin, teeth
Nitroaniline	Ingestion Absorption Contact Inhalation		Cyanosis, ataxia, tachycardia, tachypnea, dyspnea, irritability, vomiting, diarrhea, convulsions, respiratory arrest, anemia, methemoglobinemia	Blood, heart, lungs, liver
Octane	Ingestion Contact Inhalation	Yes	Irritated nose, drowsiness, dermatitis, chemical pneumonia	Skin, eyes, respiratory system

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
PCBs	Ingestion Absorption Contact Inhalation	Yes	Irritated skin, dermatitis, carcinogenic	Skin, eyes, liver
Pentachlorophenol	Ingestion Absorption Contact Inhalation	Yes	Irritated nose & throat, sneezing, coughing, weakness, anorexia, low weight, sweating, headache, dizziness, nausea, vomiting, dyspepsia, chest pain, fever, dermatitis	Cardiovascular system, respiratory system, eyes, liver, kidneys, skin, central nervous system
Pentane	Ingestion Contact Inhalation	Yes	Drowsiness, irritated nose, chemical pneumonia	Skin, eyes, respiratory system
Perchloroethylene	Ingestion Contact Inhalation	Yes	Irritated nose & throat, nausea, flush face & neck, vertigo, dizziness, incoherence, headache, somnolence, erythema, liver damage, carcinogenic	Liver, kidneys, eyes, upper respiratory system, central nervous system
Phenol	Ingestion Absorption Contact Inhalation	Yes	Irritated nose & throat, anorexia, low weight, weakness, muscle ache & pain, dark urine, cyanosis, liver & kidney damage, skin burns, dermatitis	Liver, kidneys, skin
Phosphorous trichloride	Ingestion Contact Inhalation	Yes	Irritated nose & throat, pulmonary edema, burning eyes & skin	Respiratory system, eyes, skin
Selenium	Ingestion Absorption Contact Inhalation	Yes	Irritated nose & throat, visual disturbance, headache, chills, fever, dyspepsia, bronchitis, metallic taste, gastrointestinal disturbance, dermatitis, skin & eye burns	Upper respiratory system, eyes, skin, liver, kidneys, blood
Silver	Ingestion Contact Inhalation		Blue-gray eyes, nasal septum, throat, & skin; irritated skin, ulceration, gastrointestinal disturbance	Nasal septum, skin, eyes

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Sodium hydroxide	Ingestion Contact Inhalation	Yes	Irritated nose, pneuitis, eye & skin burns, temporary loss of hair	Eyes, respiratory system, skin
Styrene	Ingestion Contact Inhalation	Yes	Irritated nose, drowsiness, weakness, unsteady gait, narcosis, dermatitis	Central nervous system, respiratory system, eyes, skin
Sulfuric acid	Ingestion Contact Inhalation	Yes	Nose & throat irritation, pulmonary edema, bronchial emphysema, conjunctivitis, stomatitis, dental erosion, skin & eye burns, dermatitis	Respiratory system, eyes, skin, teeth
Tetrachloroethylene	Ingestion Contact Inhalation	Yes	Irritated nose & throat, nausea, flush face & neck, vertigo, dizziness, incoherence, headache, somnolence, erythema, liver damage, carcinogenic	Liver, kidneys, eyes, upper respiratory system, central nervous system
Tetraethyl lead	Ingestion Absorption Contact Inhalation	Yes	Insomnia, lassitude, anxiety, tremors, hyperreflexia, hypotension, pallor, nausea, convulsions, coma, low weight, disorientation, psychosis	Central nervous system, cardiovascular system, kidneys, eyes
Tetramethyl lead	Ingestion Absorption Contact Inhalation		Insomnia, restlessness, anxiety, hypotension, nausea, delirium, convulsions, coma	Central nervous system, cardiovascular system, kidneys
Toluene	Ingestion Absorption Contact Inhalation		Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, muscle fatigue, insomnia, dermatitis	Central nervous system, liver, kidneys, skin
Trichloroethylene	Ingestion Contact Inhalation	Yes	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, carcinogenic	Respiratory system, heart, liver, kidneys, central nervous system, skin
Trichlorofluoromethane	Ingestion Contact Inhalation		Incoordination, tremors, dermatitis, frostbite, cardiac arrhythmias, cardiac arrest	Cardiovascular system, skin

Compound	Routes of Entry	Eye Irritation	Symptoms	Target Organs
Vanadium	Ingestion Contact Inhalation	Yes	Green tongue, metallic taste, eczema, coughing, rales, wheezing, bronchitis, dyspepsia, irritated throat	Respiratory system, skin, eyes
Vinyl chloride	Inhalation		Weakness, abdominal pain, gastrointestinal bleeding, hepatomegaly, pallor or cyanosis of extremities, carcinogenic	Liver, central nervous system, blood, respiratory system, lymphatic system
Xylenes	Ingestion Absorption Contact Inhalation	Yes	Dizziness, excitement, drowsiness, incoherence, staggering gait, irritated nose & throat, anorexia, nausea, vomiting, abdominal pain, dermatitis	Central nervous system, eyes, gastrointestinal tract, blood, liver, kidneys, skin
Zinc oxide	Inhalation		Sweet, metallic taste, dry throat, cough, chills, fever, tight chest, dyspepsia, rales, reduced pulmonary function, headache, blurred vision, muscular cramps, low back pain, vomiting, fatigue	Respiratory system

General First Aid Treatment:

Eye:	IRRIGATE IMMEDIATELY
Skin:	SOAP WASH PROMPTLY
Inhalation:	MOVE TO FRESH AIR
Ingestion:	GET MEDICAL ATTENTION

4.0 SITE CONTROL

4.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. Site control is especially important in emergency situations. Several site control procedures will be implemented to reduce worker and public exposure to chemical, physical, biological, and safety hazards.

4.2 Site Work Zones

To prevent the accidental spread of hazardous substances from a contaminated area to a clean area, zones will be delineated on the site where various operations will occur. The site will be divided into a minimum of three zones, as follows:

- The Exclusion Zone--The area where contamination is either known or likely to be present or, because of activity, will potentially harm personnel. Entry into the Exclusion Zone requires the use of PPE.

- The Contamination Reduction Zone--The area where personnel and equipment are decontaminated. It is essentially a buffer zone between contaminated areas and clean areas. Activities to be conducted in this zone will require personal protection as defined in Section 6.0.

- The Support Zone--The area situated in clean areas where the chance to encounter hazardous materials or conditions is minimal; therefore, PPE is not required.

4.3 Standard Safe Work Practices

4.3.1 General

The following general safe work practices apply:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in contaminated or potentially contaminated areas, or where there is a possibility for the transfer of contamination.

- Contact with potentially contaminated substances should be avoided. Puddles, pools, mud, etc., should not be walked through. Kneeling, leaning, or sitting on equipment or the ground should be avoided, whenever possible. Monitoring equipment should not be placed on a potentially contaminated surface, such as the ground.

- Spillage should be prevented, to the extent possible. In the event that spillage occurs, the liquid should be contained, if possible.

- Splashing of contaminated materials should be prevented.

- Field crew members should use all their senses to alert themselves to potentially dangerous situations (i.e., presence of strong, irritating, or nauseating odors).

- Field crew members should be familiar with the physical characteristics of investigations, including:

    - Wind direction in relation to the ground zero area
    - Accessibility to associates, equipment, and vehicles
    - Communications
    - Hot zones (areas of known or suspected contamination)
    - Site access
    - Nearest water sources
    - Routes and procedures to be used during emergencies.

- A minimum number of personnel and equipment should be in the contaminated area, but only to the extent consistent with workforce requirements of safe site operations.

- All wastes generated during Dames & Moore or subcontractor activities at the site must be disposed of as directed by the Project Manager.

- No one wearing contact lenses or having a beard will be permitted in the work area if Level C or higher protection is required.

4.3.2 Buddy System

Workers will conduct all site activities with a buddy who is able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the site supervisor if emergency help is needed.
- Prearrange hand signals or other emergency communication signals such as:
    - Hand gripping throat: out of air, can't breathe.
    - Gripping partner's wrist or placing both hands around waist: leave area immediately, no debate.
    - Hands on top of head: need assistance.
    - Thumbs up: okay, I'm alright, I understand.
    - Thumbs down: no, negative.

5.0 MONITORING

5.1 General

Monitoring will be performed for the hazards presented in Table 3-1 to ensure proper selection of engineering controls, work practices, and PPE so that employees are not exposed to levels that exceed permissible exposure limits or published exposure levels for hazardous substances. Air monitoring will be performed to identify Immediately Dangerous to Life and Health (IDLH) conditions, exposure over permissible exposure limits or published exposure levels, or other dangerous conditions such as the presence of flammable atmospheres or oxygen-deficient environments. Periodic monitoring will be conducted in the event of an IDLH condition or flammable atmosphere or when there is an indication that exposure levels may have risen, such as:

- When work begins on a different portion of the site.
- When contaminants other than those previously identified are being handled.
- When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).
- When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., spill or lagoon).

5.2 Monitoring Requirements

Equipment necessary for site monitoring consists of an oxygen (0_2) meter, a photoionization detector (PID), and a combustible gas indicator (CGI). The types of monitoring instruments specified by the hazard, as well as the action levels to upgrade personal protection, are shown Table 5-1. All ambient measurements taken to evaluate employee exposures must be taken in the individual's breathing zone and must be fairly constant for at least 30 seconds.

5.2.1 Instrument Calibration

All applicable instruments will be calibrated daily and after use. Readings will be recorded on the Daily Instrument Calibration Checksheet provided in Section 13.0.

Table 5.1
Hazard Monitoring Methods, Action Levels, and Protective Measures

HAZARD	MONITORING METHOD	ACTION LEVEL	MONITORING SCHEDULE	PROTECTIVE MEASURES
Organic Vapors	PID (10.6 eV)	Up to 3 ppm above background in the breathing zone	Periodically (every 30 minutes) during invasive field activities.	Level D
		3-10 ppm	Periodically (every 30 minutes) during invasive field activities.	Level C
		>10 ppm	Periodically (every 30 minutes) during invasive field activities.	Level B or EVACUATE AREA
Oxygen deficient atmosphere	O_2 meter	20.8%	Continue operations.	
		<20.8%	Continuous monitoring.	
		19.5%	Do not enter. Ventilate and determine if air supply is required. Consider that any low CGI readings are suspect or false.	
		>25%	Fire explosion hazard. Withdraw from area immediately.	
Explosion	CGI	<5% LEL	Continue investigation.	
		5-10% LEL	Continue monitoring with caution as high levels are encountered.	
		>10% LEL	Explosion hazard. Withdraw from area immediately.	
Toxic dust	Visual determination	No dust visible above background in the breathing zone.	Periodically (every 30 minutes) during invasive field activities.	Level D
		Dust visible to extent where SSO/team member feels protection necessary.	Periodically (every 30 minutes) during invasive field activities.	Level C Implement dust suppression

5.2.1.1 Photovac PID

Photovac must be calibrated in order to display concentration in units equivalent to ppm. First, a supply of zero air, which contains no ionizable gases or vapors, is used to set Micro-TIP's zero point. Then, span gas, containing a known concentration of a photoionizable gas or vapor, is used to set the sensitivity.

Usually clean ambient air will be suitable as zero air. If there is any doubt, use a commercial source of zero grade air and a second sampling bag. Isobutylene at 100 ppm in air is recommended as span gas. See Operation Manual for specific calibration instructions.

5.2.1.2 MSA Explosimeter Model 2A Calibration.

Before the calibration can be checked, the instrument and its aspirator sampling bulb must be in operating condition, as described in the instrument instruction manual.

- The flow control should be attached to the calibration gas tank.
- The hose should be connected to the flow control and to the instrument inlet fitting.
- The control valve should be opened.
- The meter reading should be recorded after it stabilizes. Note: It is not necessary for the aspirator bulb to be operated for the calibration sample to be obtained. If the instrument does not read within the acceptable range, the detector filament unit should be replaced and the calibration check procedure should be repeated.
- The flow control valve should be closed.
- The hose should be removed from the flow control and from the inlet fitting on the instrument.
- The flow control should be removed from the calibration gas tank.

5.2.1.3 Industrial Scientific Oxygen Meter Calibration

Switch to the OX mode and note the display reading, which should be 20.9% in normal room air. Slowly turn the S OX (OX calibration) adjustment counterclockwise until the low oxygen alarm setting is reached. Slowly turn the adjustment back and forth through the alarm point to verify the setting. After the low alarm setting is located, slowly turn the adjustment in the clockwise direction until the high oxygen alarm setting is found. Slowly turn the adjustment back and forth through the alarm point to verify the setting. Return the display to the original setting. The oxygen alarms are factory set at 19.5% for the low alarm and 23.0% for the high alarm.

5.2.2 Background Readings

Before any field activities commence, the background levels of the site must be read and noted. Daily background readings must be conducted away from areas of potential contamination to obtain accurate results.

5.2.3 Air Monitoring Frequency

All site readings must be noted on the Air Monitoring Record provided in Section 12.0, along with the date, time, background level, weather conditions, wind direction and speed, and the location where the background level was recorded.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General

PPE that will protect employees from the hazards and potential hazards likely to be encountered during site investigations will be selected and used. PPE selection will be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site. The level of protection provided will be increased when site conditions deem it necessary to reduce employee exposures to below permissible exposure limits and published exposure levels for hazardous substances.

6.2 Levels of Protection

All field activities will be initiated at Level D. If the action levels specified in Table 5-1 are reached, an upgrade will be made to Level C, as described in Table 6-1.

6.3 Respiratory Protection

If air purifying respirators are required, full facepiece respirators, with combination organic vapor and high efficiency dust and mist cartridges, will be used. Respirators belong to, and are only used and maintained by, the individual to whom they have been issued. Each Dames & Moore and subcontractor employee who anticipates working on-site must be trained, fit tested, and declared medically fit to wear respiratory equipment prior to participating in field activities.

6.4 Personal Protective Equipment Program

Details of Dames & Moore's PPE Program are described in the firmwide Health and Safety Manual, Procedure Nos.: HS 150 - 150.12 and HS 170 - 170.9.

Table 6-1
Protective Equipment for On-Site Activities

ACTIVITY	LEVEL	PROTECTIVE EQUIPMENT
Soil/Groundwater Well Monitoring, Soil Gas Survey, Drilling Operations	D	• Safety glasses
		• Hard hat with optional face shield
		• Work pants or heavy duty coveralls
		• Chemical-resistant (nitrile or butyl rubber) gloves • Latex inner gloves
		• Safety boots - chemical-resistant - steel toes and shanks
Soil/Groundwater Monitoring, Drilling Operations, Landfill Gas Monitoring, Sediment Sampling	C	Same as above plus: • Full-face respirator with organic vapor cartridge(s)/high efficiency dust and mist filters
		• Tyvek coveralls
		• Chemical-resistant (nitrile or butyl rubber) outer gloves
		• Chemical-resistant (nitrile or butyl rubber) outer boots

Note: Hearing protection will be required during drilling operations.

7.0 DECONTAMINATION

7.1 Standard Procedures

1. A decontamination area should be located between the Hot Line (upwind boundary of the Exclusion Zone) and the Support Zone boundary.

2. A personnel decontamination station (PDS) should be established.

3. All personnel should proceed through the appropriate contamination reduction sequence upon leaving the contamination area.

4. All protective gear should be left on-site during any lunch break following decontamination procedures.

5. Material Safety Data Sheets for chemicals used during decontamination procedures should be made available to those who are potentially exposed to these chemicals. These are attached to this health and safety plan. Also, see Section 12.0 "Hazard Communication" of this plan.

7.2 Decontamination of Equipment

To the extent possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices may become contaminated; however, monitoring instruments, unless they are splashed, usually do not become contaminated. Once contaminated, it is difficult to clean instruments without damaging them. Any delicate instrument that cannot be decontaminated easily should have a bag taped and secured around it. Openings should be made in the bag for sample intake.

7.2.1 Sampling Devices

Sampling devices require special cleaning. Decontamination of all sampling equipment should be performed in accordance with approved quality assurance plans.

7.2.2 Tools

Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on-site and handled only by protected workers. After use in a contaminated area, wooden tools should be discarded. For decontaminating other tools, refer to quality assurance plans or consult a laboratory.

7.2.3 Respirators

Certain parts of contaminated respirators, such as the harness assembly and cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

7.2.4 Heavy Equipment

Bulldozers, trucks, backhoes, bulking chambers, and other heavy equipment are difficult to decontaminate. Generally, they are washed with water under high pressure and/or accessible parts are scrubbed with detergent/water solution under pressure, if possible. In some cases, shovels, scoops, and lifts have been sand blasted or steamed. Particular care must be given to those components in direct contact with contaminants, such as tires and scoops.

7.2.5 Sanitizing of Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also must be sanitized. The inside of masks and clothing becomes soiled because of exhalation, body oils, and perspiration. The manufacturer's instructions should be followed to sanitize the respirator mask. If practical, protective clothing should be machine washed after a thorough decontamination; otherwise, it must be cleaned by hand.

7.2.6 Persistent Contamination

In some instances, clothing and equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A strong detergent (industrial grade) may be used to remove such contamination from equipment if it does not destroy or degrade the protective material. If persistent contamination is expected, disposable garments should be used.

Testing for persistent contamination of protective clothing and appropriate decontamination must be done by qualified laboratory personnel.

7.2.7 Disposal of Contaminated Materials

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be secured in drums or other containers and labeled. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the site.

Contaminated wash and rinse solutions should be contained by using step-in-containers (e.g., child's wading pool) to hold spent solutions. Another containment method is to dig a trench about 4 inches deep and line it with plastic. In both cases, the spent solutions should be transferred to drums, which should be labeled and disposed of with other substances on-site.

7.3 Minimal Decontamination

Less extensive procedures for decontamination can be subsequently established when disposable clothing and equipment are used, the type and degree of contamination become known, or the potential for transfer is judged to be minimal by the Site Safety Coordinator (SSC) in consultation with the Project Manager.

7.4 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during the operation should be double bagged, labeled, and either contained on-site or removed to a client-approved disposal facility. Grossly contaminated protective clothing should be disposed of on-site with the permission of the property owner. Cloth items should be bagged and removed from the site for final cleaning. All wash tubs, pails, containers, etc., should be thoroughly washed, rinsed, and dried prior to removal from the site.

7.5 Level C Decontamination

The maximum decontamination layout for Level C is shown conceptually in Figure 7-1, and sketched in Figure 7-2. A description is given below.

Maximum Measures for Level C Decontamination

Station 1:	Segregated Equipment Drop	1. Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in plastic-lined containers. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up within this area.
Station 2:	Boot Cover and Glove Wash	2. Scrub outer boot covers and gloves with decon solution or detergent and water.
Station 3:	Boot Cover and Glove Rinse	3. Rinse off decon solution from Station 2 using as much water as necessary.
Station 4:	Tape Removal	4. Remove tape around boots and gloves and deposit it in the plastic-lined container.
Station 5:	Boot Cover Removal	5. Remove boot covers and deposit them in the plastic-lined container.
Station 6:	Outer Glove Removal	6. Remove outer gloves and deposit them in the plastic-lined container.
Station 7:	Suit and Boot Wash	7. Wash splash suit, gloves, and safety boots. Scrub with long-handled scrub brush and decon solution.
Station 8:	Suit, Boot, and Glove Rinse	8. Rinse off decontamination solution using water. Repeat as many times as necessary.
Station 9:	Cartridge or Mask Change	9. If worker leaves the Exclusion Zone to change cartridges (or mask), this will be the last step in the decon procedure. After worker's cartridges are exchanged, new outer gloves and boot covers donned, and joints taped, worker returns to duty.

Station 10:	Safety Boot Removal	10. Remove safety boots and deposit them in the plastic-lined container.
Station 11.	Splash Suit Removal	11. With assistance from the helper, remove splash suit. Deposit it in the plastic-lined container.
Station 12:	Inner Glove Wash	12. Wash inner gloves with decon solution.
Station 13:	Inner Glove Rinse	13. Rinse inner gloves with water.
Station 14:	Facepiece Removal	14. Remove facepiece and deposit it in the plastic-lined container. Avoid touching face with fingers.
Station 15:	Inner Glove Removal	15. Remove inner gloves and deposit them in the plastic-lined container.
Station 16:	Inner Clothing Removal	16. Remove clothing soaked with perspiration and place it in the plastic- lined container. Do not wear inner clothing off-site because there is a possibility that small amounts of contaminants might have been transferred in removing the fully encapsulating suit.
Station 17:	Field Wash	17. Shower if highly toxic, skin corrosive, or skin absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.
Station 18:	Redress	18. Put on clean clothes.

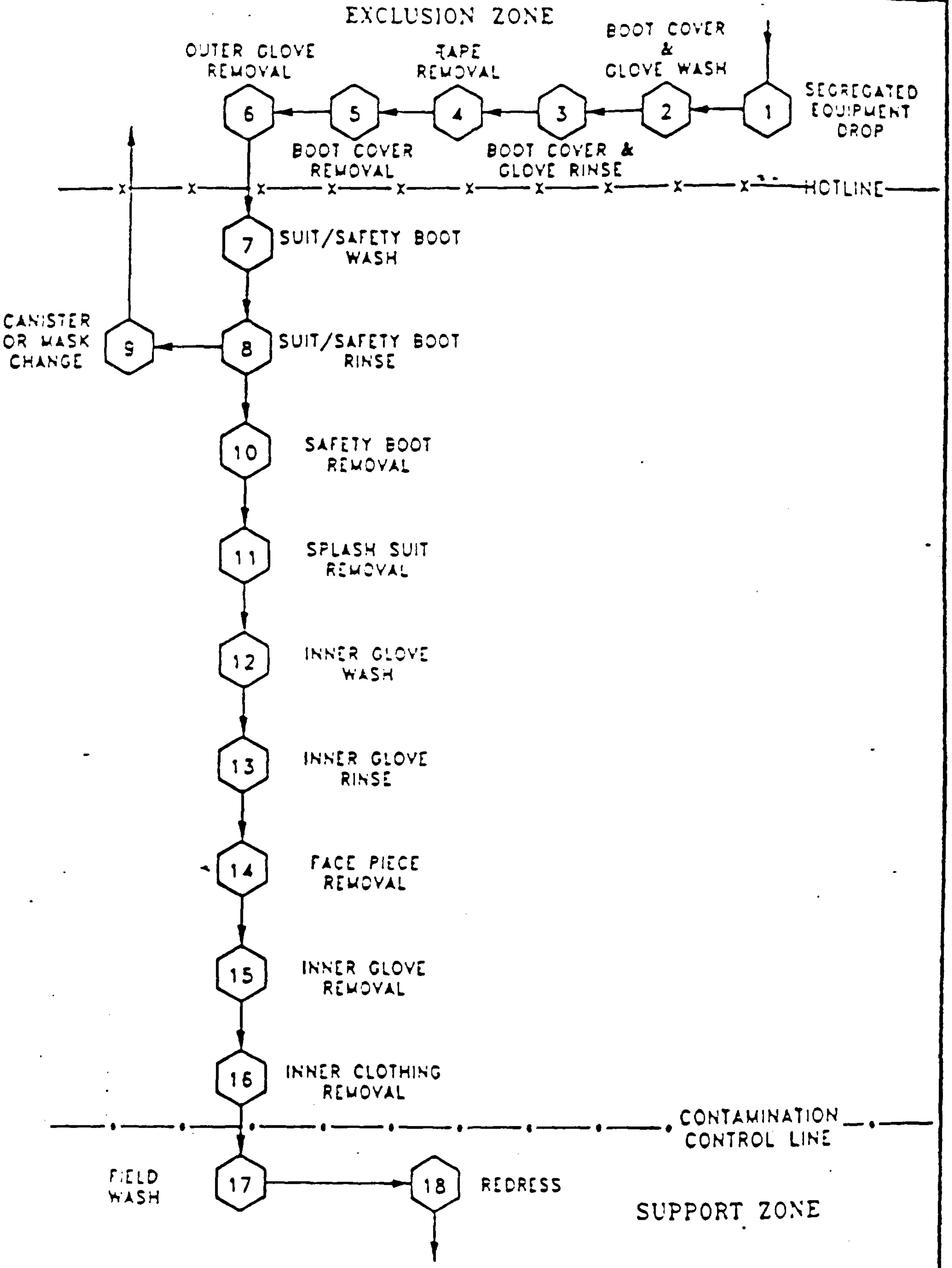

FIGURE 7-1
MAXIMUM DECONTAMINATION LAYOUT
FOR LEVEL C PROTECTION

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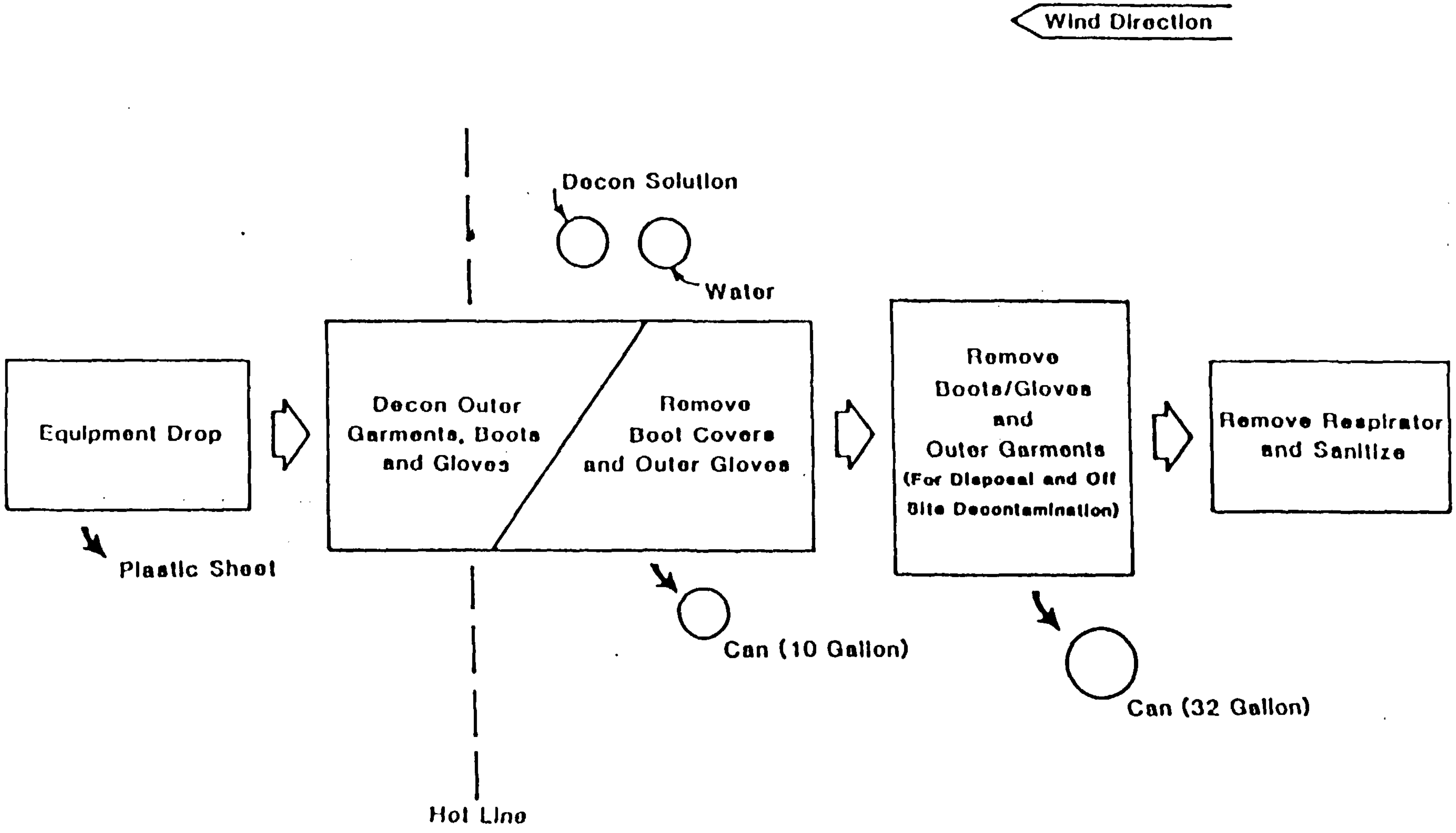

FIGURE 7-2

Layout of
Personnel Decontamination Station

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8.0 EMPLOYEE TRAINING ASSIGNMENTS

8.1 General

All employees working on-site who are exposed to hazardous substances, health hazards, or safety hazards; their supervisors; and the management responsible for the site must receive training before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances or safety or health hazards. Employees will not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

8.2 Initial Training

General site workers engaged in hazardous substance removal or other activities that may expose workers to hazardous substances and health hazards will receive a minimum of 40 hours of off-site instruction, and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor.

8.3 Management and Supervisor Training

On site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations will receive 40 hours of initial training, 3 days of supervised field experience, and at least 8 additional hours of specialized supervisory training.

8.4 Refresher Training

Employees, managers, and supervisors will receive 8 hours of refresher training annually.

8.5 Additional Training Requirements

Dames & Moore requires employees engaged in field activities be certified in both first aid and cardiopulmonary resuscitation. Details of Dames & Moore's Health and Safety Training Program are described in the firmwide Health and Safety Manual, Procedure No.: HS 110-110.4.

The U.S. Department of Transportation (DOT) requires that employees who directly affect the safety of hazardous material transportation receive General Awareness/Familiarization, Function-Specific, Safety, and (where applicable) Driver training. Those who ship any DOT hazardous materials, such as calibration or decontamination chemicals or preservatives or samples that are DOT hazardous, must have this training.

9.0 MEDICAL SURVEILLANCE

9.1 General

The following employees who participate in field activities involving hazardous waste will be included in the Dames & Moore Medical Surveillance Program:

- All employees who may be exposed to hazardous substances or health hazards at or above the permissible exposure limits, without regard to the use of respirators, for 30 days or more per year.
- All employees who wear a respirator as required by CFR 1910.134.
- All employees who are injured because of overexposure from an incident involving hazardous substances or health hazards.

9.2 Frequency of Medical Exams

Medical examinations and consultations will be made available to the employees discussed above on the following schedules:

- Prior to assignment.
- At least once every 12 months, unless the physician believes a longer interval (not greater than biennially) is appropriate.
- As soon as possible upon notification that the employee has developed signs or symptoms indicating possible overexposure.

9.3 Medical Surveillance Program

Specific requirements of Dames & Moore's Medical Surveillance Program can be found in the firmwide Health and Safety Manual, Procedure No.: HS 120-120.8.

10.0 STANDARD OPERATING PROCEDURES

10.1 Organizational Structure and Responsibilities

Responsibility for health and safety passes from the Chief Executive Officer to the Chief Operating Officer to the General Manager for each Dames & Moore division. The Chief Operating Officer appoints the firm's Director of Health and Safety. The Division Health and Safety Manager (HSM) is appointed by the General Manager. Office Safety Coordinators for each geographic office are selected by the Managing Partner or Group Leaders with concurrence from the HSM.

The health and safety issue is a project management responsibility. Each Project Manager is fully accountable for carrying out assigned work for each project in compliance with the firmwide Health and Safety Program. A complete description of the organizational structure is provided in the firmwide Health and Safety Manual, Procedure No.: HS 100.1.

10.1.1 Dames & Moore Project Manager

The Project Manager (PM) shall direct on-site investigations and operational efforts but may delegate all or part of these duties to the Site Manager. The PM:

1. Provides adequate project information to the Office Safety Coordinator so that an appropriate health and safety plan (HSP) can be developed for the project, with sufficient lead time and budget for development of the project HSP.

2. Reviews and approves the HSP.

3. Obtains appropriate monitoring and protective equipment.

4. Monitors safety performance of personnel for compliance with the project HSP.

5. Requires correction of unsafe work practices or conditions.

10.1.2 Dames & Moore Site Safety Officer

The Dames & Moore Site Safety Officer's (SSO) duties may be carried out by the PM or other site manager. The SSO:

1. Assures that Dames & Moore on-site personnel have read and clearly understand the provisions of this plan prior to on-site activities, including the procedures for handling emergencies and the location and use of first aid equipment.

2. Assures that Dames & Moore personnel are aware of the potential hazards associated with site operations.

3. Assures that the personal protective equipment designated in this plan is available and used properly by all Dames & Moore on-site personnel.

4. Supervises the safety performance of all Dames & Moore personnel to ensure that the required work practices are employed.

5. Prepares accident/incident reports and other forms.

6. Oversees implementation of the project HSP and informs the PM and OSC of any additions or modifications that may be appropriate.

7. Checks with the OSC or his designee to see that assigned personnel have correct Fit for Duty medical authorization.

8. Determines that monitoring equipment is used properly and is calibrated in accordance with manufacturer's instructions or other standards, and that results are properly recorded and filed.

9. Provides on-going review of the protection level needs as project work is performed, and informs the office safety coordinator and PM of the need to upgrade downgrade protection levels.

10. Requires correction of unsafe or potentially unsafe working conditions, or stops work in emergencies until such conditions are corrected.

11. Obtains a copy of contractor and subcontractor HSP's.

10.1.3 Dames & Moore Site Personnel

Project personnel involved in on-site investigations and operations are responsible for:

1. Taking reasonable precautions to prevent injury to themselves and to their fellow employees.
2. Performing only those tasks that they believe they can do safely, and immediately reporting any accidents or unsafe conditions to the SSO or PM.
3. Implementing the procedures set forth in the HSP, and reporting any deviations from the procedures described in the plan to the SSO or PM for action.
4. Notifying the PM and SSO of any special medical problems (i.e. allergies) and insuring that on-site personnel are aware of any such problems.

10.1.4 Regional Health and Safety Manager

The Regional Health and Safety Manager (RHSM) shall:

1. Approves the HSP.
2. Periodically audit the operation to ensure compliance with this plan.
3. Provide health and safety support as requested by the SSO and the PM.

10.2 Reporting of Accidents and Unsafe Conditions

If an accident occurs, the Project Manager and the injured person(s) are to complete an Accident Report Form for submittal to the Managing Partner (Ltd.) and the OSC, who will forward a copy to the Regional HSM and the firmwide Health and Safety Director. The OSC should ensure that follow-up action is taken to correct the situation that caused the accident. Details of Dames & Moore's procedures for reporting accidents and unsafe conditions are described in the firmwide Health and Safety Manual, Procedure No.: HS 210-210.3.

10.3 Heat Stress/Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. With regard to the wearing of Tyvek suits, because such disposal clothing does not "breathe," perspiration does not evaporate and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40 degrees Fahrenheit (°F) and an employee perspires, the employee must change to dry clothes. Table 10-1 describes the signs and symptoms of cold stress.

Wearing PPE also puts a worker at a considerable risk of developing heat stress. Table 10-2 describes the signs and symptoms of heat stress. This can result in health effects ranging from heat fatigue to serious illness or death. Consequently, regular monitoring and other precautions are vital.

For workers wearing standard work clothes, recommendations for monitoring and work/rest schedules are those approved by ACGIH and NIOSH. Workers wearing semipermeable PPE or impermeable PPE should be monitored when the temperature in the work area is above 70°F. To monitor the worker, the following should be measured:

- <u>Heart rate</u>--The radial pulse should be counted during a 30-second period as early as possible in the rest period.
    - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one third and the rest period should be kept the same.
    - If the heart rate still exceeds 110 beats per minute at the next rest period, the following work cycle should be shortened by one third.
- <u>Oral temperature</u>--A clinical thermometer (3 minutes under the tongue) or similar device should be used to measure the oral temperature at the end of the work period (before drinking).
    - If the oral temperature exceeds 99.6°F (37.6 degrees Celsius (°C)), the next work cycle should be shortened by one third, without the rest period being changed.

TABLE 10-1

Signs and Symptoms of Cold Stress

Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

Chilblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

Second-degree frostbite is manifested by skin with a white, waxy appearance and the skin is firm to the touch. Individuals with this condition are generally not aware of its seriousness, because the underlying nerves are frozen and unable to transmit signals to warn the body. Immediate first aid and medical treatment are required.

Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed:

- Involuntary shivering
- Irrational behavior
- Slurred speech
- Sluggishness.

TABLE 10-2

Signs and Symptoms of Heat Stress

Heat rash may result from continuous exposure to heat or humid air.

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms
- Pain in the hands, feet, and abdomen.

Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, and moist skin
- Heavy sweating
- Dizziness, fainting, and nausea.

Heat stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. Competent medical help must be obtained. Signs and symptoms are:

- Red, hot, and unusually dry skin
- Lack of or reduced perspiration
- Dizziness and confusion
- Strong, rapid pulse, and coma.

Have workers drink 16 ounces (0.5 liter) of fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight.

Encourage workers to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.

Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure.

Train workers to recognize, identify, and treat heat stress.

- If the oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, the following work cycle should be shortened by one third.

  - A worker should not be permitted to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

- Body water loss, if possible--Weight should be measured on a scale accurate to +/- 0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent of total body weight loss in a workday.

Initially, the frequency of monitoring depends on ambient temperature (see Table 10-3). The length of the work cycle is determined by the frequency of physiological monitoring described above.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, the following steps should be taken:

- Work schedules should be adjusted.

- Shelter (air-conditioned, if possible) or shaded areas should be provided to protect personnel during rest periods.

- Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat--i.e., 8 fluid ounces (0.23 liter) of water must be ingested for approximately every 8 ounces (0.23 kilogram) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water will be drunk to replace lost sweat. When heavy sweating occurs, the worker should be encouraged to drink more. The following strategies may be useful:

  - Water temperature should be maintained at 50°F to 60°F (10° to 15.6°C).

  - Small disposable cups that hold about 4 ounces (0.1 liter) should be provided.

TABLE 10.3

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers (1)

Adjusted Temperature (2)	Normal Work Ensemble (3)	Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

NOTES:

(1) For work levels of 250 kilocalories per hour.

(2) Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging percent of the time the sun is not covered by clouds that are thick enough to produce a shadow (100% sunshine = no cloud cover and a sharp, distinct shadow; 0% sunshine = no shadows).

(3) A normal work ensemble consists of cotton overalls or other cotton clothing with long sleeves and pants.

10.4 Drilling Safety

10.4.1 Basic Requirements

Employees will not proceed with work on, or in the proximity of, hazardous equipment until they have been properly trained and have received a safety briefing. If drilling is at a hazardous substance site, the site-specific safety plan must be reviewed on-site and discussed in the safety briefing.

Potential hazards (e.g., overhead or underground power lines, oil or gas lines in the immediate vicinity of the drill site) must be removed, avoided by relocating the drill site, or adequately barricaded to eliminate the hazard.

The use of unsafe or defective equipment is not permitted. Equipment must be inspected regularly and, if found to be defective, must be immediately removed from use and either repaired or replaced.

Employees will be familiar with the location of first-aid kits and fire extinguishers. Telephone numbers for emergency assistance must be prominently posted and kept current.

10.4.2 General Requirements at Drilling Operations

10.4.2.1 Housekeeping

Good housekeeping conditions should be observed in and around the work area. Suitable storage places should be provided for all materials and supplies. Pipe, drill rods, etc., must be securely stacked on solid, level sills.

Work surfaces, platforms, stairways, walkways, scaffolding, and accessways will be kept free of obstructions. All debris will be collected and stored in piles or containers for removal and disposal.

10.4.2.2 Salamander Heaters

Salamanders will be used only with approved fuels (e.g., do not use gasoline). Salamander heaters must not be refueled or moved until they have been extinguished and permitted to cool. Heaters will be equipped with exhaust stacks and will not be set on or placed near combustible material. They should be equipped with metal stands that will provide adequate stability and permit at least a 2-inch clearance under the unit.

Burning salamanders must be attended at all times, with suitable fire extinguishers available to each attendant. If tarpaulins or other flexible materials are used to form a heating enclosure, they must be fire resistant and installed to prevent contact with the heater. Worn salamanders that have developed holes or have been otherwise damaged will be replaced and removed from service.

10.4.2.3 Lighting

In addition to providing required or recommended illumination intensities of at least 5 foot-candles, consideration should be given to the selection and placement of lighting equipment. Proper lighting should provide minimum glare, eliminate harsh shadows, and provide adequate illumination to perform work efficiently and safely.

Light bulbs should be of the heavy duty, outdoor, nonshattering type.

All lighting circuits, including drop cords, should be grounded and have ground fault interrupters. Lighting circuits will be inspected periodically, and defective wiring or fixtures will be removed from service.

10.4.2.4 Flammable Liquids

All highly flammable liquids should be stored and handled only in approved containers. Portable containers must be the approved red safety containers equipped with flame arresters and self-closing lids.

Approved hand pumps will be used to dispense gasoline from barrels. Gasoline must not be used for degreasing or to start fires. Also, gasoline containers should be clearly labeled, and storage areas should be posted with "No Smoking" signs. Fire extinguishers should be installed in all areas that contain flammable liquids.

10.4.2.5 Public Safety

Work areas will be regulated so that the public will be protected from injury or accident. Adequate danger signs, barriers, etc., will be placed to effectively warn the public of hazards as well as to restrict access to dangerous areas.

10.4.3 Off-Road Movement of Drill Rigs

The following rules apply to the off-road movement of drill rigs:

- Before moving a drill rig, an inspection should be made of the route of travel for depressions, slumps, gullies, ruts, and similar obstacles.

- The brakes of a drill rig carrier should always be checked before traveling, particularly on rough, uneven, or hilly ground.

- All passengers should be discharged before a drill rig is moved on rough or hilly terrain.

- The front axle of 4 x 4 or 6 x 6 vehicles or carriers should be engaged when traveling off road on hilly terrain.

- Caution should be used when traveling on a hillside. The hillside capability of drill rigs should be evaluated conservatively, because the addition of drilling tools may raise the center of mass. When possible, travel should be made directly uphill or downhill.

- Obstacles such as small logs, small erosion channels, or ditches should be crossed squarely, not at an angle.

- When lateral or overhead clearance is close, someone on the ground should be used as a guide.

- After the drill rig has been moved to a new drilling site, all brakes or locks should be set. Wheels should be blocked on steep grades.

- The mast (derrick) of the drill rig should not be in the raised or partially raised position during off-road travel.

- Loads on the drill rig and supporting trucks should be tied down during transport.

10.4.4 Drilling Equipment

10.4:4.1 Skid-Mounted Units

Labels clearly indicating the function and direction of control levers should be posted on the lower unit controls of all drills.

An emergency safety power shutoff device should be installed within reach of the operator on all units. The device should be clearly labeled or otherwise made readily identifiable and checked daily to ensure that it is operable. The power unit should be operated only by authorized and qualified personnel.

Equipment will be shut down during manual lubrication and while repairs or adjustments are being made. Equipment such as internal combustion engines will not be refueled while running. Where practical, the gasoline tank should be positioned or shielded to avoid accidental spillage of fuel on the engine or exhaust manifold during refueling operations. Hazardous gears and moving parts also should be shielded to prevent accidental contact.

A dry chemical or carbon dioxide fire extinguisher, rated 5 pounds or larger, should be carried on the unit and removed to a position within 25 feet of the worksite during drilling operations. Extinguishers will be inspected and tagged at least once every 3 months.

Engine exhaust systems should be equipped with spark arresters when operated in areas where sparks constitute a fire hazard.

10.4.4.2 Overhead and Underground Utilities

Special precaution must be taken when using a drill rig on a site within the vicinity of electrical power lines and other utilities. Electricity can shock, burn, and cause death.

Overhead and underground utilities should be located, noted, and emphasized on all boring location plans and assignment sheets. When overhead electrical power lines exist at or near a drilling site, all wires should be considered dangerous.

A check should be made for sagging power lines before a site is entered. Power lines should not be lifted to gain entrance. The appropriate utility company should be contacted and a request should be made that it lift or raise and cut off power to the lines.

The area around the drill rig should be inspected before the drill rig mast (derrick) is raised at a site in the vicinity of power lines. The minimum distance from any point on the drill rig to the nearest power line should be determined when the mast is raised or is being raised. The mast should not be raised and the drill rig should not be operated if this distance is less than 20 feet, because hoist lines and overhead power lines can be moved toward each other by the wind.

The existence of underground utilities, such as electric power, gas, petroleum, telephone, sewer, and water lines, should always be suspected. These underground electric lines are as dangerous as overhead lines, so a utility locating service should always be contacted.

There are generally two types of utility locating services. One is a "free" service that is paid for by companies with underground pipes, lines, etc., to protect the public and to prevent costly repairs. However, these services have access only to drawings for primary pipes or lines, typically on public property or right-of-way easements, but not to drawings showing supply or feeder lines from a primary system to the interior of a property. Therefore, they are not required, and in fact hesitate, to locate interior lines. Sites can be cleared for drilling by such services, but without the drill operator's knowledge of the locations of underground feeder or supply lines.

A second type of locating service is provided by a paid subcontractor who physically sweeps or clears interior locations using locating equipment. Locating costs can be minimized by obtaining all available maps, drawings, and employee interview information before contracting with the locating company. This is especially important at large industrial plants or military bases, which can have an intricate network of underground utilities. It is important that every location be cleared, even those for hand-auger borings.

If a sign warning of underground utilities is located on a site boundary, it should not be assumed that underground utilities are located on or near the boundary or property line under the sign; they may be a considerable distance from the sign. The utility company should be contacted to check it out.

The owners of utility lines or the nearest underground utility location service should always be contacted before drilling is started. However, remember that some services provide information on utilities going to, but not within, a site. Metal detectors or other locating equipment may be necessary to determine the presence of shallow (surface) utilities on-site. The utility personnel should mark or flag the location of the underground lines and determine what specific precautions must be taken to ensure safety.

10.4.4.3 Site Selection and Working Platforms

In preparing a worksite located on adverse topography, precautions must be taken against cave-ins, slides, and loose boulders. The drill platform should be stabilized by outriggers or adequate timbering.

Prior to drilling, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and to provide a safe working area. Drilling should not commence when tree limbs, unstable ground, or site obstructions result in unsafe tool-handling conditions.

Suitable storage locations should be provided that allow for the convenient handling of tools, materials, and supplies without danger that they could fall and injure anyone. Storing or transporting tools, materials, or supplies within or on the drilling mast (derrick) should be avoided. Pipes, drill rods, bits, casings, augers, and similar drilling tools should be securely stacked in an orderly manner on racks or sills.

Penetration hammers or other types of driving hammers should be placed at a safe location on the ground or secured when unattended on a platform. Work areas, platforms, walkways, scaffolding, and other accessways should be kept free of obstructions and substances such as ice, grease, or oil that could create a hazardous surface. All controls, control linkages, and warning and operation lights and lenses also should be kept free of ice, grease, or oil.

In the vicinity of power transmission or distribution lines, drills should be adequately grounded and set with at least a 15-foot clearance between any part of the drill or mast and the power lines.

Toilet facilities will be convenient to drill crews, or transportation will be readily available to nearby toilet facilities. Toilets will be either the chemical type or constructed over ground pits, which will be backfilled when abandoned. They should be fly tight and maintained in a sanitary condition.

Mud pits and drainage excavations should be safely sloped and located to provide minimum interference with work. Where necessary, suitable barricades, catwalks, etc., should be provided to reduce the possibility of personal injury. Ladders will be positioned in pits or excavations that are 5 or more feet deep. Such excavations should be periodically inspected to ensure safe operation and adequate maintenance.

Truck-mounted drills will be equipped with a "safetyline" or with clearly marked and conspicuously located emergency switches. The safetyline emergency stop consists of a taut wire that runs around the back of the machine and connects to a special switch that turns off the power unit when the line is contacted. When emergency switches are used in lieu of a safetyline, there should be a minimum of two switches--one located within easy reach of the operator, and one located within easy reach of workers at ground level near the drill or auger head.

Trucks should not be moved backward unless the driver has personally inspected the area behind the truck. In restricted or congested areas, or areas where workmen are located, the assistance of a "spotter" is mandatory. Also, trucks will be equipped with serviceable automatic backup alarms.

Before the mast is raised, personnel will be cleared from the immediate area--with the exception of the operator and a helper, when necessary. A check should be made to ensure safe clearance from energized power lines or equipment. Unsecured equipment must be removed from the mast, and cables, mud lines, and catline ropes must be adequately secured to the mast before raising. After it is raised, the mast must be secured to the rig in an upright position with steel pins.

Drill equipment will not be moved until a thorough inspection has been made to ensure that the mast, drill rods, tools, and other equipment are secured. A check will also be made of the steering mechanism, brakes, lights, load limits, and proper flagging and lighting of load extensions. Applicable traffic laws will be observed when moving drill equipment over public roads.

10.4.5 Surface Drilling Operations

Before the mast of a drill rig is raised and drilling is commenced, the drill rig must first be leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after the initial setup. The mast should only be lowered when the leveling jacks are down, and the leveling jack pads should not be raised until the mast is completely lowered. Before drilling operations start, the mast should be secured or locked, if required by the drill's manufacturer.

Before the power unit is started, all gears should be disengaged, the cable drum brake should be set, and no rope should be in contact with the cathead.

Before the mast is raised, a check should be made for overhead obstructions. Everyone (with the exception of the operator) should be cleared from the areas immediately to the rear and sides of the mast and informed that the mast is being raised. The drill rig should not be driven from hole to hole with the mast in the raised position.

The drill rig should only be operated from the position of the controls. The operator should shut down the drill engine before leaving the vicinity of the drill. "Horsing around" the vicinity of the drill rig and tool and supply storage areas is strictly prohibited, even when the drill rig is shut down. Caution should be taken when mounting/dismounting the platform.

Drill operations should be terminated during an electrical storm.

The consumption of alcoholic beverages, depressants, stimulants, or any other chemical substance while on the job is strictly prohibited. All unattended boreholes must be adequately covered or protected to prevent people or animals from stepping or falling into the hole. When the drilling project has been completed, all open boreholes should be adequately covered, protected, or backfilled, according to local or state regulations.

A safety chain and cable arrangement should be used to prevent water swivel and mud line whip. All water swivels and hoisting plugs should be checked for possible frozen bearings and should be properly lubricated before use. A frozen bearing could cause mud line whip, which could injure the operator.

Only drill operators should brake or set the chucks to prevent engagement of the transmission prior to removal of the chuck wrench. Also, the chuck jaws should be periodically checked and replaced as necessary.

A string of drill rods should not be braked by the chuck jaws during lowering into the hole. A catline or hoisting cable and plug should be used for braking prior to tightening of the chuck. Failure to follow this procedure could result in steel slivers on the rods, possible hand injuries, and loss of the rods into the hole. Following braking, drill rods should be allowed to drain completely before removal from the working area.

Drill rods will not be lowered into the hole with a pipe wrench. Serious back and hand injuries may result if the rods are lowered by this method.

When using drilling fluids, a rubber or other suitable wiper should be used to remove the material from the drill rods when removing them from the drill hole. When drilling with air, the exhaust and cuttings should be directed away from workers with such devices as diverter heads, the use of which should be stipulated on drilling agreements, where appropriate.

Care must be exercised by the operator to avoid a sudden hoist release of the drill rod while the rod is being carried from the hole. The hoisting capacity and weight of the drill rod must be known to prevent collapse of the mast during drill string removal from the hole. The operating capacity of the mast and hoist also must be known and must not be exceeded.

When tool joints are broken on the ground or on a drilling platform, fingers should be positioned so they will not be caught between the wrench handle and the ground or the platform if the wrench slips or the joint suddenly lets go. Pipe wrench jaws should be checked periodically and replaced as they become worn.

10.4.6 Use of Augers

The use of mismatched auger sections should be avoided. Different brands and different weights should not be used in the same auger flight.

Because some pins lose their temper after very little use, causing the spring or clip section to fail, only tight-fitting pins designed for the auger should be used.

A daily inspection--to include a thorough check of the hydraulic hoses, connections, and valves--will be made before equipment is used. Deficiencies should be corrected or safe condition verified before the equipment is started.

A durable sign containing the following wording should be installed on all equipment in full view of the operator:

- All personnel must be clear before starting this machine
- Stop the auger to clean it
- Stop engine when repairing, lubricating, or refueling
- Do not wear loose-fitting clothing or gauntlet-type gloves.

The following general procedures should be used when advancing a boring with continuous flight or hollow stem augers:

- An auger boring should be started with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low revolutions per minute (rpm).

- A system of responsibility should be established for the series of activities required for auger drilling, such as connecting or disconnecting auger sections and inserting or removing the auger fork. The operator must be sure that the tool handler is well away from the auger column and that the auger fork has been removed before rotation is started.

- Only the manufacturer's recommended method of securing the auger to the power coupling should be used. The coupling or the auger should not be touched with the hands, a wrench, or any other tool during rotation.

- Tool hoists should be used to handle auger sections whenever possible. Hands or fingers should never be placed under the bottom of an auger section when the auger is being hoisted over the top of the auger section in the ground or other hard surface, such as the drill rig platform. Feet should never be allowed to get under the auger section that is being hoisted.

- Workers should stay clear of the auger and other rotating components of the drill rig. Workers should never reach behind or around a rotating auger for any reason.

- Hands or feet should never be used to remove cuttings from the auger.

- Augers should be cleaned only when the drill rig is in neutral and the augers have stopped rotating. A special paddle should be designed for cleaning auger flights; if available, pressurized water is recommended for jet cleaning.

10.4.7 Use of Handtools and Portable Power Tools

Handtools should be kept in good repair and used only for their designed purposes. Proper protective eyewear should be worn when using handtools and portable power tools. Unguarded sharp-edged or pointed tools will not be carried in employees' pockets.

The use of tools with mushroomed heads, split or defective handles, worn parts, or other defects will not be permitted. Tools that have become unsafe will be reconditioned before reissue or discarded.

Throwing or dropping of tools from one level to another will not be permitted; rather, containers and hand lines should be used for transporting tools from one level to another.

Nonsparking tools will be used in atmospheres where sources of ignition may cause fire or explosion.

Electric-powered shop and hand tools will be of the double-insulated, shock-proof type or be effectively grounded. Power tools should be operated only by designated employees who are familiar with their use.

Portable grinding tools will not be used without properly installed safety guards. Guards and tool rests should be maintained in proper adjustment. Grinding wheels should not be operated at speeds in excess of the manufacturer's safe ratings. Cracked or defective wheels will not be used.

Portable circular saws should be equipped with guards that automatically enclose the cutting edges. Cracked or defective blades will not be used. Also, power saws will not be left running when unattended.

Portable pneumatic tools should be inspected periodically to ensure good mechanical condition. Pneumatic impact tools will be operated with safety clips or retainers installed to prevent the tools from accidentally being discharged from the chuck. Airhoses should not be disconnected from equipment until the pressure has been shut off and exhausted from the line. Safety lashing will be provided at all hose and tool connections on air lines over 0.5 inch in diameter. Leaking or defective hoses should be replaced.

When not in use, tools will not be left on scaffolds, ladders, or overhead working spaces. Containers should be provided to hold tools and prevent them from falling.

10.4.8 Use of Ropes, Chains, and Accessories

The use of ropes and chains will be governed by the instructions on usage and safety limits as recommended by the manufacturer. Ropes and chains should be inspected before use, and their loading should not exceed the manufacturer's safety limits.

Hooks used in hoisting personnel or in hoisting loads over or in the immediate vicinity of workers should be made of forged steel and equipped with safety keepers. When shackles are used under these conditions, they should be of the locking type or the pin should be secured to prohibit turning.

Load-lifting accessories, such as sheaves, shackles, hooks, headache balls, etc., should be obtained from a reputable manufacturer. The use of job-fabricated lifting accessories is expressly prohibited. Load-lifting accessories that show excessive wear or have been bent, twisted, or otherwise damaged will be removed from service.

10.4.8.1 Slings

When in use, slings should be inspected daily for signs of overloading, excessive wear, or damage. Defective slings should be removed from service and repaired or replaced before reuse.

Proper storage should be provided for slings to prevent any damage that would impair their strength. They should be protected from sharp, rough, or square corners to prevent cutting or breaking of fibers, strands, or chain links.

10.4.8.2 Wire Rope

The safe performance of wire rope or cables can be ensured by rigid periodic inspection and by proper use and care.

The maximum allowable load for wire hoisting rope must not exceed the safe working load prescribed by the manufacturer or the ultimate strength of the rope divided by the safety factor. Commercial end-fastenings, clips, and zinc sockets must be properly applied to develop maximum strength. Wire rope should be removed from hoisting or load-carrying service when kinked or when any one of the following conditions is observed:

- The existence of 12 randomly distributed broken wires in one rope lay, or four broken wires in a single strand in one rope lay.
- Evidence of corrosion or heat damage.
- One broken wire, rust, or corrosion adjacent to a socket or end-fitting (this requires removal from service or resocketing).

- Distortion, stretching, elongation, or abnormal reduction in diameter.

Wire rope found to be defective for hoisting or load-carrying should be plainly marked as being unfit for such use.

Running lines of hoisting equipment located within 8 feet of the ground or working level will be guarded; or access to the operating area can be restricted.

Rope clips attached with U-bolts should have the U-bolts on the dead end of the rope. When a wedge-socket fastening is used, the dead or short end of the cable should be clipped to the live cable with a U-bolt or another approved fastener.

10.4.8.3 Fiber and Synthetic-Fiber Rope

In selecting fiber and synthetic-fiber ropes for load-carrying purposes, only the best quality rope should be used, with size and application in accordance with the manufacturer's recommendations. These ropes should be inspected frequently to ensure safe performance.

Proper care must be given to ropes to maintain good condition and high strength capacity. Fiber ropes should not be allowed to freeze after becoming wet, but should be cleaned carefully and dried in loose coils. Ropes should not be stored close to cement, lime, acids, or alkalies. Ropes that have been exposed to these materials should be removed from service.

10.4.8.4 Chains

Extreme care is necessary in the use and maintenance of all load-carrying chains. They should be inspected by a competent person after each installation and regularly thereafter. Chains must not be subjected to a load greater than their rated safe loading, which is determined from capacity tables issued by the chain manufacturer.

Splicing broken chains by inserting a bolt between two links with the heads of the bolt and the nut sustaining the load, or by passing one link through another and inserting a bolt or a nail to hold it, is prohibited.

10.4.8.5 Hoists

If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated on a daily basis to ensure that the swivel freely rotates under load. If a rod-slipping device is used to hoist drill rods, the drill rods should not be drilled or rotated through the slipping device. No more than 1 foot (0.3 meter) of the drill rod column should be hoisted above the top of the mast (derrick). A rod column with loose tool joints should not be hoisted while the rod column is being supported by a slipping device. If drill rods slip back into the borehole, an attempt should not be made to brake the fall of the rods with your hands.

Most sheaves on drill rigs are stationary, with a single-part line. The manufacturer of the drill rig should be consulted before the number of line parts is increased. Wire ropes must be properly matched with each sheave.

Tool handling hoists should only be used for vertical lifting of tools (except when angle hole drilling). Tool handling hoists should not be used to pull on objects away from the drill rig; however, drills may be moved by using the main hoist as the wire rope is spooled through proper sheaves, according to the manufacturer's recommendations.

When tools or similar loads cannot be raised with a hoist, the hoist line should be disconnected and the tools connected directly to the feed mechanism of the drill. Hydraulic leveling jacks should not be used for added pull to the hoist line or the feed mechanism of the drill.

When attempting to pull out a mired vehicle or drill rig carrier, only a winch on the front or rear of the vehicle or drill rig carrier should be used and workers should stay as far away as possible from the wire rope. Tool hoists should not be used to pull out a mired vehicle or a drill rig carrier. The following rules also apply:

- The shock loading of a wire rope can be minimized by smooth and steady application of loads.
- Wire rope should be protected from sharp corners or edges.
- Clutches and brakes of hoists should be periodically inspected and tested.
- Gloves should always be worn when handling wire ropes.
- Following the installation of a new wire rope, a light load should be lifted first to allow the wire rope to adjust.
- A load should never be hoisted over someone's head, body, or feet, or left suspended in the air when the hoist is unattended.

- Hands should be kept away from hoists, wire rope, hoisting hooks, sheaves, and pinch point when the slack is being taken up, and when the load is being hoisted. Hands should not be used to guide wire ropes on hoist drums.

10.5 Excavation

10.5.1 General Requirements

The following general requirements should be followed for excavation:

- Excavations shall be conducted in strict accordance with OSHA 29CFR 1926.650 Subpart P regulations, which cover open excavations and define excavation to include trenches.

- The regulations require protection of employees in excavations against cave-ins, except when the excavation is in stable rock, less than five feet deep, or deemed safe by a competent person.

- Workers must be protected from loose rock or soil and material or equipment that may fall into the excavation.

- Underground utility installations must be identified and located.

- Inspection of the site by a competent person is required daily, or following a natural or man-made event that may alter conditions. If there is evidence of possible cave-ins, protective system failure, hazardous atmospheres, or other hazardous conditions, employees at risk must be removed until corrective steps have been taken.

- Safe and accessible means of access and egress must be provided.

- Warning systems for mobile equipment are required, such as barricades, hand or mechanical signals, or stop logs.

- The regulations require testing for hazardous atmospheres and controls, including daily inspection by a competent person.

- Any of four options for sloping and benching systems may be implemented for stability of adjacent structures. These include:
    - A slope of 34 degrees or less in lieu of soil classification
    - Maximum allowable slopes according to Appendices A and B of the OSHA standard
    - Sloping or benching designs in accordance with stated criteria
    - Excavations designed by a registered professional engineer.
- Any of four options may be implemented for support and shield systems. These include:
    - Designs for timber shoring in trenches in accordance with set criteria
    - Designs using manufacturers' tabulated data in accordance with set criteria
    - Designs using other tabulated data
    - Other designs approved by a registered professional engineer.
- Excavation shall stop during inclement weather, such as high winds, heavy rainfall, lightning, etc.
- Table 10-4 contains guidance on selection of protective systems per the OSHA standard.

10.5.1.1 Preliminary Inspection

Prior to excavation, the site should be thoroughly inspected to determine conditions that require special safety measures. The location of underground utilities, such as sewer, telephone, gas, water, and electric lines, must be determined and plainly staked. Necessary arrangements must be made with the utility company or owner for the protection, removal, or relocation of the underground utilities. In such circumstances, excavation will be done in a manner that does not endanger the employees engaged in the work or the underground utility. Utilities left in place should be protected by barricading, shoring, suspension, or other measures, as necessary.

10.5.1.2 Protection of the Public

Necessary barricades, walkways, lighting, and posting should be provided for the protection of the public prior to the start of excavation. Excavation operations on or near state, county, or city streets, accessways, or other locations where there is extensive interface with the public and/or motorized equipment will not start until all of the following actions have been taken:

- The contractor has contacted the authority having jurisdiction and obtained written permission to proceed with protective measures required.
- The contractor, using the authority's instructions and these standards, has developed an extensive and detailed standard operating plan.
- The plan has been discussed with affected employees, and applicable protective measures are in place and functioning.

10.5.1.3 Access and Lighting

Safe access will be provided for employees, including installation of walkways, stairs, ladders, etc. When operations are conducted during hours of darkness, adequate lighting will be provided at the excavation, borrow pits, and waste areas.

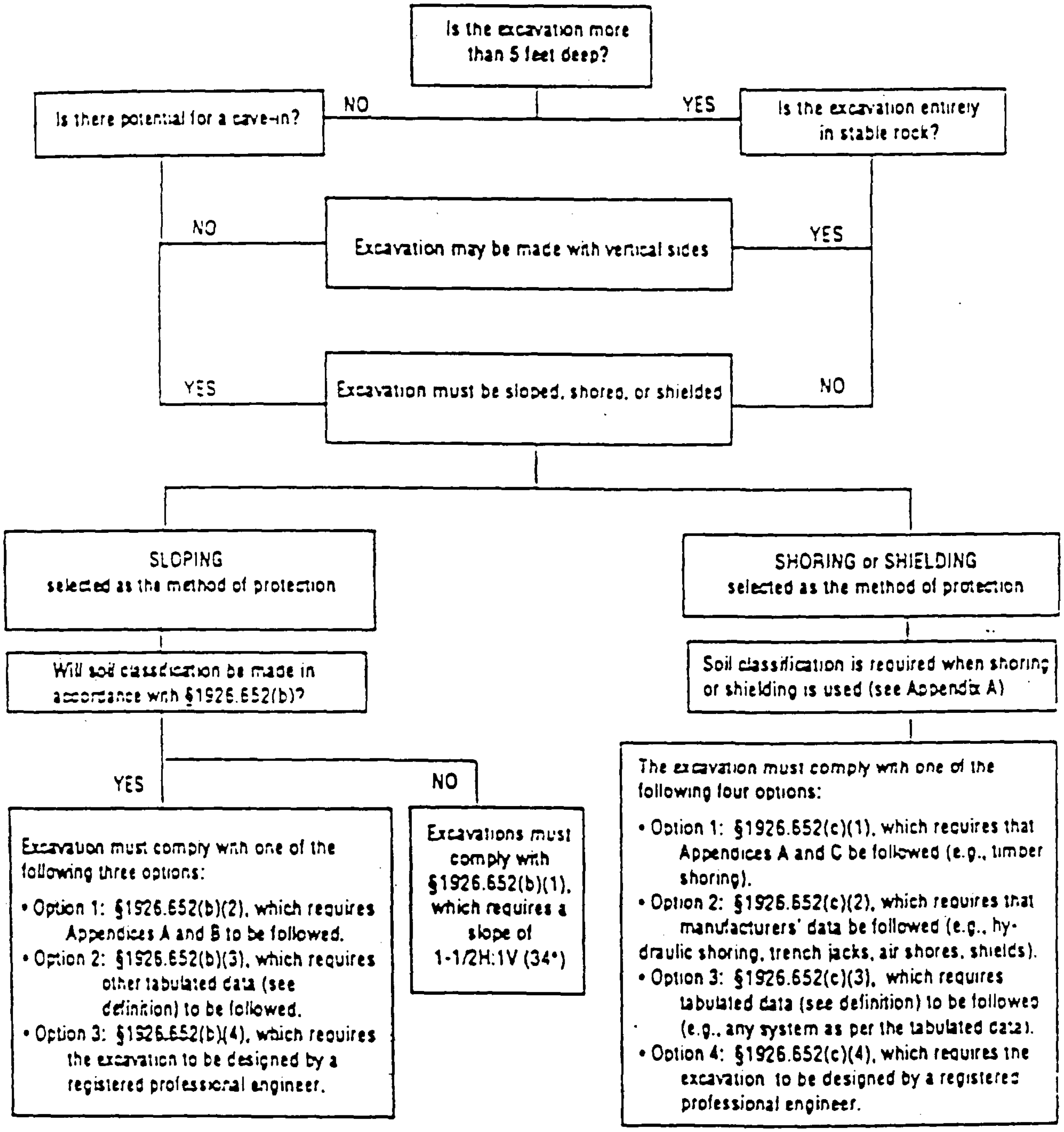
Where employees are required to enter excavations over 4 feet in depth, stairs, ladders, or ramps must be provided, so as to require no more than 25 feet of lateral travel. When access to excavations exceeds 20 feet vertically, ramps, stairs, or personnel hoists should be provided. Ladders extending from the bottom of the trench to at least 3 feet above the top must be placed within 25 feet of workers in the trench.

10.5.1.4 Personal Protective Equipment

PPE will be provided and used in accordance with the specific requirements set forth in the plan. Drillers and helpers must wear approved safety goggles or safety glasses with side shields, hearing protection, hard hats, and safety shoes.

TABLE 10-4

A Guide to Selection of Protective Systems
for use in excavations 20 feet or less in depth *



Is the excavation more than 5 feet deep?

Is there potential for a cave-in?

Is the excavation entirely in stable rock?

Excavation may be made with vertical sides

Excavation must be sloped, shored, or shielded

SLOPING selected as the method of protection

SHORING or SHIELDING selected as the method of protection

Will soil classification be made in accordance with §1926.652(b)?

Soil classification is required when shoring or shielding is used (see Appendix A)

Excavation must comply with one of the following three options:

- Option 1: §1926.652(b)(2), which requires Appendices A and B to be followed.
- Option 2: §1926.652(b)(3), which requires other tabulated data (see definition) to be followed.
- Option 3: §1926.652(b)(4), which requires the excavation to be designed by a registered professional engineer.

Excavations must comply with §1926.652(b)(1), which requires a slope of 1-1/2H:1V (34°)

The excavation must comply with one of the following four options:

- Option 1: §1926.652(c)(1), which requires that Appendices A and C be followed (e.g., timber shoring).
- Option 2: §1926.652(c)(2), which requires that manufacturers' data be followed (e.g., hydraulic shoring, trench jacks, air shores, shields).
- Option 3: §1926.652(c)(3), which requires tabulated data (see definition) to be followed (e.g., any system as per the tabulated data).
- Option 4: §1926.652(c)(4), which requires the excavation to be designed by a registered professional engineer.

* adapted from Figures 1-3 of Appendix F of 29 CFR Part 1926, Subpart P

10.5.1.5 Removal of Trees and Brush

Prior to excavation, trees, brush, boulders, and other surface obstacles that present a hazard to employees should be removed.

10.5.1.6 Slide Prevention and Trenching Requirements

All trench excavations over 5 feet in depth must be sloped to the angle of repose from the bottom of the trench, but never less than 3/4 horizontal to 1 vertical (i.e., 37 degrees from vertical), or supported by structures designed by a professional engineer. Excavations should be inspected following rainstorms or other hazardous events. Additional protection against possible slides or cave-ins shall be provided, as necessary.

10.5.1.7 Angle of Repose

The determination of the angle of repose and design of supporting systems should be based on a thorough evaluation of all pertinent factors, including depth of cut; possible variation in water content of the material; anticipated changes in the material from exposure to air, sun, water, or freezing; loading imposed by structures, equipment, or overlying or stored material; and vibrations from sources such as traffic, equipment, and blasting. The angle of repose for all excavations, including trenching, should be determined by a professional engineer, but in no event should the slope be less than 3/4 horizontal to 1 vertical (i.e., 37 degrees from vertical) from the bottom of the excavation.

10.5.1.8 Support Systems

Materials used for support systems, such as sheeting, piling, cribbing, bracing, shoring, and underpinning, should be in good serviceable condition, and timbers should be sound and free of large or loose knots. The design of support systems should be based on calculations of the forces and their directions, with consideration for surcharges, the angle of internal friction of materials, and other pertinent characteristics of the material to be retained.

When tight sheeting or sheet piling is used, full loading due to the groundwater table should be assumed unless relieved by weep holes, drains, or other means. Cross braces and trench jacks should be placed in true horizontal position and secured to prevent sliding, falling, or kickouts. Additional stringers, ties, and bracing should be provided to allow for any necessary temporary removal of individual supports. Support systems should be planned and designed by a professional engineer competent in the field.

Backfilling and removal of trench support systems should progress together from the bottom of the trench. Jacks or braces should be released slowly. In unstable soil, ropes or other safe means will be used to remove the braces from the surface after workers have left the trench.

Special precaution must be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or fill area. The use of compacted backfill as backforms on slopes that are steeper than the angle of repose of the compacted material in its natural state is prohibited.

10.5.1.9 Structural Foundations and Footings

Except in hard rock, excavations below the level of the base of any foundation, footing, or retaining wall will not be permitted unless the wall is underpinned and all necessary precautions are taken to ensure the stability of adjacent walls. If the excavation endangers the stability of adjacent buildings or structures, shoring, bracing, or underpinning designed by a qualified person will be installed. Such supporting systems must be inspected at least daily by qualified persons to ensure that protection is adequate and effectively maintained.

Small diameter footings that workers are required to enter, including bell-bottomed footings over 4 feet deep, must be provided with a steel casing or support system of sufficient strength to support the earth walls and prevent cave-ins. The casing or support system shall be provided for the full depth, except for the bell portion of bell footings.

Fixed or portable ladders must be provided for access. A lifeline, securely attached to a shoulder harness, should be worn by every employee entering the footing. The lifeline should be manned from above and should be separate from any line used to raise or lower materials.

10.5.1.10 Vertical Cuts and Slopes

Before a slope or vertical cut is undercut, the residual material must be adequately supported and the undercutting method and support system must be inspected.

When exposed to falling, rolling, or sliding rocks, earth, or other materials, employees working below or on slopes or cuts should be protected in the following manner:

- By effective scaling performed prior to exposure and at intervals necessary to eliminate the danger.

- By the installation of rock bolting, wire mesh, or equivalent support if the material continues to ravel and fall after scaling.

- By the installation of protective timber or wire mesh barricades at the slope of the cut and at necessary intervals down the slope. Wherever practical, benching sufficient to retain falling material may be used in lieu of barricades.

- By ensuring that personnel do not work above one another where there is danger of falling rock or earth. Personnel performing work on vertical cuts or slopes where balance depends on a supporting system must wear appropriate safety equipment.

10.5.1.11 Groundwater

Groundwater should be controlled. Freezing, pumping, draining, and other major control measures should be planned and directed by a competent professional engineer. Full consideration should be given to the existing moisture balance in surrounding soil and the effects on foundations and structures if it is disturbed. When continuous operation of groundwater control equipment is necessary, an emergency power source should be provided.

10.5.1.12 Surface Water

The accumulation of surface water in excavations must not be permitted and should be controlled by diversion ditches, dikes, dewatering sumps, or other effective means.

10.5.1.13 Excavated Materials

Excavated materials should be placed and retained at least 2 feet from the depth of the excavation, or at a greater distance when required to prevent hazardous loading on the face of the excavation.

10.5.1.14 Protective Devices

Guardrails, fences, barricades, and warning lights or other illumination systems will be maintained from sunset to sunrise on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Walkways or bridges that are protected by standard guardrails should be provided where employees are required or permitted to cross over excavations.

Wells, calyx holes, pits, shafts, and all similar hazardous excavations must be effectively barricaded or covered and posted. All temporary excavations of this type should be backfilled as soon as possible. When mobile equipment is permitted adjacent to excavations with steep slopes or cuts, substantial stoplogs or barricades should be installed.

10.5.1.15 Equipment Operation

Equipment that is operated on loading or waste areas must be equipped with an automatic backup alarm. Additionally, when employees are on foot or otherwise endangered by equipment in dumping or waste areas, a competent signalman should be used to direct traffic. The signalman must have no other assignment that interferes with signaling duties. If the equipment or truck cab is not shielded, the operator should stand clear of the vehicle during loading. Excavating or hoisting equipment should not be allowed to raise, lower, or swing loads over workers unless effective overhead protection is provided.

10.5.1.16 Drilling Operations

When drilling in rock or other dust-producing material, the dust should be controlled within the OSHA Permissible Exposure Limits (PELs). Except in shaft and tunnel excavation, dust control devices are not required on jackhammers as long as the operators wear approved dust respirators.

11.0 EMERGENCY RESPONSE PLAN

This section describes contingencies and emergency planning procedures to be implemented at the site. This Emergency Response Plan is compatible with local, state, and Federal disaster and emergency management plans, as appropriate. The list of appropriate emergency contacts is given in Section 3.5 above.

11.1 Pre-Emergency Planning

An emergency evacuation route(s) will be chosen immediately upon arrival at the site. During the periodic site briefings, all workers will be trained in provisions of the Emergency Response Plan, communication systems, and evacuation routes. The plan will be reviewed and revised, if necessary, on a regular basis by the OSC to ensure that the plan is adequate and consistent with prevailing site conditions.

11.2 Personnel Roles and Lines of Authority

The site supervisor has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public, such as evacuation of personnel and adjacent residents from the site area. The site supervisor must also ensure that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed. The OSC may be called upon to act on behalf of the site supervisor and will direct responses to any medical emergency.

The individual contractor organizations are responsible for assisting the Project Manager's mission within the parameters of their scope of work.

11.3 Emergency Recognition

Tables 3-1 and 3-2 above provide listings of chemical and physical hazards on-site. Personnel should be familiar with techniques of hazard recognition from pre-assignment training and site-specific briefings. The OSC should ensure that the proper prevention devices or equipment are available to personnel.

In an emergency, personnel should proceed to the closest exit with their buddies and mobilize to the safe distance area associated with the evacuation route. Personnel should remain at that area until the re-entry alarm is sounded or further instructions are provided by an authorized individual.

11.4 Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be reported immediately to the Project Manager.

Personnel who are transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the site. This information is included in Table 3-1.

Any vehicle used to transport contaminated personnel will be treated and cleaned, as necessary.

11.5 Fire or Explosion

In the event of a fire or explosion, the local fire department should be notified immediately. The Site Safety Coordinator or a designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on-site.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available on-site to control or extinguish the fire.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.

11.6 Spills or Leaks

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately.

- Locate the source of the spillage and stop the flow if it can be done safely.
- Begin containment and recovery of the spilled materials.

11.6 Exposure to Bloodborne Pathogens

For purposes of this health and safety plan, personnel fall into the category of classification B in Dames & Moore's Bloodborne Pathogens Program, which are jobs where required tasks normally do not but could involve exposure to blood, bodily fluids, or tissues--for example, in the event first aid or CPR is required. If exposure to blood, bodily fluids, or tissues occurs, Universal Precautions such as the following will minimize the chance of contracting disease.

- Wash hands with soap and water as soon as possible after contact with blood, bodily fluids, or human tissue from an injured worker. When handwashing facilities are not readily available, antiseptic hand cleansers in conjunction with clean cloth/paper towels shall be used and hands should be washed with soap and water as soon afterwards as possible.
- Wear gloves when anticipating contact with blood, bodily fluid, tissues, mucous membranes, or contaminated surfaces, or if breaks in the skin are present.
- Wear appropriate protective equipment at all times, including a mask and eye protection, if aerosolization or splattering is likely to occur when attending to an injured worker or when conducting normal work routines.
- Insure that mouthpieces and appropriate personal protective equipment are readily available in first aid kits.
- Report immediately to the Site Safety Officer all sticks or cuts, mucosal splashes, or contamination of open wounds with blood or bodily fluids.
- Dispose of all spills which contain or may contain biological contaminants in accordance with policies for hazardous waste disposal. Until cleanup is complete, an accident area should be roped off from other workers.

The following work practice controls shall also be used to eliminate or minimize employee exposure. Where occupational exposure remains after instituting these controls, personal protective equipment shall also be used.

- Ingestion of bloodborne pathogens - Eating, drinking, smoking, applying cosmetics, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure. Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on countertops or benchtops where blood or other potentially infectious materials are present.

- If handling potentially infectious bodily parts following dismemberment in an accident, specimens of blood or other potentially infectious materials shall be placed in a container which prevents leakage during collection, handling, processing, storage, transport, or shipping. The container shall be labelled or color coded according to labeling requirements and closed prior to storage, transportation, or shipping. If outside contamination of the primary container occurs, the primary container shall be placed within a secondary container that is puncture-resistant in addition to the above characteristics.

- Equipment (such as drill rigs or equipment used in first aid response) which may become contaminated with blood or other potentially infectious materials shall be examined prior to servicing or shipping and decontaminated as necessary, unless the site supervisor determines that decontamination of such equipment is not feasible. A readily observable biohazard label shall be attached to the equipment stating which portions remain contaminated. The site supervisor shall insure that this information is conveyed to all affected employees, the servicing representative and/or manufacturer as appropriate, prior to handling, servicing or shipping so that appropriate precautions may be taken.

- Personal protective equipment - appropriate personal protective equipment will be provided, such as gloves and mouthpieces in the first aid kit.

- All emergency first aid kits will contain red biohazard bags to contain waste created in first aid/emergency situations.

    - Gloves will be worn at all times.

    - Containers will not be overfilled.

- Containers will be tightly closed or sealed prior to transportation.
- Pools of blood, bodily fluid, tissue, or spills from biohazard waste containers shall be cleaned up with sodium hypochlorite or Chlorox bleach, 1 part to 10 parts water.

Employees who have had an exposure incident will be referred for a confidential post-exposure evaluation and follow-up. This will be made available within a reasonable time and location, and performed by or under the supervision of a licensed physician or licensed healthcare professional.

When an exposure incident is reported, the Project Manger will complete the Bloodborne Pathogens Incident Evaluation Form and will immediately refer the employee for a confidential medical evaluation and follow-up. This referral must be made within 24 hours.

11.6.1 Decontamination of Equipment

1. Clean spills from around equipment immediately.
2. Employees engaged in cleaning equipment shall use personal protective equipment that will insure that there is no contact of potentially contaminated material with skin or personal clothing.
3. Clean large equipment with a germicidal detergent or bleach (1 part to 10 parts water), avoiding splatter or dripping. If dripping is reasonably anticipated, use a drop cloth under the equipment being cleaned.
4. Wipe contamination from small, reusable equipment. Label the equipment with warning labels indicating which parts are contaminated before sending it to an appropriate location for reprocessing.
5. All cleaning materials and personal protective equipment shall be disposed of as infectious waste or properly prepared for transport to a laundry as potentially infectious laundry.
6. Wash hands after removal of personal protective equipment.

12.0 HAZARD COMMUNICATION

12.1 General

The Dames & Moore Hazard Communication Program complies with the OSHA Hazard Communication Standard (HCS) found in 29 CFR 1910.1200 and 29 CFR 1926.59, which applies to any chemical present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency. Although waste materials are excluded from the OSHA requirement, decontamination chemicals for sampling apparatus or protective clothing (such as acetone or trisodium phosphate) and calibration standards (such as isobutylene gas) require Material Safety Data Sheets (MSDS).

The principle of communicating the hazards of materials used in the workplace to employees applies broadly to firmwide activities, from informational programs on the conduct of hazardous waste activities to the firm's insistence upon adequate safety and health training. It is also important for personnel to have an awareness of client concern for Hazard Communication due to Federal, state, and local regulations directly affecting certain client activities.

12.2 Compliance Requirements

In order to comply with Hazard Communication Standard (29 CFR 1910.1200), Dames & Moore has determined that:

- All containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures.

- Labels, tags, or signs must be properly affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists.

- Written information (MSDS) on hazardous chemicals in the workplace must be available to employees working with the substance.

- Appropriate MSDS will be available to any contractor or subcontractor employees working in Dames & Moore offices) or laboratories or at construction, excavation, or other sites under Dames & Moore's control.

- Hazard Communication Training should be provided to Dames & Moore employees.

The Dames & Moore Hazard Communication program is further described in the firm Health and Safety Manual, procedure HS 140.

Any MSDS required for this project are attached to this health and safety plan in Section 16.0 (below).

13.0 POSTING OF NOTICE

Under provisions of Title 29, CFR Part 1903.2(a)(1), employers must post a notice, furnished by OSHA, informing employees of the protection and obligations provided for in OSHA Act of 1970. A state provided form may be used instead of the federal. The state form should be present whether or not the federal notice is used. Full-sized state and/or federal forms will be used, not a small copy of the federal form that is attached for information purposes only in Section 15.0 (below).

Where a site office is established, this notice will be posted in a conspicuous place or places where notices to employees are customarily posted. When working out of the cab of a vehicle, such notice is not required.

14.0 TOXIC SNAKE AND INSECT BITES AND PLANTS

14.1 Poisonous Snakebites

Reactions from snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from poisonous snakebite include: the amount of venom injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick antivenin therapy; and location of the bite.

First Aid Procedure

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration.

The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

1. Keep the victim from moving around.
2. Keep the victim as calm as possible and preferably in a lying position.
3. Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours and if no symptoms develop, no further first aid measures need be applied.
4. If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be ¾ to 1½ inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to be slipped underneath. Watch out for swelling. Loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not stopped.
5. If severe symptoms develop, make an incision and apply suction immediately. Apply a constricting band, if this has not already been done, and make a cut in the skin through the fang mark(s). Use a sharp, sterilized knife. Cuts should be 1/2 inch long, extending over the suspected venom deposit point. (Because a

snake strikes downward, the deposit point is usually lower than the fang mark.) Cuts should be made along the long axis of the limb. Do not make cross-cut incisions. Do not make cuts on the head, or trunk. Apply suction with a suction cup for 30 minutes. If a suction cup is not available, use the mouth. There is little risk to the rescuer who uses his mouth, but it is recommended that the venom not be swallowed and that the mouth be rinsed out.

If the hospital is not close, that is, if it cannot be reached in 4 or 5 hours, take the following measures:

- Keep trying to obtain professional care, either by transporting the victim to a place where medical care is available or by using an emergency communications system to obtain medical advice.
- If no symptoms develop, keep trying to reach the hospital and give the general first aid described above.
- If any symptoms at all develop, apply a constricting band, make incisions, and apply suction immediately, as described above in steps 4 and 5.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.
- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform cardiopulmonary resuscitation (CPR) if you have been trained to do so.
- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.
- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.
- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Some painkillers, however,

may be given. Consult a doctor or other medical personnel for specific medications that may be used.

- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of snakebite.

14.2 Poisonous Insect Bites

Spiders

Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (Latrodectus Mactans) and the Brown Recluse or violin spider (Lox Osceles Reclusa).

The symptoms of a Black Widow spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. Victims recover in almost all cases, but an occasional death is reported.

Field personnel should exercise caution when lifting covers off manholes, sumps, etc., since Black Widow spiders can typically be found in these areas.

Scorpions

Scorpions inject venom through a stinger in the tail. In bites from the more dangerous species, there are marked systemic effects within 1 to 2 hours. Fatalities have been recorded.

The symptoms of a scorpion bite are: excruciating pain at the site of the sting, nausea and vomiting, abdominal pain, shock, and possible development of convulsions and coma.

General First Aid for Poisonous Insect Bites:

1. Minor Bites and Stings

    - Cold applications.
    - Soothing lotions, such as calamine.

2. Severe Reactions

- Give artificial respiration if indicated.
- Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place.
- Keep the affected part down, below the level of the victim's heart.
- If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
- Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.
- Give home medicine, such as aspirin, for pain.
- If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.
- In case of a bee sting, remove and discard the stinging apparatus and venom sac.

14.3 Tickborne Diseases

Lyme Disease

Lyme disease is an illness caused by a bacterium which may be transmitted by the bite of a tick (Ixodes Dammini), commonly referred to as the "Deer Tick". The tick is about the size of a sesame seed, as distinguished from the Dog Tick, which is significantly larger. The Deer Tick is principally found along the Atlantic coast, living in grassy and wooded areas, and feeds on mammals such as mice, shrews, birds, raccoons, opossums, deer, and humans. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, but not firmly, until it releases its hold on the skin. Save the tick in a jar labelled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic and seek medical attention as soon as possible.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage treatment by a physician is usually effective; but, if left alone, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems which may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do not get the characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the changes of being bitten by a tick:

1. Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.

2. Wear light colored clothing so ticks can be easily spotted.

3. Wearing tick repellents may be useful.

4. Inspect clothing frequently while in tick habitat.

5. Inspect your head and body thoroughly when you return from the field.

6. Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin. Do not squeeze or crush it.

Rocky Mountain Spotted Fever

In the eastern and southern United States this tickborne disease is transmitted by the infected Dog Tick (Dermacentor Variabilis). It is important to note that the Dog Tick is significantly larger than the Deer Tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, shills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

Other Tickborne Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

14.4 Poisonous Plants

Characteristic Reactions

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and a rash.

Some of the most common and most severe allergic reactions result from contact with plants of the Poison Ivy group including Poison Oak and Poison Sumac. the most distinctive features of poison ivy and Poison Oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

First Aid Procedure

1. Remove contaminated clothing.

2. Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.

3. Apply calamine or other soothing skin lotion if the rash is mild.

4. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

15.0 HAZARDOUS MATERIALS SHIPPING

15.1 Basic Requirements

The U.S. Department of Transportation (DOT) regulates the packaging, marking, labeling, and transport of hazardous materials in commerce. Dames & Moore personnel may become involved in transporting hazardous materials through laboratory, sampling, decontamination, or other activities. For example, concentrated acid may be taken to a field site to fix a sample; samples gathered for laboratory analysis could contain concentrations adequate to fulfill one or more hazard class definitions and therefore be considered hazardous; or calibration gas may have to be shipped to a field location. DOT allows the use of International Civil Aviation Organization (ICAO) technical instructions, or International Air Transportation Association (IATA) air shipping regulations; some air carriers (e.g., Federal Express) follow IATA regulations instead of DOT domestic regulations.

Note that EPA hazardous waste regulations do not apply to samples taken from hazardous waste sites due to the exclusion in the Resource Conservation and Recovery Act (40 CFR 261.4) that exempts samples taken for laboratory analysis from EPA manifesting, transportation, and storage requirements. However, classification and packaging of the samples as hazardous material, if such is the case, is still required.

Whether the hazardous materials are samples, reagents, or other materials, DOT hazardous materials regulations apply, and civil and criminal penalties are possible for noncompliance. In particular, the person who offers hazardous materials for shipment or transports non-exempt quantities of hazardous materials must sign a manifest declaring that the materials are properly packaged, marked, and labeled.

Personnel involved in the transportation of any hazardous materials, whether preservatives, decontamination or calibration chemicals, or DOT hazardous samples, must be trained. Section 8.5 above, *Additional Training Requirements*, summarizes this DOT requirement.

15.2 Shipping Identified Hazardous Materials

The Hazardous Materials Transportation Table (49 CFR 172.101) or the IATA List of Dangerous Goods is the starting point for handling hazardous materials properly. By following the instructions in the appropriate table and accompanying regulations, the proper container, packaging, marking, labeling, and manifesting requirements will be met. Those who will be packaging or transporting hazardous materials should obtain a copy of the pertinent regulations. What follows is information specifically on samples, since sample shipping decisions can be difficult unless sample constitutents are identified through DOT-related testing in a laboratory.

Samples that fulfill hazard class definitions have the same transportation requirements as other hazardous materials; however, a problem arises when samples are presumed hazardous but the constituents are unknown. For such cases the following guidance has been developed. Any manifest, whether for identified hazardous materials or for samples considered hazardous, should have:

- The emergency response phone number.
- The emergency response guide number next to each Proper Shipping Name.
- The letters "RQ" at the beginning of the Proper Shipping Name, when applicable.

15.3 Shipping Samples

The following general guidelines have been developed to aid in determining whether a sample should be considered hazardous for compliance with the Department of Transportation (DOT) and International Air Transport Association (IATA) shipping regulations. Samples may not frequently meet the DOT or IATA definition of a hazardous material; however, the following guidelines should be considered when shipping samples to prevent inadvertent shipment of hazardous samples as non-hazardous.

Samples should be considered hazardous when any of the following conditions have been met:

- Samples of neat chemicals collected from drums or containers, of free product, or of hazardous waste streams that are listed in the hazardous materials tables and meet the DOT or IATA defnition of a hazardous material.
- Liquid samples that have a pH of less than 2 or greater than 12.5. Samples preserved in accordance with SW-846 or 40 CFR 136 that are preserved with acids or bases are not considered to be DOT hazardous by reason of low or high pH; but this does not preclude the sample from being hazardous due to its other characteristics.

- Samples that are believed to contain hydrocarbons (including chlorinated hydrocarbons) and exhibit a head space reading of 10 ppm or greater.
- Samples that contain radioactive materials with an activity of greater than 0.002 microCuries/gram.
- Samples containing pesticides in concentrations that may potentially approach the percentage concentrations listed in Table 3.6.D of the IATA regulations. Note that most pesticides listed in this table must be at a concentration of 10,000 ppm or greater to be considered hazardous.

Samples that do not meet the criteria of a hazard class or division are not considered hazardous and do not have to be shipped as a hazardous material.

It is believed most contaminated soil and water samples that exhibit headspace readings in excess of the above criteria will have Proper Shipping Names of "Environmentally hazardous substance, liquid, n.o.s. UN 3082" or "Environmentally hazardous substance, solid, n.o.s. UN 3077." The packing group associated with this Proper Shipping Name is always Packing Group III. This will not be the case when samples collected exhibit significant amounts of free product, the sample is saturated with product, or immiscible liquids are present that meet the definition of a hazardous material. Such samples should be called "Flammable liquid, n.o.s. UN 1993" or whatever Proper Shipping Name best applies to the specific conditions. The packing group for these materials will generally fall into the Packing Group II category, or whichever Packing Group is associated with that Proper Shipping Name, unless that material does not meet the criteria of the assigned Packing Group.

The particular requirements for samples shipped from this site are:

- **[insert proper shipping name and UN/ID number]**
- **[insert the specification number for inner and outer packaging]**
- **[insert other special instructions; e.g., "Cargo Aircraft Only," etc.**

The bullets above should be repeated for each sample type they apply to; e.g., samples of free product from beneath a leaching UST, soil samples from Area A, etc.

16.0 FORMS

The following forms will be provided to the SSC during final preparations for departure to the job site:

- Federal Safety Poster
- Daily Instrument Calibration Checksheet
- Air Monitoring Data Sheet
- Plan Acceptance Form
- Plan Feedback Form
- Accident/Exposure Report Form
- Site Safety Briefing Form.

The Plan Acceptance Form will be filled out by all employees working on the site. The Plan Feedback Form will be filled out by the SSC and any other on-site employee who wishes to fill one out. The Accident Report Form will be filled out by the Project Manager if an accident occurs. The Site Safety Briefing Form will be filled out by the SSC and signed by all persons who received the site safety briefing.

ALL COMPLETED FORMS SHOULD BE RETURNED TO THE OFFICE OSC FOR RETENTION IN PROJECT FILES.

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

Bill Brock

William E. Brock, Secretary of Labor

U.S. Department of Labor
Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

DAILY INSTRUMENT CALIBRATION CHECK SHEET

PROJECT NAME: ______________________________
PROJECT NUMBER: ______________________________
INSTRUMENT(S): ______________________________
SERIAL #(S): ______________________________

Date	Pure Air (Y/N)	Calibration Gas (PPM)	Battery Check (Good/Bad)	Calibrated By	Remarks

- *PROPER CALIBRATION OF INSTRUMENTS SHALL BE CONDUCTED IMMEDIATELY PRIOR TO SITE ACTIVITIES. USING FELT TIP PENS/MARKERS OR SIMILAR ITEMS IS NOT CONSIDERED PROPER CALIBRATION AND IS NOT ACCEPTABLE.*

AIR MONITORING DATA SHEET

SAMPLED BY: ____________ PROJECT NAME: ____________

DATE: ____________ PROJECT NUMBER: ____________

INSTRUMENT USED: ____________ CALIBRATION DATE: ____________

ESTIMATED WIND DIRECTION: ☐ N ☐ S ☐ E ☐ W ☐ NE ☐ NW ☐ SE ☐ SW

ESTIMATED WIND SPEED: ☐ CALM ☐ MODERATE ☐ STRONG

FIELD ACTIVITIES: ____________

BACKGROUND LEVEL: ____________ LOCATION: ____________

Sample Number	Time	Duration (Minutes)	Location	Reading (PPM)	Comments
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

PLAN ACCEPTANCE FORM

PROJECT HEALTH & SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each Dames & Moore employee to work on the subject project work site and returned to the Office Safety Coordinator prior to site activities.

Project No.: ____________________

Client/Project: ____________________

Date: ____________________

I represent that I have read and understand the contents of the above Plan and agree to perform my work in accordance with it.

____________________ Signed	____________________ Signed
____________________ Print Name	____________________ Print Name
____________________ Date	____________________ Date
____________________ Signed	____________________ Signed
____________________ Print Name	____________________ Print Name
____________________ Date	____________________ Date

PLAN FEEDBACK FORM
(OPTIONAL)

Project Number: ______________________________

Project Name: ______________________________

Date: ______________________________

Problems with plan requirements:

____
____
____
____
____

Unexpected situations encountered:

____
____
____
____
____

Recommendations for future revisions:

____
____
____
____
____

DAMES & MOORE

Accident/Exposure Report

EMPLOYEE NAME____________________ DATE OF BIRTH __________

HOME ADDRESS____________________ PHONE NO.__________

SEX: MALE____ FEMALE____ JOB TITLE______________ SOCIAL SECURITY NO.__________

OFFICE NO.________ OFFICE LOCATION______________ DATE OF HIRE __________

HOURS USUALLY WORKED: HOURS PER DAY________ HOURS PER WEEK________ TOTAL HOURS WEEKLY________

WHERE DID ACCIDENT OR EXPOSURE OCCUR? (INCLUDE ADDRESS)______________________

COUNTY____________ ON EMPLOYER'S PREMISES? YES______ NO______

WHAT WAS EMPLOYEE DOING WHEN INJURED? (BE SPECIFIC)______________________

HOW DID THE ACCIDENT OR EXPOSURE OCCUR? (DESCRIBE FULLY)______________________

WHAT STEPS COULD BE TAKEN TO PREVENT SUCH AN OCCURRENCE?______________________

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE______________________

DESCRIBE THE INJURY OR ILLNESS______________ PART OF BODY AFFECTED__________

NAME AND ADDRESS OF PHYSICIAN______________________

IF HOSPITALIZED, NAME AND ADDRESS OF HOSPITAL______________________

DATE OF INJURY/ILLNESS__________ TIME OF DAY__________ LOSS OF ONE OR MORE DAY OF WORK? YES/NO______

IF YES-DATE LAST WORKED__________

HAS EMPLOYEE RETURNED TO WORK?______ IF YES-DATE RETURNED________ DID EMPLOYEE DIE?______ IF YES-DATE________

COMPLETED BY (PRINT)____________________ SIGNATURE____________________

TITLE____________________ DATE____________________

An accident/exposure report must be completed by the supervisor or site safety officer immediately upon learning of the incident. The completed report must be immediately transmitted to the office administrative manager.

HS 210A

SITE SAFETY BRIEFINGS

Job Name______________________________ Number ________________

Date______________ Start Time__________ Completed ______________

Site Location____

Type of Work (General)____

****

SAFETY ISSUES

Tasks (this shift)____

____

Protective Clothing/Equipment__________________________________

____

Chemical Hazards____

____

Physical Hazards____

____

Control Methods____

____

____

Special Equipment/Techniques___________________________________

____

Nearest Phone____

Hospital Name/Address____

Special Topics (incidents, actions taken, etc.)________________

____

____

****

ATTENDEES

Print Name	Sign Name

Meeting conducted by: ____

17.0 MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheet

from Genium's Reference Collection

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 674

ISOBUTYLENE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: ISOBUTYLENE

Description (Origin/Uses): Obtained from refinery steams by absorption on 65% sulfuric acid (H_2SO_4) at 59°F (15°C). Used primarily to produce diisobutylene, trimers, butyl rubber, and other polymers; also used to produce antioxidants for foods, plastics, and packaging food supplements.

NFPA

HMIS
H 1
F 4
R 0
PPG*
*See sect. 8

R 1
I 1
S 1
K 4

Other Designations: Isobutene; 2-Methylpropene; *gamma*-Butylene; $CH_2{=}C(CH_3)_2$; CAS No. 0115-11-7

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Isobutylene, CAS No. 0115-11-57 *Monitor NIOSH, *RTECS* (UD0890000), for additional data.	Ca 100	OSHA PEL None Established ACGIH TLV, 1988-89 None Established NIOSH REL None Established Toxicity Data* Rat, Inhalation, LC_{50}: 620 g/m³ (4 Hrs) Mouse, Inhalation, LC_{50}: 415 g/m³ (2 Hrs)

SECTION 3. PHYSICAL DATA

Boiling Point: -19.6°F (-6.9°C)
Melting Point: -220°F (-140°C)
Vapor Density (Air = 1): 1.9
Specific Gravity (H_2O = 1): Ca 0.6

Molecular Weight: 56 Grams/Mole
Solubility in Water (%): Insoluble*
% Volatile by Volume: 100

Appearance and Odor: A colorless, extremely flammable gas; odor not listed.

*Isobutylene is very soluble in alcohol, ether, and sulfuric acid.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature: 869°F (465°C)	LEL: 1.8% v/v	UEL: 9.6% v/v

Extinguishing Media: Isobutylene gas is an extremely flammable gas that has a substantial explosive air-gas range. For isobutylene fires, the recommended fire-fighting technique is to stop the flow of gas instead of extinguishing the fire. If the flames are extinguished and the isobutylene gas continues to escape or leak, an explosive air-gas mixture can form quickly and ignite without warning. A resulting explosion could cause greater damage than that which would be caused by allowing the fire to burn itself out. If the fire must be extinguished to allow safe access to shutoff valves, recommended extinguishing agents include CO_2 and dry chemical. **Unusual Fire or Explosion Hazards:** In many cases, the preferred strategy is to allow the flames to continue to burn and to cool the surroundings with water spray to prevent ignition of nearby combustibles. Isobutylene gas is heavier than air and can collect in low-lying, confined spaces. Potentially explosive air-gas mixtures are especially likely to build up in such an area, so enter it with extreme caution whether or not it is presently involved in a fire. Possible sources of ignition must not be brought into any area suspected of containing substantial concentrations of isobutylene gas. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

* Sax (Genium ref. 6) reports a flash point of -105°F (-76°C) for isobutylene.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Isobutylene is stable in closed, pressurized containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Isobutylene can react dangerously with strong oxidizing materials. **Conditions to Avoid:** Prevent exposing isobutylene to any source of ignition such as an open flame, sparks, lighted tobacco products, or steam lines. **Hazardous Products of Decomposition:** Isobutylene fires can produce toxic gases such as carbon monoxide (CO) or lower-molecular-weight hydrocarbons. **Comments:** The extreme flammability of isobutylene means that any reactions involving this material, including nonhazardous ones, must be performed carefully in order to prevent fires and/or explosions.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Isobutylene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Isobutylene is a simple asphyxiant. As such it will not cause significant physiological responses, but it can displace the minimum required atmospheric oxygen level. Significant displacement by isobutylene results in an oxygen-deficient atmosphere with no adequate warning properties. Asphyxiation fatalities can occur especially in confined, low-lying, poorly ventilated spaces because isobu-

SECTION 6. HEALTH HAZARD INFORMATION, cont.

lene gas is almost twice as dense as air itself (see sect. 3). **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** None reported. *Primary Entry:* Inhalation. **Acute Effects:** Initial symptoms of the effects of simple asphyxiant gases are rapid respiration and air hunger, diminished mental alertness, and impaired muscular coordination. Continuing lack of oxygen causes faulty judgment, depression of all sensations, rapid fatigue, and emotional instability. As the asphyxia continues, nausea; vomiting; prostration; loss of consciousness; and, finally, convulsions; deep coma; and death can occur. **Chronic Effects:** None reported.
FIRST AID: **Inhalation.** Would-be rescuers need to be concerned about their own safety when entering confined, poorly ventilated, oxygen-deficient areas. Self-contained breathing equipment must be readily available for rescuers. Station standby workers outside the immediate area so that they can summon additional help if it is needed. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Comments:** The extreme flammability of isobutylene gas warrants special attention even during rescue operations. Rescue personnel must not smoke. All emergency lamps and floodlights that must be lowered into enclosed areas for rescue operations must be explosion proof. Obtain this equipment before any emergency occurs and make it accessible to emergency-response personnel. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: *Treat any isobutylene gas leak as an emergency.* If the leaking gas has not yet ignited, use water spray to direct flammable gas-air mixtures away from sources of ignition. Extinguish all sources of ignition as quickly as possible; however, if the leaking gas is burning, do not attempt to extinguish the flames until the source of the isobutylene gas is located and sealed. Otherwise, flammable isobutylene gas-air mixtures can explode without warning and cause widespread damage that might not have occurred if the original fire had been allowed to burn itself out. If it is necessary to extinguish isobutylene flames in order to gain access to a shutoff valve, use dry chemical or carbon dioxide as extinguishing agents. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z): Not Listed
EPA Designations (40 CFR 302.4): Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

Respirator: Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres, which lack warning properties; to work in them safely requires that an SCBA be worn. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the lower explosive limit cited in section 4. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale isobutylene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store isobutylene in closed, pressurized containers in a cool, dry, well-ventilated area away from sources of ignition, combustible materials, and strong oxidizers. Protect containers from physical damage. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Electrically ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent static sparks. **Comments:** Isobutylene is an extremely explosive and flammable gas. It must not be exposed to any possible source of ignition in work or storage areas.

Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Liquefied Petroleum Gas
DOT Hazard Class: Flammable Gas
ID No. UN1055
DOT Label: Flammable Gas
DOT Packaging Requirements: 49 CFR 173.304, .314, .315
DOT Packaging Exceptions: 49 CFR 173.306

IMO Shipping Name: Isobutylene
IMO Hazard Class: 2.1
IMO Label: Flammable Gas

References: 1, 6, 84-94, 116, 117, 120, 122.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

Material Safety Data Sheet
Required under USDL Safety and Health Regulations for Shipyard Employment (29 CFR 1915)

U.S. Department of Labor
Occupational Safety and Health Administration

OMB No 1218-0074
Expiration Date 05/31/86

PREPARED 1/10/86

Section I

Manufacturer's Name ALCONOX, INC.		Emergency Telephone Number (212) 473-1300	
Address (Number, Street, City, State and ZIP Code) 215 PARK AVENUE SOUTH		Chemical Name and Synonyms	N.A.
NEW YORK, N.Y. 10003		Trade Name and Synonyms	LIQUI-NOX
		Chemical Family ANIONIC DETERGENT	Formula N.A.

Section II - Hazardous Ingredients

Paints, Preservatives, and Solvents	%	TLV (Units)	Alloys and Metallic Coatings	%	TLV (Units)
Pigments NONE			Base Metal NONE		
Catalyst NONE			Alloys NONE		
Vehicle NONE			Metallic Coatings NONE		
Solvents ETHYLENE GLYCOL MONO-BUTYL ETHER	4	25	Filler Metal Plus Coating or Core Flux NONE		
Additives NONE			Others NONE		
Others NONE					

Hazardous Mixtures of Other Liquids, Solids or Gases	%	TLV (Units)
NONE		

Section III - Physical Data

Boiling Point (°F)	210	Specific Gravity (H_2O=1)	1.065
Vapor Pressure (mm Hg)	NO DATA	Percent Volatile by Volume (%)	34
Vapor Density (AIR=1)	NO DATA	Evaporation Rate (________ =1)	SLOWER THAN ETHER

Solubility in Water COMPLETE

Appearance and Odor YELLOW LIQUID - PRACTICALLY ODORLESS

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) NONE (CLOSED CUP)	Flammable Limits NA	Lel NA	Uel NA

Extinguishing Media WATER, CO_2, DRY CHEMICAL, FOAM, SAND/EARTH

Special Fire Fighting Procedures FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER WITHOUT PROTECTIVE EQUIPMENT AND SELF CONTAINED BREATHING APPARATUS

Unusual Fire and Explosion Hazards NONE

Section V - Health Hazard Data

Threshold Limit Value: NO DATA AVAILABLE

Effects of Overexposure: CONTACT WITH EYES AND MUCOUS MEMBRANES MAY BE IRRITATING

Emergency First Aid Procedures: EYES-FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SKIN-FLUSH WITH PLENTY OF WATER. INGESTION - INDUCE VOMITING AND CONSULT A PHYSICIAN.

Section VI - Reactivity Data

Stability	Unstable		Conditions to Avoid NONE
	Stable X		

Incompatability (Materials to Avoid): STRONG OXIDIZING AGENTS

Hazardous Decomposition Products: CO, CO_2, SO_2, MAY BE RELEASED ON BURNING

Hazardous Polymerization	May Occur		Conditions to Avoid NONE
	Will Not Occur X		

Section VII - Spill or Leak Procedures

Steps to be Taken in Case Material is Released or Spilled: MATERIAL FOAMS PROFUSELY. RECOVER AS MUCH AS POSSIBLE WITH ABSORBENT MATERIAL AND RINSE REMAINDER TO SEWER. MATERIAL IS COMPLETELY BIODEGRADABLE.

Waste Disposal Method: SMALL QUANTITIES MAY BE DISPOSED OF IN SEWER. LARGE QUANTITIES SHOULD BE SOAKED UP WITH ABSORBENT MATERIAL AND DISPOSED OF ACCORDING TO LOCAL REQUIREMENTS FOR NON-HAZARDOUS DETERGENT.

Section VIII - Special Protection Information

Respiratory Protection (Specify Type): NOT NECESSARY

Ventilation	Local Exhaust: NORMAL	Special: N.A.
	Mechanical (General): N.A.	Other: N.A.

Protective Gloves: REQUIRED	Eye Protection: REQUIRED

Other Protective Equipment

Section IX - Special Precautions

Precautions to be Taken in Handling and Storing: NONE REQUIRED - VISCOSITY OF MATERIAL INCREASES AT VERY LOW TEMPERATURES.

Other Precautions: NO SPECIAL REQUIREMENTS OTHER THAN THE GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES EMPLOYED WITH ANY INDUSTRIAL CHEMICAL.

DATE: 04/19/91 ACCT: 192095-01
INDEX: 01911070364 CAT NO: A206C212 PO NBR: 02492-014-5355

NITRIC ACID
NITRIC ACID
NITRIC ACID

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

SUBSTANCE: **NITRIC ACID**

TRADE NAMES/SYNONYMS:
AQUA FORTIS; WFNA; RFNA; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; NITAL; STCC 4918528; UN 2031; A200; A200C; A200S; A202; A206C; A509; A467; A200SI; A198C; A483; HNO3; ACC16550

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3

MOLECULAR WEIGHT: 63.01

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NITRIC ACID PERCENT: 70

COMPONENT: WATER PERCENT: 30

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NITRIC ACID:
2 PPM (5 MG/M3) OSHA TWA; 4 PPM (10 MG/M3) OSHA STEL
2 PPM (5 MG/M3) ACGIH TWA; 4 PPM (10 MG/M3) ACGIH STEL
2 PPM NIOSH RECOMMENDED 10 HOUR TWA

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS TO PALE YELLOW LIQUID WITH A SUFFOCATING ODOR.

BOILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5027 @ 25 C VAPOR PRESSURE: 47.9 MMHG @ 20 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: VERY SOLUBLE

VAPOR DENSITY: 3.2

SOLVENT SOLUBILITY: SOLUBLE IN ETHER.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:

WATER, DRY CHEMICAL OR SODA ASH
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM AREA AND LET FIRE BURN (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 44).

USE FLOODING AMOUNTS OF WATER AS FOG. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS. KEEP UPWIND. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
  OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
  OXIDIZER AND CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.268
EXCEPTIONS: NONE

TOXICITY

NITRIC ACID:
TOXICITY DATA:
  ANHYDROUS: 110 MG/KG UNREPORTED-MAN LDLO; 430 MG/KG ORAL-HUMAN LDLO; REPRODUCTIVE EFFECTS DATA (RTECS).
  MONOHYDRATE: NO DATA AVAILABLE.
  TRIHYDRATE: NO DATA AVAILABLE.
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYES, INGESTION.
ACUTE TOXICITY LEVEL: INSUFFICIENT DATA.
TARGET EFFECTS: NO DATA AVAILABLE.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH IMPAIRED PULMONARY FUNCTION, PRE-EXISTING EYE AND SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NITRIC ACID:
CORROSIVE. 100 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
  ACUTE EXPOSURE- INHALATION OF ACIDIC SUBSTANCES MAY CAUSE SEVERE RESPIRATORY IRRITATION WITH COUGHING, CHOKING, AND POSSIBLY YELLOWISH BURNS OF THE MUCOUS MEMBRANES. OTHER INITIAL SYMPTOMS MAY INCLUDE DIZZINESS, HEADACHE, NAUSEA, AND WEAKNESS. PULMONARY EDEMA MAY BE IMMEDIATE IN THE MOST SEVERE EXPOSURES, BUT MORE LIKELY WILL OCCUR AFTER A LATENT PERIOD OF 5-72 HOURS. THE SYMPTOMS MAY INCLUDE TIGHTNESS IN THE CHEST, DYSPNEA, DIZZINESS, FROTHY SPUTUM, AND CYANOSIS. PHYSICAL FINDINGS MAY INCLUDE HYPOTENSION, WEAK, RAPID PULSE, MOIST RALES, AND HEMOCONCENTRATION. IN NON-FATAL CASES, COMPLETE RECOVERY MAY OCCUR WITHIN A FEW DAYS OR WEEKS OR, CONVALESCENCE MAY BE PROLONGED WITH FREQUENT RELAPSES AND CONTINUED DYSPNEA AND OTHER SIGNS AND SYMPTOMS OF PULMONARY INSUFFICIENCY. IN SEVERE EXPOSURES, DEATH DUE TO ANOXIA MAY OCCUR WITHIN A FEW HOURS AFTER ONSET OF THE SYMPTOMS OF PULMONARY EDEMA OR FOLLOWING A RELAPSE.
  CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED EXPOSURE TO AN ACIDIC SUBSTANCE MAY CAUSE EROSION OF THE TEETH, INFLAMMATORY AND ULCERATIVE CHANGES IN THE MOUTH, AND POSSIBLY JAW NECROSIS. BRONCHIAL IRRITATION WITH COUGH AND FREQUENT ATTACKS OF BRONCHIAL PNEUMONIA MAY OCCUR. GASTROINTESTINAL DISTURBANCES ARE ALSO POSSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
NITRIC ACID:
CORROSIVE.
  ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR VAPOR MAY CAUSE SEVERE PAIN, BURNS AND POSSIBLY YELLOWISH STAINS. BURNS MAY BE DEEP WITH SHARP EDGES AND HEAL SLOWLY WITH SCAR TISSUE FORMATION. DILUTE SOLUTIONS OF NITRIC ACID MAY PRODUCE MILD IRRITATION AND HARDEN THE EPIDERMIS WITHOUT DESTROYING IT.

CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED CONTACT WITH ACIDIC SUBSTANCES MAY RESULT IN DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
NITRIC ACID:
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT WITH ACIDIC SUBSTANCES MAY CAUSE PAIN AND LACRIMATION, PHOTOPHOBIA, AND BURNS, POSSIBLY SEVERE. THE DEGREE OF INJURY DEPENDS ON THE CONCENTRATION AND DURATION OF CONTACT. IN MILD BURNS, THE EPITHELIUM REGENERATES RAPIDLY AND THE EYE RECOVERS COMPLETELY. IN SEVERE CASES, THE EXTENT OF INJURY MAY NOT BE FULLY APPARENT FOR SEVERAL WEEKS. ULTIMATELY, THE WHOLE CORNEA MAY BECOME DEEPLY VASCULARIZED AND OPAQUE RESULTING IN BLINDNESS. IN THE WORST CASES, THE EYE MAY BE TOTALLY DESTROYED. CONCENTRATED NITRIC ACID MAY IMPART A YELLOW COLOR TO THE EYE UPON CONTACT.

CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED EXPOSURE TO ACIDIC SUBSTANCES MAY CAUSE CONJUNCTIVITIS OR EFFECTS AS IN ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NITRIC ACID:
CORROSIVE.

ACUTE EXPOSURE- ACIDIC SUBSTANCES MAY CAUSE CIRCUMORAL BURNS WITH YELLOW DISCOLORATION AND CORROSION OF THE MUCOUS MEMBRANES OF THE MOUTH, THROAT AND ESOPHAGUS. THERE MAY BE IMMEDIATE PAIN AND DIFFICULTY OR INABILITY TO SWALLOW OR SPEAK. EPIGLOTTAL EDEMA MAY RESULT IN RESPIRATORY DISTRESS AND POSSIBLY ASPHYXIA. MARKED THIRST, EPIGASTRIC PAIN, NAUSEA, VOMITING AND DIARRHEA MAY OCCUR. DEPENDING ON THE DEGREE OF ESPOHAGEAL AND GASTRIC CORROSION, THE VOMITUS MAY CONTAIN FRESH OR DARK PRECIPITATED BLOOD AND LARGE SHREDS OF MUCOSA. SHOCK WITH MARKED HYPOTENSION, WEAK, RAPID PULSE, SHALLOW RESPIRATION, AND CLAMMY SKIN MAY OCCUR. CIRCULATORY COLLAPSE MAY ENSUE AND IF UNCORRECTED, LEAD TO RENAL FAILURE. IN SEVERE CASES, GASTRIC, AND TO A LESSER DEGREE, ESOPHAGEAL PERFORATION AND SUBSEQUENT PERITONITIS MAY OCCUR AND BE ACCOMPANIED BY FEVER AND ABDOMINAL RIGIDITY. ESOPHAGEAL, GASTRIC ANC PYLORIC STRICTURE MAY OCCUR WITHIN A FEW WEEKS, BUT MAY BE DELAYED FOR MONTHS OR EVEN YEARS. DEATH MAY RESULT WITHIN A SHORT TIME FROM ASPHYXIA, CIRCULATORY COLLAPSE OR ASPIRATION OF EVEN MINUTE AMOUNTS. LATER DEATH MAY BE DUE TO PERITONITIS, SEVERE NEPHRITIS OR PNEUMONIA. COMA AND CONVULSIONS SOMETIMES OCCUR TERMINALLY.

CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION, REPEATED INGESTION OF ACIDIC SUBSTANCES MAY RESULT IN INFLAMMATORY AND ULCERATIVE CHANGES IN THE MUCOUS MEMBRANES OF THE MOUTH AND OTHER EFFECTS AS IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER.

INCOMPATIBILITIES:
NITRIC ACID:
ACETIC ACID: MAY REACT EXPLOSIVELY.
ACETIC ANHYDRIDE: EXPLOSIVE REACTION BY FRICTION OR IMPACT.
ACETONE: MAY REACT EXPLOSIVELY.
ACETONITRILE: EXPLOSIVE MIXTURE.
4-ACETOXY-3-METHOXYBENZALDEHYDE: EXOTHERMIC REACTION.
ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ACRYLONITRILE: EXPLOSIVE REACTION AT 90 C.
ACRYLONITRILE-METHACRYLATE COPOLYMER: INCOMPATIBLE.
ALCOHOLS: POSSIBLE VIOLENT REACTION OR EXPLOSION; FORMATION OF EXPLOSIVE COMPOUND IN THE PRESENCE OF HEAVY METALS.
ALKANETHIOLS: EXOTHERMIC REACTION WITH POSSIBLE IGNITION.
2-ALKOXY-1,3-DITHIA-2-PHOSPHOLANE: IGNITION REACTION.
ALLYL ALCOHOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ALLYL CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

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AMINES (ALIPHATIC OR AROMATIC): POSSIBLE IGNITION REACTION.
2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
2-AMINOTHIAZOLE: EXPLOSIVE REACTION.
AMMONIA (GAS): BURNS IN AN ATMOSPHERE OF NITRIC ACID VAPOR.
AMMONIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
AMMONIUM NITRATE: FORMS EXPLOSIVE MIXTURE.
ANILINE: IGNITES ON CONTACT.
ANILINIUM NITRATE: FORMS EXPLOSIVE SOLUTION.
ANION EXCHANGE RESINS: POSSIBLE VIOLENT EXOTHERMIC REACTION.
ANTIMONY: VIOLENT REACTION.
ARSINE: EXPLOSIVE REACTION.
ARSINE-BORON TRIBROMIDE: VIOLENT OXIDATION.
BASES: REACTS.
BENZENE: EXPLOSIVE REACTION.
BENZIDINE: SPONTANEOUS IGNITION.
BENZONITRILE: POSSIBLE EXPLOSION.
BENZOTHIOPHENE DERIVATIVES: FORMATION OF POSSIBLY EXPLOSIVE COMPOUNDS.
N-BENZYL-N-ETHYLANILINE: VIGOROUS DECOMPOSITION.
1,4-BIS(METHOXYMETHYL)2,3,5,6-TETRAMETHYLBENZENE: GAS EVOLUTION.
BISMUTH: INTENSE EXOTHERMIC REACTION OR EXPLOSION.
1,3-BIS(TRIFLUOROMETHYL)BENZENE: POSSIBLE EXPLOSION.
BORON: VIOLENT REACTION WITH INCANDESCENCE.
BORON DECAHYDRIDE: EXPLOSIVE REACTION.
BORON PHOSPHIDE: IGNITION REACTION.
BROMINE PENTAFLUORIDE: IGNITION REACTION.
N-BUTYL MERCAPTAN: IGNITION REACTION.
N-BUTYRALDEHYDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CADMIUM PHOSPHIDE: EXPLOSIVE REACTION.
CALCIUM HYPOPHOSPHITE: IGNITION REACTION.
CARBON (PULVERIZED): VIOLENT REACTION.
CELLULOSE: FORMS EASILY COMBUSTIBLE ESTER.
CHLORATES: REACTS.
CHLORINE: INCOMPATIBLE.
CHLORINE TRIFLUORIDE: VIOLENT REACTION.
CHLOROBENZENE: POSSIBLE EXPLOSION.
4-CHLORO-2-NITROANILINE: FORMS EXPLOSIVE COMPOUND.
CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
COAL: EXPLOSIVE MIXTURE.
COATINGS: MAY BE ATTACKED.
CRESOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CROTONALDEHYDE: VIOLENT DECOMPOSITION WITH IGNITION.
CUMENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CUPRIC NITRIDE: EXPLOSIVE REACTION.
CUPROUS NITRIDE: VIOLENT REACTION.
CYANATES: POSSIBLE EXPLOSIVE REACTION.
CYCLOHEXANONE: VIOLENT REACTION.
CYCLOHEXYLAMINE: FORMS EXPLOSIVE COMPOUND.
CYCLOPENTADIENE: EXPLOSIVE REACTION.
1,2-DIAMINOETHANEBIS(TRIMETHYLGOLD): EXPLOSIVE REACTION.
DIBORANE: SPONTANEOUS IGNITION.
DI-2-BUTOXYETHYL ETHER: VIOLENT DECOMPOSITION REACTION.
2,6-DI-T-BUTYL PHENOL: FORMATION OF EXPLOSIVE COMPOUND.
DICHLOROETHANE: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
DICHLOROETHYLENE: FORMS EXPLOSIVE COMPOUND.
DICHLOROMETHANE: FORMS EXPLOSIVE SOLUTION.
DICYCLOPENTADIENE: SPONTANEOUS IGNITION.
DIENES: IGNITION REACTION.
DIETHYLAMINO ETHANOL: POSSIBLE EXPLOSION.
DIETHYL ETHER: POSSIBLE EXPLOSION.
3,6-DIHYDRO-1,2,2H-OXAZINE: EXPLOSIVE INTERACTION.
DIISOPROPYL ETHER: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
DIMETHYLAMINOMETHYLFERROCENE: VIOLENT DECOMPOSITION IF HEATED.
DIMETHYL ETHER: FORMS EXPLOSIVE COMPOUND.
DIMETHYL HYDRAZINE: IGNITES ON CONTACT.
DIMETHYL SULFOXIDE + 1,4-DIOXANE: EXPLOSION.
DIMETHYL SULFOXIDE + <14% WATER: EXPLOSIVE REACTION.
DINITROBENZENE: EXPLOSION HAZARD.
DINITROTOLUENE: EXPLOSIVE REACTION.
DIOXANE + PERCHLORIC ACID: POSSIBLE EXPLOSION.
DIPHENYL DISTIBENE: EXPLOSIVE OXIDATION.
DIPHENYL MERCURY + CARBON DISULFIDE: VIOLENT REACTION.
DIPHENYL TIN: IGNITION REACTION.
DISODIUM PHENYL ORTHOPHOSPHATE: VIOLENT EXPLOSION.
DIVINYL ETHER: POSSIBLE IGNITION REACTION.
EPICHLOROHYDRIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
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ANESL   MIDE   OSIV   TION
ETHOXY-ETHYLENE DITHIOPHOSPHATE: IGNITION ON CONTACT.
N-ETHYL ANILINE: IGNITION REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENE GLYCOL: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
ETHYLENEIMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
5-ETHYL-2-METHYL PYRIDINE: EXPLOSIVE REACTION.
ETHYL PHOSPHINE: IGNITION REACTION.
5-ETHYL-2-PICOLINE: FORMS EXPLOSIVE COMPOUNDS.
FERROUS OXIDE (POWDERED): INTENSE EXOTHERMIC REACTION.
FLUORINE: POSSIBLE EXPLOSIVE REACTION.
FORMIC ACID: EXOTHERMIC REACTION WITH RELEASE OF TOXIC GASES.
2-FORMYLAMINO-1-PHENYL-1,3-PROPANEDIOL: POSSIBLE EXPLOSION.
FUEL OIL (BURNING): EXPLOSION.
FULMINATES: REACTS.
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FURFURYLIDENE KETONES: IGNITES ON CONTACT.
GERMANIUM: VIOLENT REACTION.
GLYCEROL: POSSIBLE EXPLOSION.
GLYOXAL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HEXALITHIUM DISILICIDE: EXPLOSIVE REACTION.
HEXAMETHYLBENZENE: POSSIBLE EXPLOSION.
2,2,4,4,6,6-HEXAMETHYLTRITHIANE: EXPLOSIVE OXIDATION.
HEXENAL: EXPLODES ON HEATING.
HYDRAZINE: VIOLENT REACTION.
HYDRAZOIC ACID: ENERGETIC REACTION.
HYDROGEN IODIDE: IGNITION REACTION.
HYDROGEN PEROXIDE: FORMS UNSTABLE MIXTURE.
HYDROGEN PEROXIDE AND KETONES: FORMS EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN PEROXIDE AND THIOUREA: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN SELENIDE: IGNITION REACTION.
HYDROGEN SULFIDE: INCANDESCENT REACTION.
HYDROGEN TELLURIDE: IGNITION AND POSSIBLE EXPLOSIVE REACTION.
INDANE AND SULFURIC ACID: EXPLOSIVE REACTION.
ISOPRENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
KETONES (CYCLIC): VIOLENT REACTION.
LACTIC ACID + HYDROFLUORIC ACID: EXPLOSIVE REACTION.
LITHIUM: IGNITION REACTION.
LITHIUM SILICIDE: INCANDESCENT REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
MAGNESIUM + 2-NITROANILINE: MAY IGNITE ON CONTACT.
MAGNESIUM PHOSPHIDE: INCANDESCENT REACTION.
MAGNESIUM SILICIDE: VIOLENT REACTION.
MAGNESIUM-TITANIUM ALLOY: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
MANGANESE (POWDERED): INCANDESCENCE AND POSSIBLE EXPLOSION.
MESITYL OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
MESITYLENE: POSSIBLE EXPLOSIVE REACTION.
METALS: VIOLENT REACTION WITH EXPLOSION OR IGNITION.
METAL ACETYLIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CARBIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CYANIDES: EXPLOSIVE REACTIONS.
METAL FERRICYANIDE OR FERROCYANIDE: VIOLENT REACTION.
METAL SALICYLATES: FORMS EXPLOSIVE COMPOUNDS.
METAL THIOCYANATES: POSSIBLE EXPLOSION.
2-METHYLBENZIMIDAZOLE + SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
4-METHYLCYCLOHEXANONE: EXPLOSIVE REACTION.
2-METHYL-5-ETHYLPYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED
  CONTAINER.
METHYL THIOPHENE: IGNITION REACTION.
NEODYMIUM PHOSPHIDE: VIOLENT REACTION.
NICKEL TETRAPHOSPHIDE: IGNITION REACTION.
NITRO AROMATIC HYDROCARBONS: FORMS HIGHLY EXPLOSIVE PRODUCTS.
NITROBENZENE: EXPLOSIVE REACTION, ESPECIALLY IN THE PRESENCE OF WATER.
NITROMETHANE: EXPLOSIVE REACTION.
NITRONAPHTHALENE: EXPLOSION HAZARD.
NON-METAL OXIDES : EXPLOSIVE REACTION.
OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ORGANIC MATERIALS: FIRE AND EXPLOSION HAZARD.
ORGANIC SUBSTANCES AND PERCHLORATES: POSSIBLE EXPLOSION.
ORGANIC SUBSTANCES AND SULFURIC ACID: POSSIBLE EXPLOSION.
PHENYL ACETYLENE + 1,1-DIMETHYLHYDRAZINE: VIOLENT REACTION.
PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: FORMS EXPLOSIVE PRODUCTS.
PHOSPHINE + OXYGEN: SPONTANEOUS IGNITION.
PHOSPHONIUM IODIDE: IGNITION REACTION.
PHOSPHORUS (VAPOR): IGNITES WHEN HEATED.
PHOSPHOROUS HALIDES: IGNITION REACTION.
PHOSPHORUS TETRAIODIDE: VIGOROUS REACTION.
PHOSPHORUS TRICHLORIDE: EXPLOSIVE REACTION.
PHTHALIC ACID AND SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
PHTHALIC ANHYDRIDE: EXOTHERMIC REACTION AND FORMS EXPLOSIVE PRODUCTS.
PICRATES: REACTS.
PLASTICS: MAY BE ATTACKED.
POLYALKENES: INTENSE REACTION..
POLYDIBROMOSILANES: EXPLOSIVE REACTION.
POLY(ETHYLENE OXIDE) DERIVATIVES: POSSIBLE EXPLOSION.
POLYPROPYLENE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
POLY(SILYLENE): IGNITION.
POLYURETHANE (FOAM): VIGOROUS REACTION.
POTASSIUM HYPOPHOSPHITE: EXPLOSIVE REACTION.
POTASSIUM PHOSPHINATE: EXPLODES ON EVAPORATION.
B-PROPIOLACTONE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PROPIOPHENONE + SULFURIC ACID: EXOTHERMIC REACTION ABOVE -5 C.
PROPYLENE GLYCOL + HYDROFLUORIC ACID + SILVER NITRATE: EXPLOSIVE MIXTURE.
PROPYLENE OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYROCATECHOL: IGNITES ON CONTACT.
REDUCING AGENTS: POSSIBLE EXPLOSIVE OR IGNITION REACTION.
RESORCINOL: POSSIBLE EXPLOSION.
RUBBER: VIGOROUS REACTION, POSSIBLE EXPLOSION.
SELENIUM: VIGOROUS REACTION.
SELENIUM HYDRIDE: IGNITION OR INCANDESCENT REACTION.
SELENIUM IODOPHOSPHIDE: EXPLOSIVE REACTION.
SILICON: VIOLENT REACTION.
SILICONE OIL: POSSIBLE EXPLOSION.
SILVER BUTEN-3-YNIDE: EXPLOSION.
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SODIUM: SPONTANEOUS IGNITION.
SODIUM AZIDE: EXOTHERMIC REACTION.
SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
STIBINE: EXPLOSIVE REACTION.
SUCROSE (SOLID): VIGOROUS REACTION.
SULFAMIC ACID: VIOLENT REACTION WITH EVOLUTION OF TOXIC NITROUS OXIDE.
SULFIDES: REACTS.
SULFUR DIOXIDE: EXPLOSIVE REACTION.
SULFUR HALIDES: VIOLENT REACTION.
SULFURIC ACID + GLYCERIDES: EXPLOSIVE REACTION.
SULFURIC ACID + TEREPHTHALIC ACID: VIOLENT REACTION.
SURFACTANTS + PHOSPHORIC ACID: EXPLOSION HAZARD.
TERPENES: SPONTANEOUS IGNITION.
TETRABORANE: EXPLOSIVE REACTION.
TETRABORANE DECAHYDRIDE: EXPLOSIVE REACTION.
TETRAPHOSPHOROUS DIIODOTRISELENIDE: EXPLOSIVE REACTION.
TETRAPHOSPHOROUS IODIDE: IGNITES ON CONTACT.
TETRAPHOSPHOROUS TETRAOXIDE TRISULFIDE: VIOLENT REACTION.
THIOALDEHYDES: VIOLENT REACTION.
THIOKETONES: VIOLENT REACTION.
THIOPHENES: EXPLOSIVE REACTION.
TITANIUM: FORMS SHOCK-SENSITIVE COMPOUND.
TITANIUM ALLOYS: POSSIBLE EXPLOSIVE REACTION.
TITANIUM-MAGNESIUM ALLOY: POSSIBLE EXPLOSION ON IMPACT.
TOLUENE: VIOLENT REACTION.
TOLUIDENE: IGNITION REACTION.
1,3,5-TRIACETYLHEXAHYDRO-1,3,5-TRIAZINE + TRIFLUOROACETIC ANHYDRIDE:
EXPLOSIVE REACTION.
TRIAZINE: VIOLENTLY EXPLOSIVE REACTION.
TRICADMIUM DIPHOSPHIDE: EXPLOSIVE REACTION.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: IGNITION REACTION.
TRIMETHYLTRIOXANE: INTENSE REACTION.
TRIS(IODOMERCURI)PHOSPHINE: VIOLENT DECOMPOSITION.
TRITHIOACETONE: EXPLOSIVE REACTION.
TURPENTINE: EXPLOSIVE MIXTURE.
UNSYMMETRICAL DIMETHYL HYDRAZINE: SPONTANEOUS IGNITION.
URANIUM: EXPLOSIVE REACTION.
URANIUM ALLOY: VIOLENT REACTION.
URANIUM DISULFIDE: VIOLENT REACTION.
URANIUM-NEODYMIUM ALLOYS: EXPLOSIVE REACTION.
VINYL ACETATE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
VINYLIDENE CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
WOOD: POSSIBLE IGNITION.
P-XYLENE: INTENSE REACTION IN PRESENCE OF SULFURIC ACID.
ZINC: INCANDESCENT REACTION.
ZINC ETHOXIDE: POSSIBLE EXPLOSION.
ZIRCONIUM-URANIUM ALLOYS: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

PROTECT AGAINST PHYSICAL DAMAGE. SEPARATE FROM METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, TURPENTINE, ORGANIC ACIDS, AND ALL COMBUSTIBLE, ORGANIC OR OTHER READILY OXIDIZABLE MATERIALS. PROVIDE GOOD VENTILATION AND AVOID DIRECT SUNLIGHT (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A

NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002.
100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY WITH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT AND LATER DISPOSAL.

WATER SPILL:
ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT GET WATER INSIDE CONTAINER. FOR SMALL SPILLS, FLUSH AREA WITH FLOODING AMOUNTS OF WATER. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

NITRIC ACID:

125 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

250 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST NITRIC ACID.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

NOTE: ONLY NON-OXIDIZABLE SORBENTS ARE ALLOWED (NOT CHARCOAL).

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
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-ADDITIONAL INFORMATION-