

# Report

**CITY OF NEW BEDFORD**

**Department of**

**Environmental Stewardship**

Site Specific Addendum to Quality  
Assurance Plan

478-480 Union Street  
New Bedford, Massachusetts

March 2011

***Weston&Sampson***

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Site Name: 478 – 480 Union Street  
Site Location: 478 - 480 Union St, New Bedford, MA

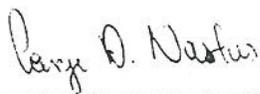
Title: Site Specific Addendum to Generic QAPP  
Revision Number: 0  
Revision Date: March 25, 2011  
Page 1 of 22

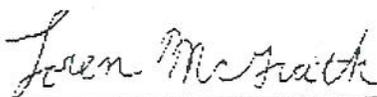
**PROJECT MANAGEMENT  
Forms (A-G, K)**

**FORM A – TITLE AND APPROVAL PAGE**

**MASSACHUSETTS BROWNFIELDS QUALITY ASSURANCE PROJECT PLAN (QAPP)  
EPA ASSESSMENT GRANT NUMBER: BF 97193601**

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### TABLE OF CONTENTS

	<b>Page</b>
FORM A – TITLE AND APPROVAL PAGE .....	1
TABLE OF CONTENTS.....	2
LIST OF FIGURES .....	2
INTRODUCTION .....	3
FORM B - PROJECT ORGANIZATION AND RESPONSIBILITY .....	4
FORM C - PROBLEM DEFINITION.....	5
FORM D - PROJECT DESCRIPTION/PROJECT TIMELINE .....	9
FORM E - SAMPLING DESIGN AND SITE FIGURES .....	11
FORM F - SAMPLING AND ANALYTICAL METHODS REQUIREMENTS .....	15
FORM G - METHOD AND SOP REFERENCE TABLE .....	21
FORM K - ANALYTICAL SENSITIVITY, PRECISION AND ACCURACY .....	22

### LIST OF FIGURES

- Figure 1: Locus Map
- Figure 2: Site Plan
- Figure 3: Area Receptors Map

### LIST OF APPENDICES

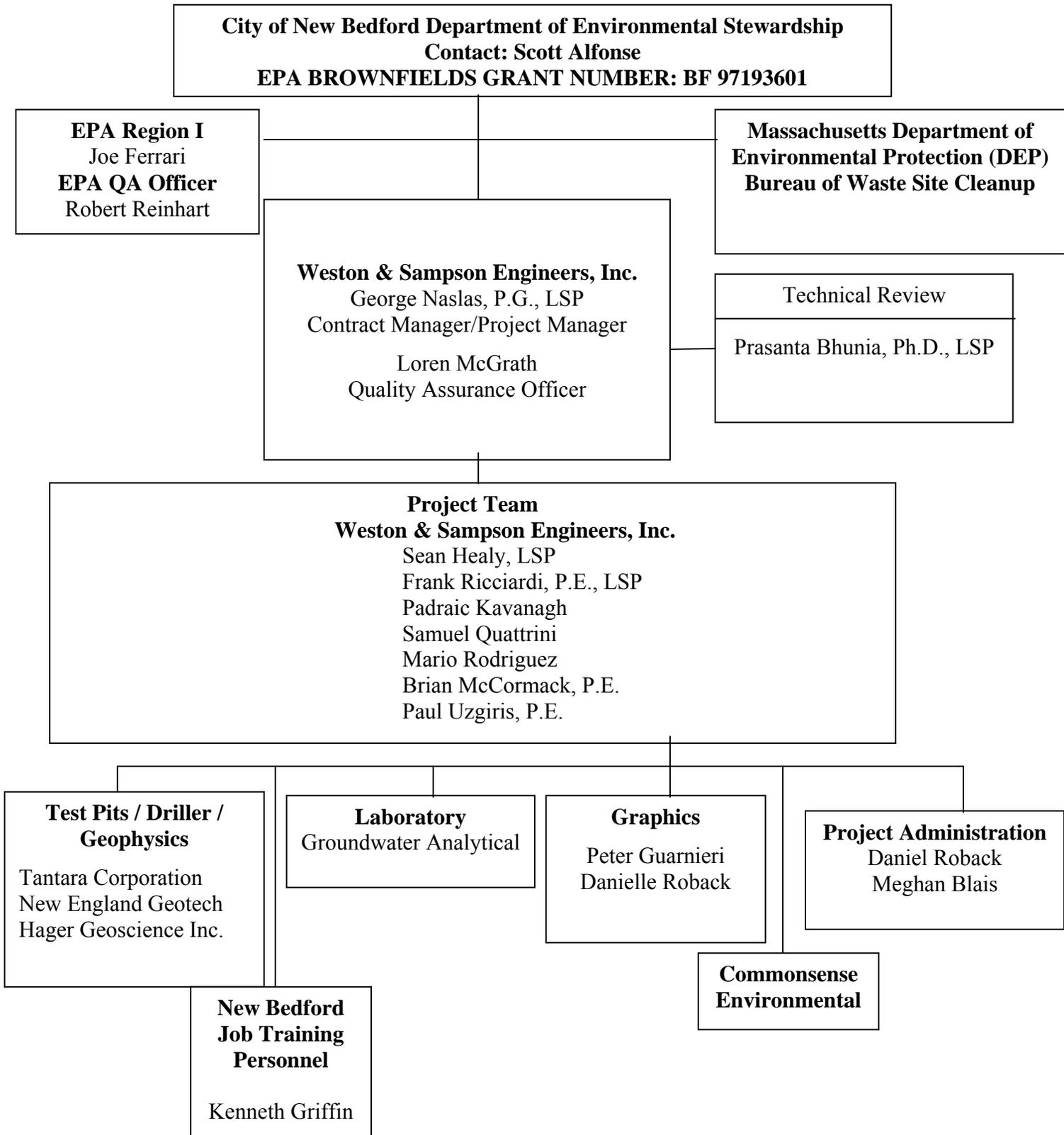
- Appendix A – Historical Data
- Appendix B – Laboratory SOPs

## **INTRODUCTION**

Weston & Sampson has prepared this Site Specific Addendum to our Massachusetts Generic Quality Assurance Project Plan (QAPP) [dated December 18, 2008, Revision 1, EPA QA Tacking Number RFA # 09058 on behalf of the New Bedford Department of Environmental Stewardship and Environmental Assessment and Remediation Planning Services for 478-480 Union Street, New Bedford, Massachusetts (the “Site”). See Figure 1 – Locus Map. This Site Specific addendum to the Generic QAPP describes the Phase II Environmental Site Assessment (ESA) Scope of Work (SOW) and associated Quality Assurance and Quality Control Samples.

The Site was identified by the City of New Bedford as part of their Brownfields redevelopment initiative focusing on returning vacant or underutilized commercial and industrial properties back into useful and viable facilities. The City acquired the Site in July 2009 through non-payment of back taxes. The project is being funded through Cooperative Agreements between the City and the United States Environmental Protection Agency (US EPA) through a Brownfields Assessment Grant; Brownfields Grant# BF 97193601. The assessment will meet the performance standards of the Massachusetts Contingency Plan (MCP); 310 CMR 40.0000. The City is the project manager for this project and Weston & Sampson is providing technical services, including Licensed Site Professional (LSP) Services to the City of New Bedford Department of Environmental Stewardship.

### FORM B - PROJECT ORGANIZATION AND RESPONSIBILITY



## FORM C - PROBLEM DEFINITION

### Introduction

The project involves a Phase II ESA to assess potential Recognized Environmental Conditions (RECs) identified during the Phase I ESA. Weston & Sampson contracted Common Sense Environmental, Inc. of New Bedford, Massachusetts to perform a Phase I Environmental Site Assessment (ESA). The Phase I ESA was performed on behalf of the City of New Bedford in general accordance with American Society for Testing and Materials (ASTM) standard E1527-05 and to meet EPA’s proposed All Appropriate Inquiry (AAI) standard. The primary purpose of the ESA was to identify *recognized environmental conditions* in connection with the Site. Recognized environmental conditions (RECs) are defined as “the presence or likely presence of hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or material threat of a release into structures on the property or into the ground, groundwater, or surface water of the property.” The major findings of the Phase I ESA are described below.

### Site Description and Background

The Site consists of an 18,329 square foot (0.42 acre) irregular-shaped lot located south of the intersection of Union and Newton Streets in New Bedford, Massachusetts. The Site is developed with a vacant single story building that occupies a footprint of approximately 11,980 square feet. The southern portion of the building has been partially demolished and contains a concrete slab and portions of concrete block walls. A Locus Map is included in Figure 1 and a Site Plan is included as Figure 2.

The geographical coordinates for the property are as follows:

UTM Coordinates:	4,610,604 m N
	338,479 m E
Latitude/Longitude:	41° 37' 58" N
	70° 56' 21" W

The Site abutters consist of:

- Union Street to the north;
- Residential properties to the south, east, and west.

As shown in Figure 3 Area Receptors Map, no natural resource areas as described in 310 CMR 40.0483 (1)(a)(8) are located within 500 feet of the Site, with the exception of one area of local, state and/or federal protected open space located within 500 feet to the northwest of the Site. Based on review of Massachusetts GIS maps, none of the following natural resource areas are located within 500 feet of the Site:

1. Mapped surface waters, including wetlands, vernal pools, ponds, lakes, streams, rivers and reservoirs;
2. Public drinking water supplies consisting of Zone II areas, Interim Wellhead Protection areas, Zone A areas, or Potentially Productive Aquifers; or

3. Areas of Critical Environmental Concern, Sole Source Aquifers, fish habitats and habitats of Species of Special Concern or Threatened or Endangered Species.

### **Site Visit**

During the ESA Site walk, scattered debris was observed including; an unlabeled 55-gallon drum on the southern portion of the Site; an unlabeled 55-gallon drum inside the Site building; and dumped aerosol and paint cans, roofing asphalt, cement adhesive, and roofing compound containers. Two rusted and corroded 330-gallon fuel oil Above-Ground Storage Tanks (ASTs) were also observed outside at the rear of the Site building along with a potential catch basin that is located adjacent to the ASTs. The debris, rusted and corroded fuel oil ASTs and potential catch basin are considered potential RECs.

### **Site History**

Historical atlas maps indicate that the Site was developed with two residential structures in 1906. A gasoline filling station and automobile service garage existed at the Site between 1915 and the late 1950's. Five gasoline tanks are depicted in the 1924 atlas map on the northern portion of the Site. A 1950 atlas map indicated that three gasoline tanks were located on the northwestern portion of the Site. The Site was reportedly utilized by a restaurant supply company between the late 1950's and 1989 and a dance studio in the 1990's. The former use of the Site as a gasoline filling station and automotive service garage with gasoline tanks is considered a potential REC.

Municipal records and historic atlas maps indicated that numerous underground storage tanks (USTs) were historically located at the Site. As indicated above, historic atlas maps indicate that 8 separate gasoline tanks were located on the northern portion of the Site. Municipal records indicate that two 1,000-gallon #2 fuel oil USTs were removed from the Site in 1984 and 1992 and a 550-gallon waste oil UST was removed from the Site in 1989. Tank installation and/or removal permits also exist for numerous other USTs including one 3,000-gallon gasoline UST, one 500-gallon gasoline UST, and two 1,000-gallon gasoline USTs. Figure 2 (attached) depicts the location of some of the historic on-Site USTs. However, additional UST information, including reports detailing the removal of the historic USTs at the Site, was not identified during the ESA. Based on the lack of information concerning historic USTs and removals, the former use of numerous USTs at the Site is considered a potential REC.

### **Summary of Historical Data**

The Phase I ESA included a review of a previous Phase I Site Investigation report prepared by Harborline Engineering in 1992. Harborline conducted an investigation in 1992 which included the installation of three groundwater monitoring wells (MW-1, MW-2 and MW-3). Photoionization detector (PID) field screening of soil samples collected from the borings identified concentrations of total volatile organic compounds (TVOCs) ranging from 1.2 to 65 parts per million volatiles (ppmv); however, soil samples were not submitted for laboratory analysis. According to Harborline's boring logs, a petroleum odor was detected at MW-1 at a depth of 10-20 feet below grade surface. Analysis of groundwater samples identified total petroleum hydrocarbon (TPH) at a concentration of 679 mg/l in MW-1 (west of the Site building) and 1,2-dichlorobenzene at a concentration of 13.6 ug/l in MW-3 (northeast of the Site building). Harborline determined the results indicated

that a release of oil or hazardous material was identified at the Site. The release was subsequently reported to the Massachusetts Department of Environmental Protection (DEP) and Release Tracking Number (RTN) 4-1265 was assigned to the Site. The Phase I Initial Site Investigation Report, dated September 10, 1992 and prepared by Harborline Engineering, is included in Appendix A.

A previous Response Action Outcome (RAO) Statement for the Site, prepared by Prime Engineering, Inc. in 1997, was also reviewed as part of the Phase I ESA. The RAO indicated that additional groundwater sampling was performed at the Site by Olde Boston Environmental in 1993, 1994 and 1997. Analysis of the groundwater samples collected from MW-1 identified concentrations of TPH concentrations above GW-2/GW-3 standards and volatile organic compounds (VOCs) (benzene, ethylbenzene, and total xylenes) were detected at concentrations below the MCP GW-2/GW-3 standards.

Prime installed two soil borings (P-1 and P-2) in 1997 on the northern portion of the Site in the location of the former on-site gasoline USTs. Field screening of soil samples collected from the borings identified concentrations of TVOCs ranging from 3.5 to 121 ppmv. A single composite sample was collected from each boring and submitted for laboratory analyses of Extractable Petroleum Hydrocarbons (EPH) with target polycyclic aromatic hydrocarbons (PAHs) and Volatile Petroleum Hydrocarbons (VPH) with target VOCs. The results indicated that VPH parameters were detected in both soil samples at concentrations below the Method 1 S-1 soil standards. Analysis of groundwater samples collected in 1997 from MW-1, MW-2, and MW-2 detected EPH and VPH concentrations below the applicable GW-2/GW-3 standards. A Method 2 Risk Assessment was conducted as part of the RAO Statement and it was concluded that a condition of No Significant Risk to human health and the environment existed at the Site. A Class B-1 RAO was therefore filed for the Site in 1997. The RAO Statement is included in Appendix A.

Although an RAO has been issued, the soil and groundwater sampling performed in support of the RAO did not include sampling in the area of many of the historic UST locations at the Site; therefore the location of these USTs and the detection of impacted soil and groundwater at the Site during the previous investigation is considered a REC.

Historic City Directories indicate that Leeds Cleaners was located at 475 Union Street, across Union Street to the northeast of the Site. Based on the northeasterly groundwater flow direction as calculated during previous investigation at the Site, this facility is located hydrogeologically downgradient of the Site. Therefore, this former facility is not considered an immediate concern at this time. However, the Phase II ESA will include sampling of groundwater on the northeastern portion of the Site to confirm that there are no impacts to Site groundwater from this former off-Site dry cleaner.

### **State Regulatory Information**

The Site is listed with the DEP under RTN 4-1265 for the detection of Total Petroleum Hydrocarbons (TPH) and 1,2-dichlorobenzene during a Phase I Site Investigation conducted by Harborline Engineering in 1992. A Class B-1 RAO Statement was submitted by Prime Engineering on October 15, 1997.

Site Name: 478 – 480 Union Street

Title: Site Specific Addendum to Generic QAPP

Revision Number: 0

Site Location: 478 - 480 Union St, New Bedford, MA

Revision Date: March 25, 2011

Page 8 of 22

**Future Intended Use**

The future intended use for the Site has not been determined.

## **FORM D - PROJECT DESCRIPTION/PROJECT TIMELINE**

### **Objective**

The overall objectives of the Scope of Work are to evaluate potential impacts at the Site related to historical use as a gas station and vehicular repair garage, evaluate data gaps in the RAO, evaluate conditions that could impact future development and evaluate if Site groundwater has been impacted from the historic use of a dry cleaning facility located to the northeast of the Site. Weston & Sampson will conduct a Phase II ESA consisting of the following activities.

- A geophysical survey will be conducted on the northern and western portions of the Site. The purpose of the survey will be to locate any historic USTs remaining at the Site and/or locate former tank grave areas.
- Nine (9) test pits will be excavated at the Site following the geophysical survey to assess locations of historic USTs and tank graves identified during the geophysical survey and to assess subsurface conditions on the southern portion of the Site where automobile servicing may have occurred.
- Eleven (11) soil borings will be advanced at the Site. Permanent groundwater monitoring wells will be installed within eight (8) of the borings. The purpose of the soil boring and monitoring wells will be to assess soil and groundwater conditions throughout the Site
- Soil samples will be collected continuously within each of the borings and groundwater samples will be collected from each of the monitoring wells for laboratory analysis.

### **Applicable Standards**

The applicable standards for the Site, in accordance with the MCP for soil and groundwater, are as follows:

- Soil – Soil sample results will be compared to MCP Reportable Concentrations RCS-1 standards as well as Method 1 S-1, S-2, and S-3 soil standards for risk characterization purposes. The Site has been closed out under the MCP; therefore, the data will be compared to the assumptions and exposure point concentrations utilized in the RAO. If new contaminants are detected, they will be compared to RCS-1 standards because the Site is located within 500 feet of a residence.
- Groundwater – Groundwater analytical results will be compared to MCP Reportable Concentrations RCGW-2 standards because the Site is not located in a RCGW-1 area (current or potential drinking water source area). Groundwater at the Site will also be compared to Method 1 GW-2 and GW-3 standards. GW-1 is not applicable because groundwater is not a current or potential drinking water source. GW-2 is applicable because the Site is within 30 feet of an existing building and groundwater is located less than 15 feet from grade surface. GW-3 is a default category that applies to all groundwater and is associated with its impact on a receiving surface water body. Groundwater concentrations will also be compared to the exposure point concentrations in the RAO.

Site Name: 478 – 480 Union Street

Title: Site Specific Addendum to Generic QAPP

Revision Number: 0

Site Location: 478 - 480 Union St, New Bedford, MA

Revision Date: March 25, 2011

Page 10 of 22

### **Project Timeline**

Upon approval of this QAPP Addendum, Weston & Sampson anticipates commencing field activities within one week of approval, weather permitting. It is anticipated that the geophysical survey will be completed in one day, test pit excavations activities will be completed in 2 days, drilling and soil sampling will be completed in one day, and groundwater sampling will be completed in one day. Soil and groundwater samples will be submitted for analysis under a standard laboratory turn around time (TAT) of 10 business days.

## FORM E - SAMPLING DESIGN AND SITE FIGURES

Our approach is to conduct a Phase II ESA that includes a geophysical survey, excavation of test pits (including soil sampling), advancement of soil borings (including soil sampling), installation of groundwater monitoring wells, collection of groundwater samples, and performing a groundwater elevation survey. Each of the activities is detailed below.

### Geophysical Survey

A geophysical survey will be conducted in an attempt to locate any historic USTs remaining at the Site and/or locate former tank grave areas. The survey will be performed utilizing ground penetrating radar (GPR), electromagnetic induction, and magnetometer instruments. The survey will be conducted outside the existing Site building on the northern and western portions of the Site.

### Test Pits

Weston & Sampson will oversee the excavation of nine (9) test pits (TP-1 through TP-9) in areas of former gasoline, fuel oil, and waste oil tanks. The test pits will be excavated to depths of up to 15 feet below ground surface (bgs). Proposed test pit locations are shown in Figure 2. Test pit locations may be adjusted slightly based upon results of the geophysical survey.

Weston & Sampson will collect soil samples throughout the test pits at 3 foot intervals and will conduct field screening with a PID for TVOCs. Samples will be selected for analysis based on PID headspace field screening results and/or visual or olfactory evidence of contamination. If no evidence of contamination is observed, then a sample will be collected from immediately above the groundwater table. In addition, soil samples will be logged in the field for texture and grain size classification using the Burmister Soil Classification system. Weston & Sampson will collect one soil sample from each of the test pits for the following analyses:

#### TP-1 through TP-6: Area of Former Gasoline USTs

- VPH with target VOCs via MADEP Methodology
- Total Lead via EPA Method 6010B

#### TP-8 : Area of Former Fuel Oil Tanks

- EPH with target PAHs and VPH with targeted VOCs via MADEP Methodology

#### TP-7 and TP-9: Area of Former Waste Oil Tank and on Southern Portion of Site

- EPH with target PAHs via MADEP Methodology
- VPH with target VOCs via MADEP Methodology
- VOCs via EPA Method 8260
- Polychlorinated Biphenyls (PCBs) via EPA Method 8082
- RCRA 8 Metals via EPA Method 6010

Additional soil samples collected from depth within each test pit will also be submitted to the laboratory and placed on hold for potential future analysis.

For Quality Assurance/Quality Control (QA/QC) purposes, Weston & Sampson will collect one field duplicate for all parameters and one matrix spike and matrix spike duplicate for RCRA 8 metals only. A laboratory supplied trip blank will accompany all soil samples at a frequency of 1 trip blank per cooler for VOC analysis by EPA Method 8260.

### **Soil Borings and Monitoring Wells**

Weston & Sampson will oversee the advancement of eleven (11) soil borings using hydraulic push Geoprobe technology. Eight (8) of the borings will be completed as groundwater monitoring wells. The monitoring wells will be installed to depths of approximately 15 feet bgs. The monitoring wells will be constructed with Schedule 40, threaded, flush-jointed, 2-inch ID PVC riser pipe. The wells will be completed with a 10-foot long 0.01-inch (10 slot) factory slotted well screen and will be screened across the water table. The proposed location of the soil borings and monitoring wells are shown on Figure 2.

As shown in Figure 2, five (5) of the borings / monitoring wells (WS-1 through WS-5) will be installed on the northern portion of the Site in the area of the former USTs. One boring/ monitoring well (WS-6) will be installed adjacent and southwest of the Site building in the area of two former fuel oil USTs. Two soil borings / monitoring wells (WS-7 and WS-8) will be installed south of the Site building to assess for potential impacts from historic automobile servicing. One soil boring (WS-9) will be advanced south of the building adjacent to the two abandoned fuel oil ASTs. One soil boring (WS-10) will be advanced south of the building adjacent to a potential catch basin. One soil boring (WS-11) will be installed on the southern portion of the Site in an area of an unlabeled 55-gallon drum.

Weston & Sampson will collect soil samples throughout the borings at continuous intervals and will conduct field screening with a PID for TVOCs. Soil samples will be collected based on PID headspace field screening results and/or visual or olfactory evidence of contamination. If no evidence of contamination is observed, then a sample will be collected from immediately above the groundwater table. In addition, soil samples will be logged in the field for texture and grain size classification using the Burmister Soil Classification system.

If grossly impacted soils are identified, the soil will either be stockpiled on polyethylene sheeting and covered with polyethylene sheeting or stored in 55-gallon drums for future disposal.

Soil samples will not be submitted for analysis from the borings that are to be advanced adjacent to the test pit locations unless significant impacts that were not observed during the above test pit activities are identified during the soil boring activities.

However, based on field screening and visual observations, one soil sample will be collected from selected soil borings listed below and will be submitted for the following laboratory analysis:

WS-8 and WS-11: Advanced South of Site Building in Former Service Area

- EPH with target PAHs via MADEP Methodology
- VOCs via EPA Method 8260
- PCBs via EPA Method 8082
- RCRA 8 Metals via EPA Method 6010

WS-9: Advanced Adjacent to Two Fuel Oil ASTs

- EPH with target PAHs via MADEP Methodology
- VPH with target VOCs via MADEP Methodology

WS-10: Advanced Adjacent to Potential Catch Basin

- EPH with target PAHs via MADEP Methodology
- VOCs via EPA Method 8260
- PCBs via EPA Method 8082
- RCRA 8 Metals via EPA Method 6010

For Quality Assurance/Quality Control (QA/QC) purposes, Weston & Sampson will collect one field duplicate for all parameters and one matrix spike and matrix spike duplicate for RCRA 8 metals only. A laboratory supplied trip blank will accompany all soil samples at a frequency of 1 trip blank per cooler for VOC analysis by EPA Method 8260.

**Groundwater Sampling**

Approximately one week following the installation of the groundwater monitoring wells, Weston & Sampson will gauge the depth to groundwater and collect groundwater samples from each of the eight (8) newly installed wells (WS-1 through WS-8) as well as two existing monitoring wells (MW-1 and MW-2) at the Site. Groundwater samples will be collected using the Environmental Protection Agency's (EPA) low flow groundwater sampling methodology. Groundwater samples will be collected from the following locations for the indicated parameters:

WS-1, WS-2, WS-3, WS-4 and MW-2: Area of Former Gasoline Tanks

- VPH with targeted VOCs via MADEP Methodology
- VOCs via EPA Method 8260 (MW-4 only)

WS-5: Area of Former Waste Oil Tank

- EPH with PAHs via MADEP Methodology
- VPH via MADEP Methodology
- VOCs via EPA Method 8260
- RCRA 8 Metals via EPA Method 6010 (Dissolved)

WS-6 and MW-1 ; Area of Former Fuel Oil USTs

- EPH with PAHs and VPH with targeted VOCs via MADEP Methodology

WS-7, and WS-8: Southern Portion of Site

- EPH with PAHs via MADEP Methodology
- VPH via MADEP Methodology
- VOCs via EPA Method 8260
- RCRA 8 Metals via EPA Method 6010 (Dissolved)

For Quality Assurance/Quality Control (QA/QC) purposes, Weston & Sampson will collect one field duplicate for all parameters. A laboratory supplied trip blank will accompany all samples at a frequency of 1 trip blank per cooler for the analysis of VOCs by EPA Method 8260.

**Groundwater Elevation Survey**

Weston & Sampson will perform a field survey to locate and record elevations of the test pits and monitoring wells. Groundwater depths at all of Site monitoring well will be measured with an electronic water level meter. Results of the survey will be utilized to prepare a detailed Site plan and a groundwater contour map which will be incorporated in future report submittals.

## **FORM F - SAMPLING AND ANALYTICAL METHODS REQUIREMENTS**

The actual parameters and number of samples associated with each analysis are presented below. The laboratory SOPs from Groundwater Analytical Laboratories, Inc. were previously submitted with the Walnut and Pleasant Street, New Bedford QAPP dated August 4, 2010, EPA RLF Number 2B 96113401-1, with the exception of the following two SOPs: Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis; Mercury Analysis in Water. The above-mentioned SOPs are included in Appendix B. In addition, the sampling SOP for VOCs in soil was recently submitted with the response memo to EPA's comments for the Former Goodyear Facility QAPP dated March 2, 2011.

Parameter	Matrix	Number of Samples	Sampling SOP (Generic QAPP-APP A)	Analytical Method (Generic QAPP – APP B)	Containers	Preservation Requirements	Maximum Holding Time
Extractable Petroleum Hydrocarbon (EPH) ranges with target polycyclic aromatic hydrocarbons (PAHs)	Soil	7 samples, plus 2 Field Duplicates	2.01, 5.01	MADEP EPH Groundwater Analytical SOP by GC-FID, Version 1.5, Effective Date: 05/05/10	(1)-4-ounce (oz) amber glass jar with Teflon-lined screw cap	Cool to $\leq 6^{\circ}\text{C}$ but not frozen	Extracted within 14 days; extract analyzed within 40 days
Volatile Petroleum Hydrocarbon (VPH) ranges with target volatile organic compounds (VOCs)	Soil	10 samples, plus 2 Field Duplicates	2.01, 5.01	MADEP VPH Groundwater Analytical SOP by GC-PID/FID, Version 1.4, Effective Date: 11/02/09	(1)-40-millimeter (mL) or (1)-60 mL methanol vial with Teflon-lined septa screw cap	1 mL methanol for every gram soil/sediment; add before or at time of sampling; Cool to $\leq 6^{\circ}\text{C}$	28 days
Polychlorinated Biphenyls (PCBs)	Soil	5 samples, plus 2 Field Duplicates	2.01, 5.01	SW-846 Method 8082A Groundwater Analytical SOP PCBs by GC-ECD, Version 1.8, Effective Date: 4/27/10	(1)-8-ounce (oz) glass jar with Teflon-lined screw cap	Cool to $\leq 6^{\circ}\text{C}$	Extracted within 1 year of collection; extract analyzed within 40 days

VOCs by EPA Method 8260B	Soil	5 samples, plus 2 Field Duplicates plus 2 Trip Blanks	2.01, 5.01	SW-846 Method 8260B Groundwater Analytical SOP 8260B Version 3.3, Effective Date: 11/02/09	1 methanol vial (high- level analysis)  2 sodium bisulfate vials or 2 deionized (DI) water vials (low- level analysis)  Trip Blank: 1 set) 40-mL VOC vial with Teflon-lined septa caps	1 mL methanol for every gram soil/sediment; cool to $\leq 6^{\circ}\text{C}$ but not frozen.  5 ml sodium bisulfate or DI water; add before or at time of sampling; cool to $\leq 6^{\circ}\text{C}$ in field and deliver to laboratory for freezing ( $-7^{\circ}\text{C}$ ) or analysis, both within 48 hours of sample collection  DI water	14 days

<p>RCRA 8 Metals – arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver</p>	<p>Soil</p>	<p>5 samples, plus 2 Field Duplicates, 2 Matrix Spike/Matrix Spike Duplicates</p>	<p>2.01, 5.01</p>	<p>SW-846 Method 6010B ICP and 7471A Groundwater Analytical SOP AMA0610 and AMA0820, Version 4.3 and 2.2, Effective Date: 7/7/08 and 3/10/08</p>	<p>(1) 4-oz glass jar with a Teflon-lined screw cap</p>	<p>Cool to <math>\leq 6^{\circ}\text{C}</math></p>	<p>180 days: all metals except mercury 28 days: mercury</p>
<p>Lead</p>	<p>Soil</p>	<p>6 samples (up to 6 samples collected only if PID readings are greater than 10 ppmv)</p>	<p>2.01, 5.01</p>	<p>SW-846 Method 6010B ICP Groundwater Analytical SOP AMA0610 Version 4.3 Effective Date: 7/7/08</p>	<p>(1) 4-oz glass jar with a Teflon-lined screw cap</p>	<p>Cool to <math>\leq 6^{\circ}\text{C}</math></p>	<p>180 days</p>

Parameter	Matrix	Number of Samples	Sampling SOP (Generic QAPP-APP A)	Analytical Method (Generic QAPP – APP B)	Containers	Preservation Requirements	Maximum Holding Time
Extractable Petroleum Hydrocarbon (EPH) ranges with target polycyclic aromatic hydrocarbons (PAHs)	Groundwater	5 samples, plus 1 Field Duplicate	4.01, 6.01	MADEP EPH Groundwater Analytical SOP by GC-FID, Version 1.5, Effective Date: 05/05/10	(2) 1-Liter amber glass bottles with Teflon-lined screw caps	1:1 HCL to pH<2; Cool to ≤6°C but not frozen	14 days to extraction; 40 days fro extraction to analysis
Volatile Petroleum Hydrocarbon (VPH) ranges with target volatile organic compounds (VOCs)	Groundwater	10 samples, plus 1 Field Duplicate	4.01, 6.01	MADEP VPH Groundwater Analytical SOP by GC-PID/FID, Version 1.4, Effective Date: 11/02/09	(2) 40-mL VOC vials with Teflon-lined septa screw caps and protect from light	Adjust pH to <2.0 by addition of HCL to container before sampling. Cool to ≤6°C but not frozen	14 days
VOCs by EPA Method 8260B	Groundwater	8 samples, plus 1 Field Duplicate, 1 Trip Blank	4.01, 6.01	SW-846 Method 8260B Groundwater Analytical SOP 8260B Version 3.3, Effective Date:	(2) 40-mL VOC vials with Teflon-lined septa screw caps and protect from light	Adjust pH to <2.0 by addition of HCL or NaHSO <sub>4</sub> to container before sampling. Cool to ≤6°C	14 days

Site Name: 478-480 Union Street

Title: Site Specific Addendum to Generic QAPP

Revision Number: 0

Site Location: 478-480 Union Street, New Bedford, MA

Revision Date: March 25, 2011

Page 20 of 22

				11/02/09		but not frozen	
RCRA 8 Metals – arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver	Groundwater	3 samples, plus 1 Field Duplicate	4.01, 6.01	SW-846 Method 6010B ICP and 7471A Groundwater Analytical SOP AMA0610 and AMA0820, Version 4.3 and 2.2, Effective Date: 7/7/08 and 3/10/08	500 mL Polyethylene Bottle	HNO <sub>3</sub> to pH <2 for Total Metals; Dissolved Metals: Filter through 0.45 micron filter on site; or at lab (prior to acid preservation) within 24 hours of collection; then preserve with HNO <sub>3</sub> to pH <2	180 days: all metals Mercury: 28 days

Site Name: 478-480 Union Street

Title: Site Specific Addendum to Generic QAPP

Site Location: 478-480 Union Street, New Bedford, MA

Revision Number: 0

Revision Date: March 25, 2011

Page 21 of 22

### FORM G - METHOD AND SOP REFERENCE TABLE

<b>Analytical Method Reference: Include document title, method name/no., revision number, date</b>	<b>Project Analytical SOPs (see Appendices B and C): Include document title, date, revision number, and originator name</b>
1a. SW-846 Method 6010C; Trace Metals by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES), Revision No. 1, July 1, 2010.	1b. Metals Determination By Inductively Coupled Argon Plasma (ICP) EPA Method 6010B/EPA 200.7: SOP AMA0610, Version 4.3, Effective Date 7/7/08, Groundwater Analytical, Inc.
2a. SW-846 Method 6010C; Trace Metals by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES), Revision No. 1, July 1, 2010.	2b. Acid Digestion of Sediments, Sludges, Soils, oils, Paint Chips, and Wipes: SOP AMP0340, Version 1.0, Effective Date 1/10/05, Groundwater Analytical, Inc.
3a. SW-846, Methods 7470A and 7471B, Mercury by Cold Vapor Atomic Absorption (CVAA) Spectrometry, Revision No. 1, July 1, 2010.	3b. Mercury Analysis in Soils by Semi-Automated Cold Vapor Atomic Absorption Spectroscopy: SOP AMA0820, Version 2.2, Effective Date 3/10/08, Groundwater Analytical, Inc.
5a. SW-846 Method 8082A; Polychlorinated Biphenyls (PCBs) by Gas Chromatography (GC), Revision No. 1, July 1, 2010.	5b. Determination of PCBs in Water, Solids, Wipes and Waste Dilutions by GC/ECD: SOP PCBs by GC-ECD, Version 1.8, Effective Date 4/27/10, Groundwater Analytical, Inc.
6a. SW-846 Method 8260B; Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Revision No. 1, July 1, 2010.	6b. Determination of VOCs in Waters and Solids by GC/MS by Method 8260B: SOP 8260B, Version 3.3, Effective Date 11/02/09, Groundwater Analytical, Inc.
9a. SW-846 Method 6010C; Trace Metals by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES), Revision No. 1, July 1, 2010.	9b. Acid Digestion of Aqueous Samples and Extracts for Total Metals Analysis y ICP Atomic Emission Spectroscopy-EPA 3010A: SOP AMP0320, Version 2.0, Effective Date 1/1/05, Groundwater Analytical, Inc.
10a. SW-846, Methods 7470A and 7471B, Mercury by Cold Vapor Atomic Absorption (CVAA) Spectrometry, Revision No. 1, July 1, 2010.	10b. Mercury Analysis in Water by Semi-Automated Cold Vapor Atomic Absorption Spectroscopy: SOP AMA0810, Version 1.2, Effective Date 7/7/08, Groundwater Analytical, Inc.
11a. MADEP EPH Method, Analysis of Extractable Petroleum Hydrocarbons (EPH), Revision No. 1, July 1, 2010.	11b. Determination of EPH in Water, Solids and Wastes by GC-FID: SOP EPH, Version 1.5, Effective Date 5/5/10, Groundwater Analytical, Inc.
12a. MADEP VPH Method, Analysis of Volatile Petroleum Hydrocarbons (VPH), Revision No. 1, July 1, 2010.	12b. Determination of Volatile Petroleum Hydrocarbons in Water and Solids by GC-FID: SOP VPH, Version 1.4, Effective Date 11/2/09, Groundwater Analytical, Inc.

Site Name: 478-480 Union Street

Title: Site Specific Addendum to Generic QAPP

Revision Number: 0

Site Location: 478-480 Union Street, New Bedford, MA

Revision Date: March 25, 2011

Page 22 of 22

## **FORM K - ANALYTICAL SENSITIVITY, PRECISION AND ACCURACY**

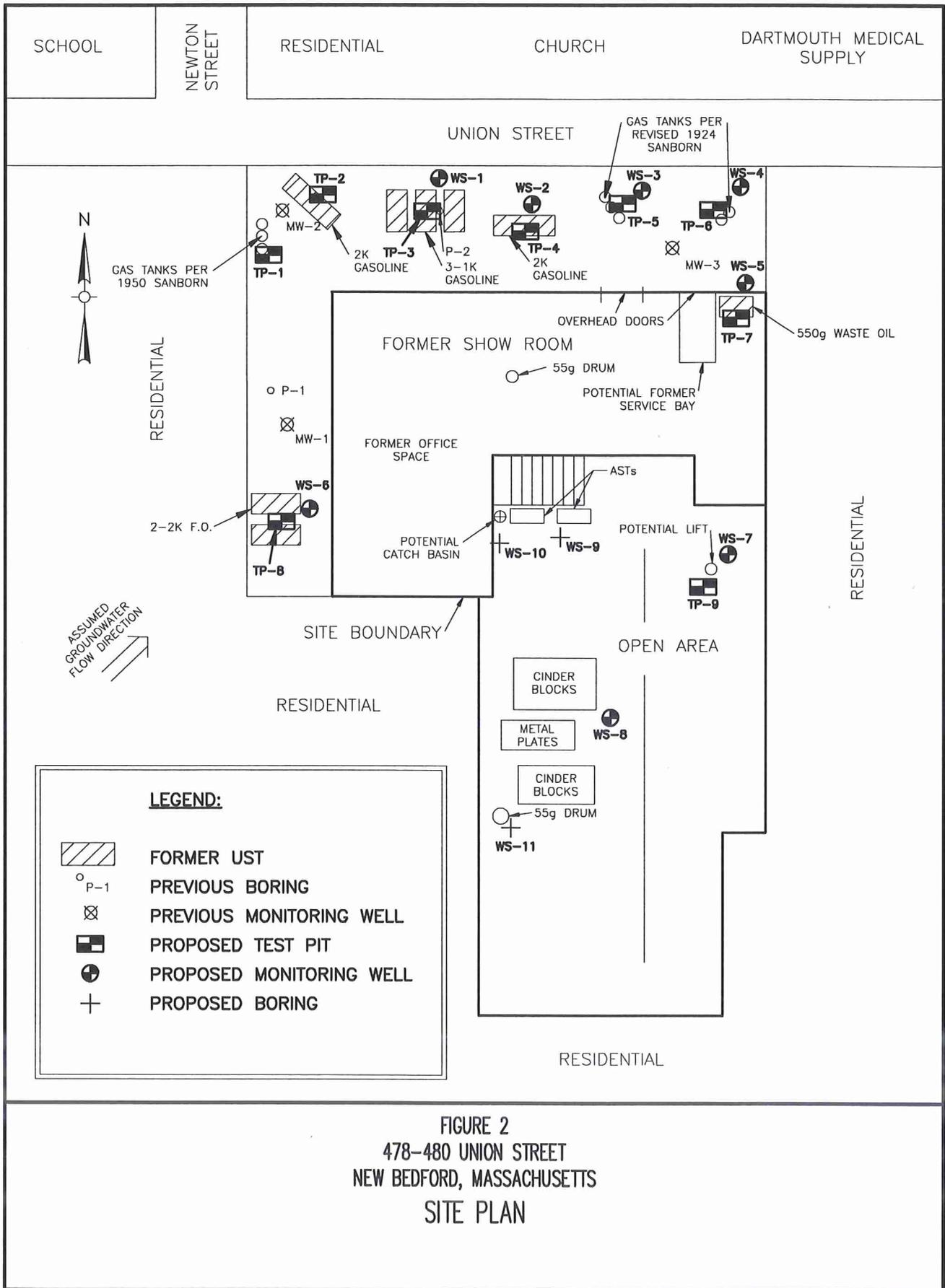
The specific analytical sensitivity, precision and accuracy requirements for each analytical method are included in the SOPs in Appendix B.



**FIGURE 1**  
**NEW BEDFORD, MASSACHUSETTS**  
**478-480 UNION STREET**

**LOCUS MAP**

0 2,000 4,000 Feet



M:\SH ESS Projects\New Bedford Brownfields\CADD\Union St\Union Site Plan Revised.dwg by LEM with no scale.dwg



**APPENDIX A**

Historical Data

Copy 1 of 2  
To WEP  
Date 10/26/92  
Initial WEP

OCT 27 1992

SCANNED

# PHASE I SITE INVESTIGATION

For the Site known as:

Union Street  
New Bedford, Massachusetts

SCANNED  
4-1265

Prepared for:

Mr. Alan Cohen  
38 Beverly Street  
North Dartmouth, Massachusetts

Prepared by:

Harborline Engineering, Inc.  
286 Herman Melville Blvd.  
New Bedford, Massachusetts 02740

September 10, 1992

September 10, 1992

Mr. Alan Cohen  
38 Beverly Street  
North Dartmouth, Massachusetts

RE: Phase I - Limited Site Investigation relative to MGL CH 21E  
Union Street  
New Bedford, MA

Dear Mr. Cohen:

Harborline Engineering Inc., is pleased to submit a Phase I - Limited Site Investigation for the above-referenced location, relative to Massachusetts General Law Chapter 21E (MGL Chapter 21E), the Massachusetts Oil and Hazardous Material Release Prevention and Response Act, and the Massachusetts Contingency Plan (310 CMR 40.00).

The assessment included a visual inspection of the Site and surrounding properties, review of state and local records relative to the use, storage, and/or release of oil and hazardous materials at the Site or in the Site vicinity, interviews and discussions with local officials and Site personnel regarding the Site history and usage, the installation and sampling of test borings and groundwater monitoring wells, electronic soil screening, and laboratory analyses of groundwater. The report that follows summarizes our findings and interpretations.

Based upon the above cited investigations, we conclude that there has been a release of oil or hazardous materials as defined by MGL CH 21E and 310 CMR 40.00, at the above-referenced location.

It has been a pleasure working with you on this project. If we can be of further assistance, please do not hesitate to call. My associates and I will be glad to answer any questions or comments you may have.

Sincerely,

  
Robert D. Martin  
President

## INTRODUCTION

Mr. Alan Cohen contracted Harborline Engineering, Inc. ("Harborline") to conduct a Phase I-Limited Site Investigation of the property located on Union Street in New Bedford, Massachusetts (the "Site"). The investigation was designed to satisfy requirements pursuant to Massachusetts General Law Chapter 21E (MGL CH 21E) the Massachusetts Oil and Hazardous Materials Release Prevention and Response Act, and the Massachusetts Contingency Plan (310 CMR 40.00). Harborline's assessment did not include an evaluation for the possible presence of radon, asbestos, or asbestos-containing material.

Harborline's investigation consisted of:

- a. A visual site inspection;
- b. Historical records research;
- c. Interviews with municipal officials and Site personnel regarding the Site history and usage;
- d. Environmental records review at state and local agencies regarding the use, storage, and/or release of oil and hazardous material at the site or in the Site vicinity;
- e. Data reduction, interpretation, and evaluation.

Subsurface investigations consisted of the following:

- a. Three test borings with associated groundwater monitoring wells;
- b. Electronic soil screening to determine the presence of volatile organic compounds within the soil matrices;
- c. Groundwater sampling and related laboratory analyses for volatile organic compounds and total petroleum hydrocarbons by EPA methods;
- d. Data reduction, interpretation, and evaluation.

The findings and interpretations of Harborline's investigations are contained in this report.

**GEOGRAPHIC LOCATION, IDENTIFICATION AND TOPOGRAPHY**

This section was compiled from information reviewed at the ~~Town~~ of City of New Bedford Assessor's Office and from United States Geological Survey (USGS) Topographic Maps and is intended to locate and bound the Site.

The Site is located on the south side of Union Street in a mixed residential-commercial area in New Bedford, Massachusetts. The property consists of an 18,329 square foot parcel. The Site is shown as Lot 9 on Map 45 on the New Bedford Assessor's Maps.

Topography on the Site is relatively flat, at an elevation of approximately 120 feet NGVD (National Geodetic Vertical Datum). The Site is located approximately 1 mile west of the Acushnet River (source: USGS Topographic Map, New Bedford-North Quadrangle-Appendix A).

Site coordinates are 41° 37' 58" N latitude by 70° 56' 23" W longitude. Universal Transverse Mercator coordinates are 338,425 meters east by 4,610,600 meters north.

A more complete description of the Site parcel and surrounding areas is contained within the Site Inspection of this report.

## **REGIONAL GEOLOGIC AND HYDROGEOLOGIC SETTING**

According to available geologic and hydrogeologic maps the Site lies within the Buzzards Bay Drainage Basin. The Buzzards Bay Drainage Basin is located within the Narragansett Geologic Basin. A basin is a geologic term used to describe a low area in the earth's crust, of Tectonic Origin, in which sediments have accumulated.

The Narragansett Basin, comprising areas in both Massachusetts and Rhode Island is constructed of four stratigraphic units or formations. In order from youngest to oldest, they include:

1. Dighton Conglomerate
2. Rhode Island Formation
3. Wamsutta Formation
4. Pondville Conglomerate

According to a bedrock geologic map of Massachusetts, the Site and Site vicinity consists mainly of nonmarine sedimentary rock such as the Rhode Island Formation which is comprised of sandstone, graywacke, shale, and conglomerate. These sedimentary rocks were deposited in a broad crustal downwrap (geosyncline) during the Upper and Middle Pennsylvanian period (of the Paleozoic Era) on the geologic time scale, approximately 280-330 million years ago. The sedimentary rock (or bedrock) can be expected to be encountered at depths ranging from five to fifteen feet below grade.

During the Wisconsin Glacial Episode (the last major ice advance) massive ice sheets moved southward and south eastward, scragging all of the preglacial deposits from the bedrock surfaces, and depositing a layer of glacial till (approximately 15 feet in thickness), or unsorted, nonstratified glacial drift consisting of clay, silt, sand and boulders transported and deposited thick stratified sediments or glacial outwash (from glacial meltwater) in the bedrock valleys. Also, during the glacial retreat, isolated blocks of ice remained in the bedrock valleys and lakes formed around them, creating lake deposits or glaciolacustrine sediments (mostly silt and clay). When the remaining glacial ice had melted and the glacial lakes had drained, many shallow lakes, streams, and wetlands were created.

The surficial geology or unconsolidated deposits of the Site consist of compact, unsorted, silty, bouldery gravel (till).

According to the "Soil Survey of Bristol County Massachusetts (Southern Part)" performed by the United States Department of Agriculture Soil Conservation Service, the Site is located on urban land. Urban land has nearly level to moderately steep areas which are occupied by urban works and structures; on glacial uplands. Some examples are industrial areas, shopping centers, parking lots and roads.

**SITE HISTORY**

According to a review of available files and plans at the New Bedford Building Department, the Bristol County Registry of Deeds, and the personal recollections of municipal officials and others familiar with the Site, the earliest Site development occurred circa 1915, with the construction of a service garage. Associated underground gasoline storage tanks were also installed. All of the gasoline tanks were allegedly removed by 1958 when the garage stopped operation, however, definitive records were not available. Between that time and 1989 the Site building was used for various other businesses which included a restaurant supply company. A 19' x 32' brick addition was constructed in 1984. The Site building currently houses a dance studio.

No other evidence of Site development was discovered.

## SITE DESCRIPTION

On April 11, 1992 the Site property, buildings, and surrounding properties were inspected by Robert D. Martin from Harborline Engineering, Inc. The Site was traversed on foot, on a representative transect basis and thoroughly visually inspected. The following Site description was compiled from information obtained during the visual inspection, interviews and discussions with municipal officials and Site personnel, and review of environmental records at state and local agencies.

### Lot Size , Building Description and Utilities

The Site consists of an irregular shaped 18,329 square foot parcel. The Site is occupied primarily by the Site building. A small grassy area is located in the rear of the building. All other areas contain asphalt or concrete paving.

The Site building consists of two separate units. The one to the west consists of a dance studio which contains office and studio areas. The eastern unit consists of open shop areas and several smaller storage rooms. A catch basin was observed near the boiler room of the shop area. Several large steel plates were observed on the floor but no pits and or breaks in the floor were observed under several that were moved. A 55 gallon drum which contained liquid soap was observed towards the rear of the shop area.

There is service by the following utilities: water; sewer; electric; and telephone.

### Zoning

The area in which the site is located is zoned residential-commercial.

### Abutting Properties

The following properties abut the Site:

- North:        The Site is abutted to the north by Union Street, a paved public way, and both multifamily homes and small businesses.
- East:         The Site is abutted to the east by multifamily homes.
- South:        The Site is abutted to the south by multifamily homes.
- West:         The Site is abutted to the west by multifamily homes.

## ENVIRONMENTAL RECORDS REVIEW

Record reviews were conducted at the Massachusetts Department of Environmental Protection (DEP), the New Bedford Fire Department, the New Bedford Public Health Department, the New Bedford Building Inspector's Office, and the Municipal Clerk's Office. All available information pertaining to a release or threat of release of oil or hazardous material at the Site or in the Site vicinity is listed below.

### Massachusetts DEP

Available records regarding releases of oil and hazardous materials were reviewed at the DEP Southeast Regional Office in Lakeville, MA on April 6, 1992. No record of a release on the Site parcel or adjacent parcels was discovered during this review. Neither the Site property nor any nearby properties are listed on the DEP "List Of Confirmed Disposal Sites And Locations To Be Investigated" (January 15, 1991).

### Environmental Protection Agency

The EPA's List of Hazardous Waste Generators registered under the Resource Conservation and Recovery Act (RCRA) did not identify any generator on or in close proximity to the Site.

The Comprehensive Environmental Response, Conservation and Liability Act Information System (CERCLIS) list of Sites for possible investigation under the Federal Superfund Program does not include any Sites within close proximity to the "Site".

### Fire Department

A review of available files at the New Bedford Fire Prevention Bureau concerning the Site was performed by at the request of Harborline. No record of a release of oil or hazardous material on or affecting the Site was discovered in the available files. The following is a table of oil and hazardous material storage records relative to the Site at the New Bedford Fire Prevention Bureau:

#### UNDERGROUND STORAGE TANKS

<u>LOCATION</u>	<u>QUANTITY/SIZE (GAL)/ PRODUCT</u>	<u>STATUS</u>
480 UNION STREET THE "SITE"	2 - 2,000 GALLON GASOLINE	ALL GAS TANKS
	3 - 1,000 GALLON GASOLINE	ALLEGEDLY REMOVED BY 1958.
	1 - 1,000 GALLON #2 FUEL OIL	REMOVED 1984
	1 - 550 GALLON WASTE OIL	REMOVED 1989
	1 - 1,000 GALLON #2 FUEL OIL	REMOVED 1992

**Public Health Department**

A review of files concerning the Site at the New Bedford Public Health Department was performed by Mr. Raymond Belanger of the Health Department at the request of Harborline. No record of a release of oil or hazardous material on or affecting the Site was discovered in this review of available files.

**Water Department**

According to water department records, the Site was connected to municipal water in 1915.

**Municipal Clerk's Office**

A review of available files at the New Bedford Municipal Clerk's Office concerning the Site was performed at the request of Harborline. No evidence of a release was encountered.

**Building Inspector's Office**

A review of available files concerning the Site at the New Bedford Building Department was performed at the request of Harborline. No record of a release of oil or hazardous material on or affecting the Site was discovered during this review of available department files. The earliest Site development occurred in 1915.

**Engineering Department**

According to Engineering Department records the Site building was connected to municipal sewer in 1915.

### **SUBSURFACE INVESTIGATIONS**

In order to assess the subsurface and groundwater conditions at the Site. Harborline implemented subsurface investigations. These investigations consisted of test borings, the installation of groundwater monitoring wells, electronic soil screening, groundwater sampling and laboratory analyses.

### **Site Health and Safety Plan**

All personnel at the work Site has conformed with EPA and OSHA protocols for Level D Personal Protection. Level D consists primarily of a work uniform affording minimal protection and provides for nuisance contamination only. Level D is generally used when the atmosphere contains no known hazards and the work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

The following personal protective equipment was worn by all on-Site personnel:

1. Work clothes or overalls
2. Gloves, leather or rubber
3. Boots/shoes, chemical-resistant, steel toe and shank
4. Safety glasses or face shield
5. Hardhat
6. Other optional protective equipment

Some pieces of protective equipment (such as hardhats and boots) have specific standards for manufacture. Only those items meeting these standards were used.

An H-Nu Systems, Inc. Model GP-101 photoionization detector was used when on-Site to continuously monitor for the presence of volatile organic compounds in the ambient air. Monitoring equipment is calibrated regularly per manufacturers recommendations.

Prior to the start of a project, certain provisions were made for prompt medical attention in case of serious injury or illness. At least one person at the worksite was trained in first aid. First aid supplies were readily available, stored in sanitary and weatherproof containers, and kept in individually sealed packages. First aid supplies included materials such as bandaids, gauze, bandages, and sterile dressings. Proper equipment was provided for prompt transportation of an injured or ill person to a physician or hospital.

**NOTE:** Harborline and associated personnel adhered to the above health and safety plan during the performance of all on-site investigations.

**Test Borings**

Test borings were performed by Enviro Tech of Boston, Massachusetts, using 4.25 inch hollow stem augers, driven on a truck mounted rotary drill rig. The borings were completed to depths of 21.5 feet in boring #1, 17.5 feet in boring #2, and 19.5 feet in boring #3, below grade into the groundwater table.

The borings were continuously observed and logged. The exploration logs enclosed in this report are based on field logs. Disturbed but representative soil samples were obtained by using the Standard Penetration Procedure in accordance with ASTM: D1587. The test and sampling method consists of driving a standard 2 inch outside diameter split spoon sampler a distance of 18 inches into the soil with a 140 pound hammer free falling a distance of 30 inches. The blow count provides a measure of the relative density of granular soils or the relative consistency of cohesive soils.

The various types of soil and depth where soils or characteristics of the soils changed are indicated on the boring logs. The soils were classified using the Unified Soil Classification System. The depth indicated on the boring logs where soil conditions changed may represent gradational changes between soil types in the field. If changes occurred between sample intervals in the boring they were interpreted.

### **Monitoring Wells**

Test borings were continued approximately 5 to 10 feet into the groundwater table. Prior to the removal of the augers from the ground, a monitoring well was constructed in each boring. Monitoring wells consist of 5-10 feet of 2 inch diameter Schedule 40 slotted PVC well screen with sufficient riser (unslotted) pipe to reach surface grade. Environmental filter sand was then placed in the boring, up to one foot above the well screen. This allows for sufficient groundwater flow to the well and to prevent clogging of the well screen by fine soil particles. A one foot bentonite pellet seal was placed approximately one foot above the well screen to protect the integrity of the monitoring well from surface water contamination. The monitoring wells are protected by cast iron roadway boxes cemented in place at grade. Boring logs, which describe the well construction and soils encountered, are attached in Appendix D. Approximate locations of the groundwater monitoring wells are shown on the Site plan, attached in Appendix C.

### Electronic Soil Screening

Soil samples collected during the boring operations were immediately placed into clean glass jars and screened for the presence of volatile organic compounds (VOC's) via the standard jar headspace method using an H-Nu Systems, Inc. Model GP-101 Photoionization Detector, equipped with a 10.2 eV lamp probe and calibrated to benzene.

Most of the light permanent gases such as the ambient gases hydrogen, helium, etc. have ionization potentials of 12 eV or more. Volatile organic compounds generally have ionization potentials below 10 eV. The photoionization readings are shown in the margins of the boring logs (Appendix D). The H-Nu screening is a measure of the total volatiles and does not distinguish between different components. Results of the photoionization screening are shown below in Table 1.

**TABLE 1**  
**RESULTS OF PHOTOIONIZATION SCREENING**  
**IN PARTS PER MILLION (PPM)**

SAMPLE	DEPTH	BORING MW-1	BORING MW-2	BORING MW-3
S-1	0'-2'	1.2	7	10.4
S-2	5'-7'	4.6	12.4	13.2
S-3	10'-12'	22	13.2	---
S-4	15'-17'	65	16.4	---
S-5	19'-21'	---	15.4	13

### Groundwater Sampling and Gauging

On April 17, 1992, prior to sample collection, monitoring wells MW-1, MW-2, and MW-3, were purged of at least three well volumes of groundwater using clean, dedicated PVC bailers suspended on a teflon line. After purging, groundwater samples were recovered, placed in duplicate clean, laboratory-prepared VOA vials and 1-liter glass jars equipped with teflon caps and placed in refrigerated coolers for preservation.

Samples were transported on the date of collection to American Environmental Laboratories, Inc., a state-certified analytical testing laboratory. CERT # P.

Prior to purging and sampling of the wells, the depth to groundwater in each well was gauged using an ORS Instruments Groundwater Interface Probe. In addition, a stadia survey of well head elevations was performed in relation to an arbitrary benchmark (assumed elevation = 100 feet). The stadia survey and well gauging measurements were combined for the calculation of relative groundwater elevations, which allows the determination of approximate groundwater flow direction(s).

Groundwater gauging and stadia survey results are presented below in Table 2. These results indicate that the approximate groundwater flow direction on the property is generally to the northeast. The approximate groundwater flow direction is shown on the Site plan in Appendix C.

**TABLE 2**  
**MONITORING WELL GAUGING AND STADIA SURVEY RESULTS**  
**FOR THE DETERMINATION OF GROUNDWATER ELEVATIONS AND FLOW DIRECTION**  
**(IN FEET)**

STA	BS(+)	HI	FS(-)	ELEV	DEPTH TO GW	GW ELEV
BM-1	3.4	103.40		100.00 ✓ (Assumed)		
MW-1			3.86	99.54 ✓	11.27	88.27 ✓
MW-2			4.20	99.20 ✓	11.06	88.14 ✓
MW-3			4.38	99.02 ✓	12.48	86.54 ✓
BM-1 (Check)			3.40	100.00 ✓		

**LEGEND**

STA =	STATION	ELEV =	ELEVATION
BS =	BACKSIGHT	GW =	GROUNDWATER
HI =	HEIGHT OF INSTRUMENT	BM =	BENCHMARK
FS =	FORESIGHT	MW =	MONITORING WELL

**STATION DESCRIPTION**

BM 1 = NORTHWEST CORNER OF BRICK WALL

**Laboratory Analyses**

Groundwater samples recovered from monitoring wells MW-1, MW-2, and MW-3, were subjected to laboratory analyses for EPA Methods-624 Volatile Organic Compounds (VOC's) and 418.1 Total Petroleum Hydrocarbons (TPH). The results of these tests determine the quality of the groundwater in relation to EPA Primary Drinking Water Standards. Groundwater samples were recovered on April 17, 1992.

The analytical laboratory results are attached in Appendix F.

## ENVIRONMENTAL ASSESSMENT AND OPINION

The environmental quality of the property located on Union Street in New Bedford, Massachusetts was assessed by means of a field investigation based upon; a visual Site inspection, investigation of records at state and local agencies, interviews and discussions with local officials and Site personnel, a review of the Site history, subsurface explorations, photoionization of soils, and limited chemical analyses of the on-site groundwater.

Photoionization of soils did not reveal levels which exceeded 100 ppm.

Laboratory analyses of groundwater indicated the presence of TPH (679 ppm) in MW-1 and 1,2 Dichlorobenzene (13.6 ppb) in MW-3.

It is possible that the levels of TPH are the result of a historic release from a UST which was removed several years ago.

Based upon the investigation cited above, it is the opinion of Harborline Engineering, Inc. that evidence exists, as of the date of this report, of a release of oil or hazardous materials at the Site as defined by Massachusetts General Law Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.00. However, since the area of contamination is small, is capped by asphalt, and the local groundwater is not used for drinking, Harborline does not see this as a threat to the environment or human health, and therefore requires no further action.

**RECOMMENDATIONS**

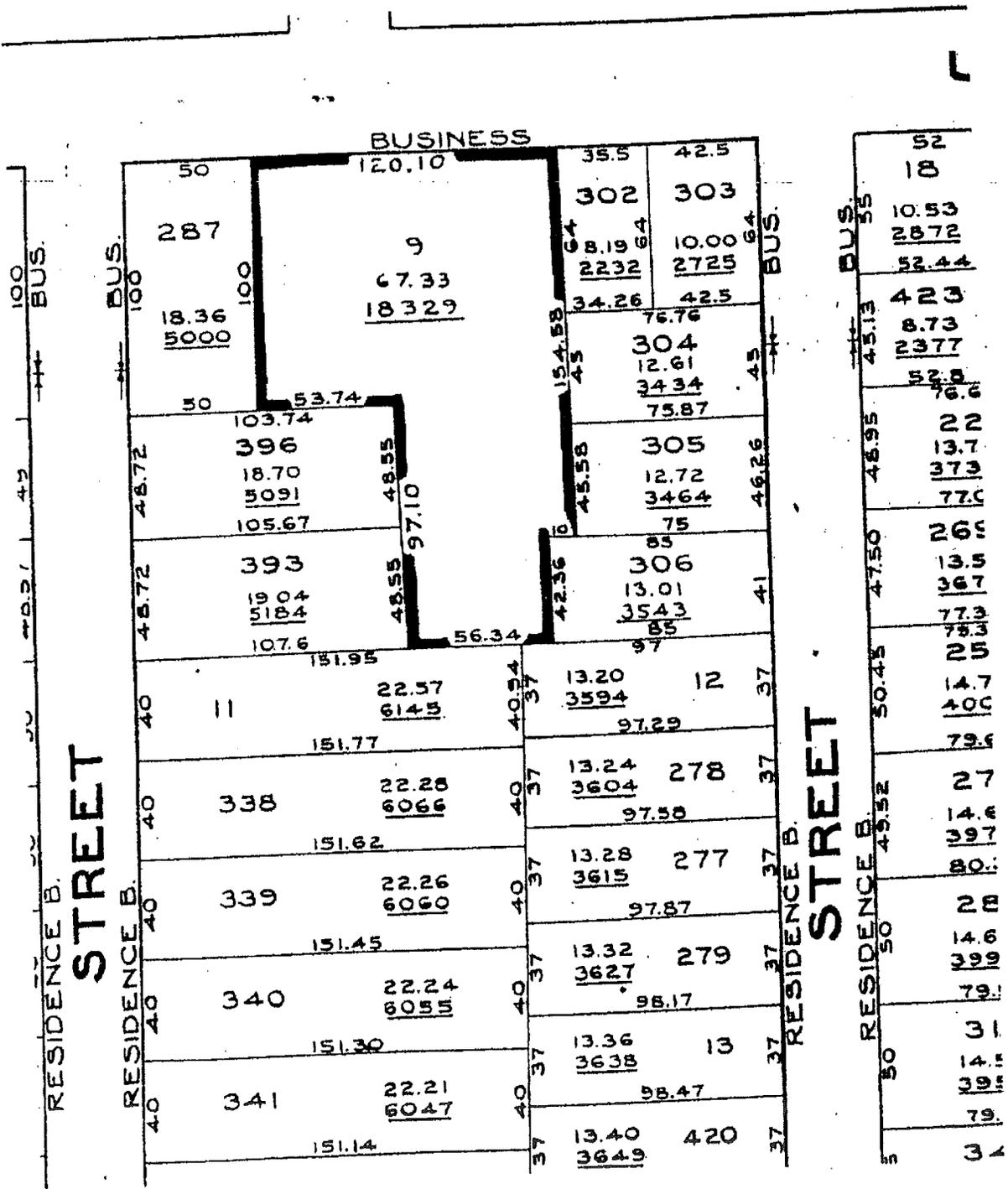
Harborline Engineering, Inc. would like to make the following recommendations:

Any level of contamination is reportable to the DEP. Harborline recommends that a copy of this report be forwarded to the Lakeville offices;

**RECOMMENDATIONS**

Harborline Engineering, Inc. would like to make the following recommendations:

Any level of contamination is reportable to the DEP. Harborline recommends that a copy of this report be forwarded to the Lakeville offices;



PLAT PLAN



**HARBORLINE ENGINEERING INC.**  
 286 HERMAN MELVILLE BLVD.  
 NEW BEDFORD, MA. 02740

PAGE 1 OF 3

**BORING LOG**

BORING / WELL NO.: TP-1/MW-1

SITE: 480 Union Street, New Bedford

INSTALLATION: 2" .010 PVC MW

PROJECT NO: CLIENT/PROJECT: Alan Cohen

DRILLER:

HAZWRAP CONTRACTOR: DRLG. CONTRACTOR: Enviro Tech

BOREHOLE DIA.(S) 4.25"

DRLG. STARTED: 4/12/92 (8:30 a.m.) DRLG. ENDED: 4/12/92 (10:00 a.m.)

DRLG. METHOD / RIG TYPE: Hollow stem auger, Split spoon/Acker AD II

PROTECTION LVL: D

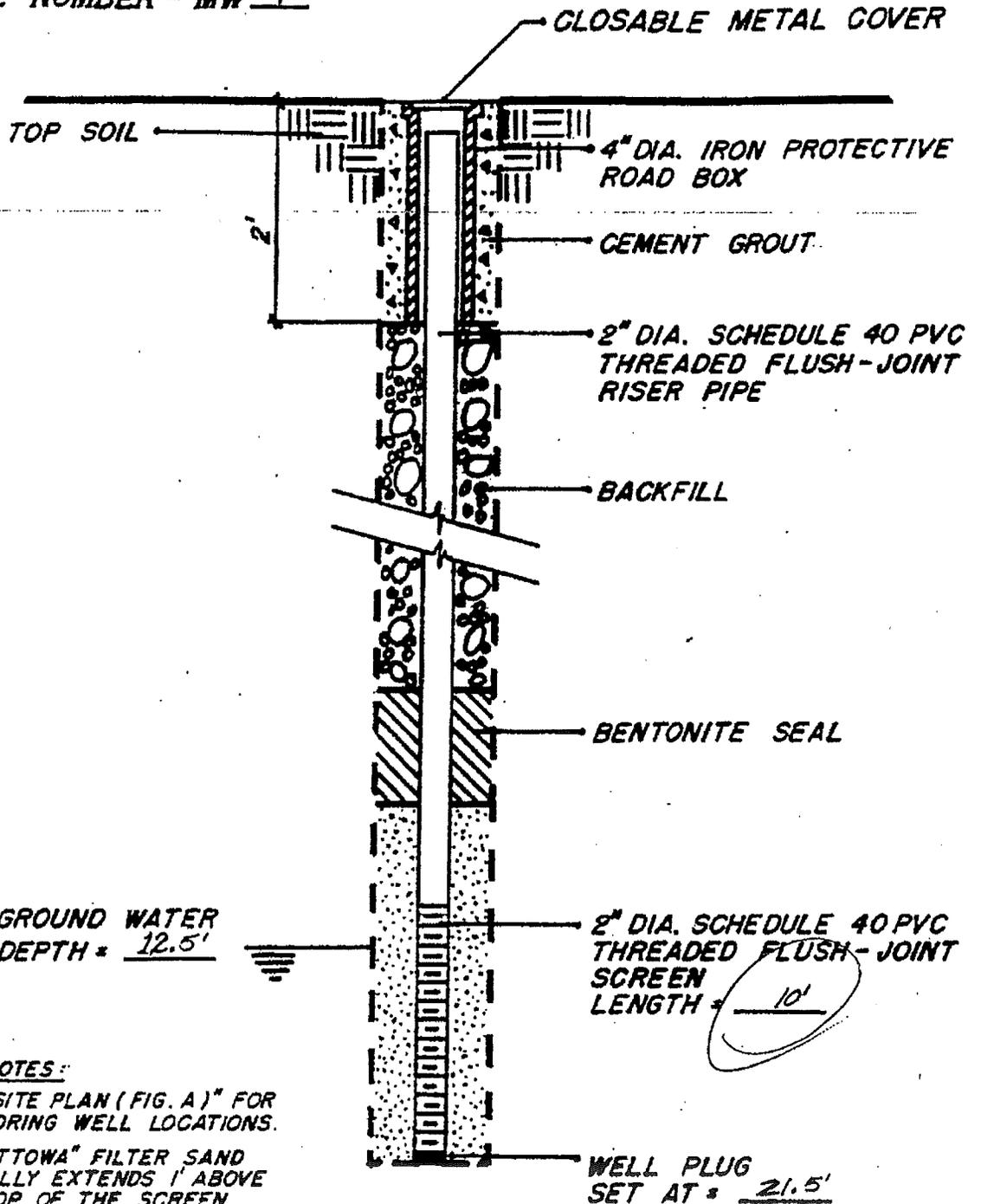
LOGGED BY: P.T.C. E-LOG (Y/N) FROM \_\_\_\_\_ TO \_\_\_\_\_

DEPTH (FT.) SAMPLE NO. SAMPLE NO. HDSP (PPM) RECOVERY (l.n.s.) LITHOLOGIC DESCRIPTION BLOWS / 6" GRAPHIC LOG WELL DATA WATER DEPTH + REMARKS ELEV.

DEPTH (FT.)	SAMPLE NO.	SAMPLE NO.	HDSP (PPM)	RECOVERY (l.n.s.)	LITHOLOGIC DESCRIPTION	BLOWS / 6"	GRAPHIC LOG	WELL DATA	WATER DEPTH + REMARKS	ELEV.
	A	1.2	n/a		10 yr 3/2 (very dark grayish brown), loamy coarse sand, dry, coarse fragments 5%	17 21 11				
5	B	4.6	14		10 yr 5/3 (brown), silt loam, moist	14 20 27				5
10	C	22	16		10 yr 5/3 (brown), loamy med/coarse sand, moist, petroleum odor	12 23 31			Water at 12.5 feet	10
15	D	65	12		10 yr 5/1 (gray), loamy med/coarse sand, very moist, petroleum odor					15
20	Well set at 21.5' 10' PVC screen 11.5' PVC riser 200 lbs. filter sand 25 lbs. bentonite Road box									20
25										25
30										30
35										35

U = THIN WALL TUBE R = ROCK CORING FIELD G/C (MAKE/MOD.) GP-101 (H-Nu)  
 S = SPLIT SPOON (TUBE) O = OTHER G/C OPER.: PC  
 C = CUTTINGS NOTES: Dig Safe # 92151959

WELL NUMBER - MW 1



**GENERAL NOTES:**

- 1.) SEE "SITE PLAN (FIG. A)" FOR MONITORING WELL LOCATIONS.
- 2.) THE "OTTAWA" FILTER SAND TYPICALLY EXTENDS 1' ABOVE THE TOP OF THE SCREEN.
- 3.) THE BENTONITE SEAL IS TYPICALLY 1' THICK.



Harborline  
Engineering, Inc.

PLAN TITLE:

**MONITORING WELL DETAIL**

DRAWN BY: P.C.

DATE:

FIGURE



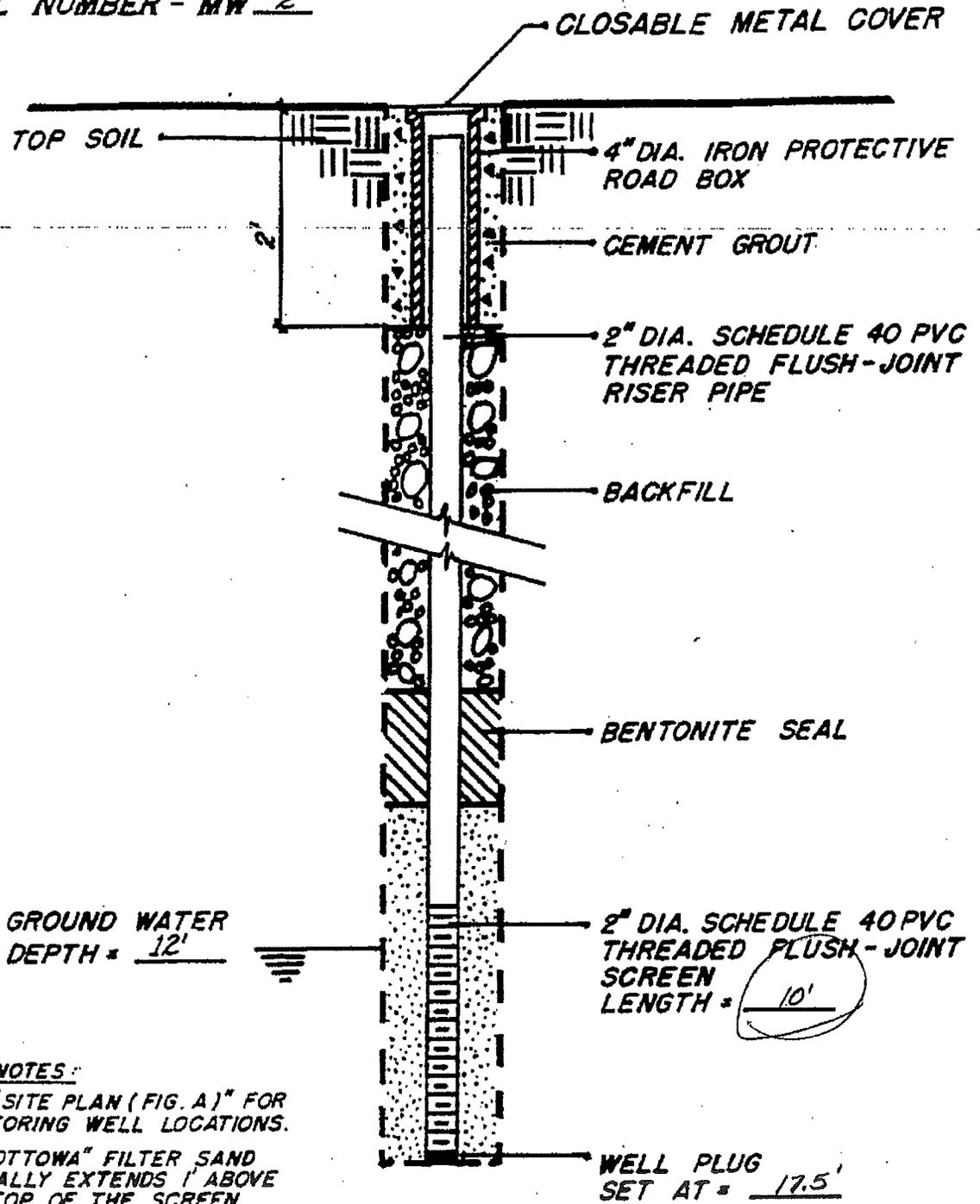
**HARBORLINE ENGINEERING INC.**  
 286 HERMAN MELVILLE BLVD.  
 NEW BEDFORD, MA. 02740

<b>BORING LOG</b>		BORING / WELL NO.: TP-2/MW-2	PAGE 2 OF 3
INSTALLATION: 2" .010 Slot PVC MW		SITE: 480 Union St., New Bedford	
PROJECT NO.:	CLIENT / PROJECT: Alan Cohen		
HAZWRAP CONTRACTOR:	DRLG. CONTRACTOR: Enviro Tech	DRILLER:	
DRLG. STARTED: 4/12/92 (10:45 a.m.)	DRLG. ENDED: 4/12/92 (11:45 a.m.)	BOREHOLE DIA. (S) 4.25"	
DRLG. METHOD / RIG TYPE: Hollow stem auger, Split spoon/Acker AD II			
LOGGED BY: PTC	E-LOG (Y/N) FROM _____ TO _____		PROTECTION LVL: D

DEPTH (FT.)	SAMPLE NO. / PID	HOSE (ppm) / RECOVERY (ins.)	LITHOLOGIC DESCRIPTION	BLOWS / 6"	GRAPHIC LOG	WELL DATA	WATER DEPTH + REMARKS	ELEV.
7.0	12		10 yr 4/3 (brown), fine/med sandy loam, dry					
12.4	13		10 yr 4/4 (dark yellowish brown), loamy sand, dry	41 79 75				
13.2	12		10 yr 5/4 (yellowish brown), loamy sand, dry	10 22 25				
16.4	14		10 yr 5/3 (brown), very fine sandy loam, wet	17 19 21			Water at 12 feet	
15.4			10 yr 5/3 (brown), very fine sandy loam, wet					
Well set at 17.5' 200 lbs. filter sand 25 lbs. bentonite 10' PVC screen 7.5' PVC riser Road box								

U = THIN WALL TUBE    R = ROCK CORING    FIELD G/C (MAKE/MOD.) GP-101 (H-Nu)  
 S = SPLIT SPOON (TUBE)    O = OTHER    G/C OPER.: PC  
 C = CUTTINGS    NOTES: Dig Safe # 92151959

WELL NUMBER - MW 2



**GENERAL NOTES:**

- 1.) SEE "SITE PLAN (FIG. A)" FOR MONITORING WELL LOCATIONS.
- 2.) THE "OTTAWA" FILTER SAND TYPICALLY EXTENDS 1' ABOVE THE TOP OF THE SCREEN.
- 3.) THE BENTONITE SEAL IS TYPICALLY 1' THICK.



Harborline  
Engineering, Inc.

PLAN TITLE:

**MONITORING WELL DETAIL**

DRAWN BY: P. C.

DATE:

FIGURE



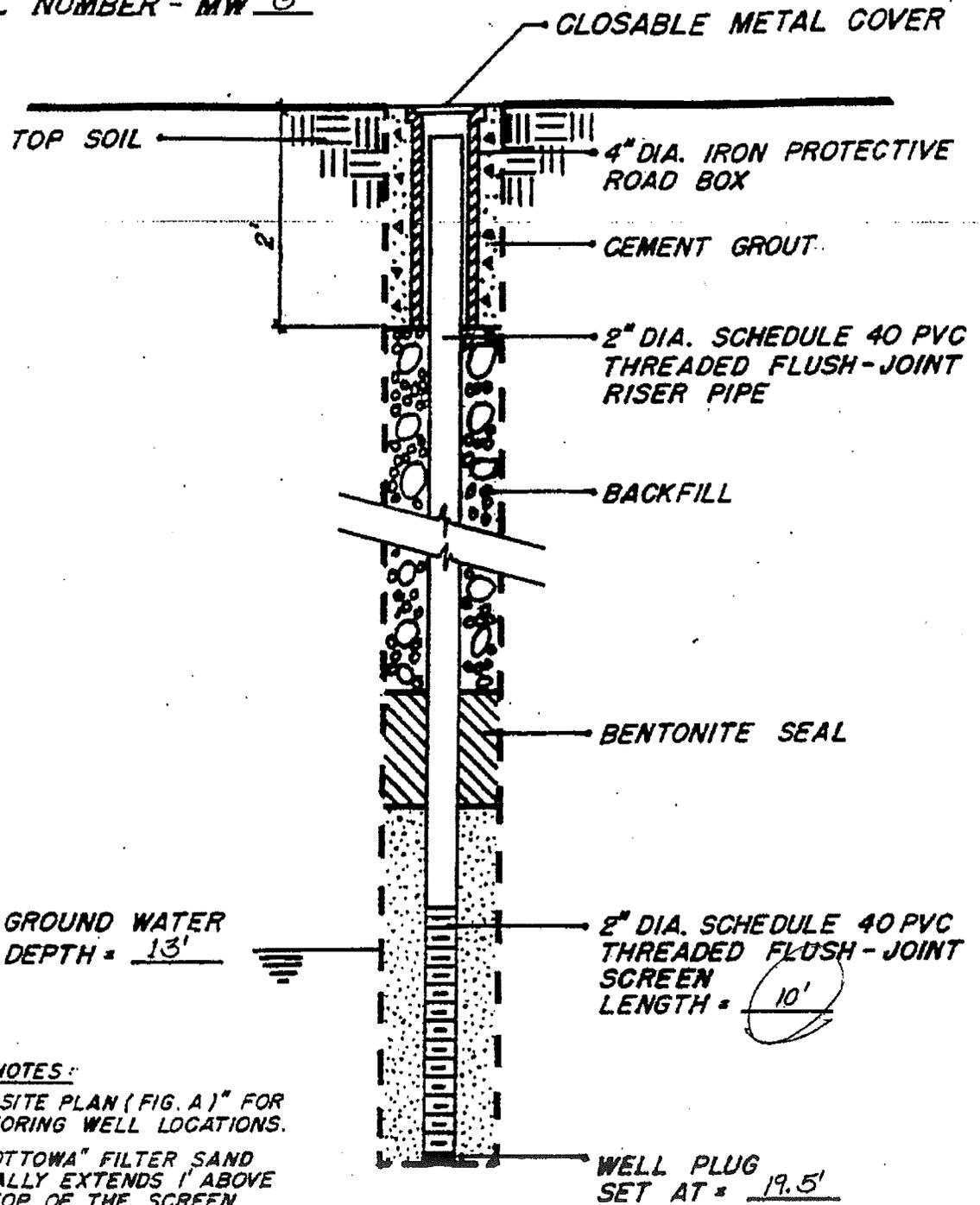
**HARBORLINE ENGINEERING INC.**  
 286 HERMAN MELVILLE BLVD.  
 NEW BEDFORD, MA. 02740

<b>BORING LOG</b>		BORING / WELL NO.: TP-3/MW-3	PAGE 3 OF 3
INSTALLATION: 2" .010 Slotted PVC MW		SITE: 480 Union St., New Bedford	
PROJECT NO:	CLIENT / PROJECT: Alan Cohen		
HAZWRAP CONTRACTOR:	DRLG. CONTRACTOR: Enviro Tech	DRILLER:	
DRLG. STARTED: 4/12/92 (12:00 P.M.)	DRLG. ENDED: ( P.M.)	BOREHOLE DIA.(S): 4.25"	
DRLG. METHOD / RIG TYPE: Hollow stem auger, Split spoon/Acker AD II			
LOGGED BY: PTC	E-LOG (Y/N) FROM _____ TO _____		PROTECTION LVL: D

DEPTH(FT.)	SAMPLE NO.	SAMPLE NO. PID	HDSP (ppm) RECOVERY (ins.)	LITHOLOGIC DESCRIPTION	BLOWS / 6"	GRAPHIC LOG	WELL DATA	WATER DEPTH + REMARKS	ELEV.	
	A	10.4	12	10 yr 4/2 (dark grayish brown), loamy med/coarse sand, moist						
5	B	13.2	10	10 yr 4/6 (dark yellowish brown), fine/med sandy loam, moist	34 11 10				5	
10	C	---	0	---	64 41 30				10	
15	D	---	4	2/5 y 4/4 (olive brown), sandy loam, moist, high mica content	21 12 10			Water at 13 feet	15	
20	E	13	14	2.5 y 4/4 (olive brown), sandy loam, moist, high mica content	27 40 103				20	
25	Well set at 19.5 10 ft. PVC screen 9.5 ft. PVC riser 200 lbs. filter sand 25 lbs. bentonite Road box									25
30										30
35										35

U = THIN WALL TUBE      R = ROCK CORING      FIELD G/C (MAKE / MOD.) GP-101 (H-Nu)  
 S = SPLIT SPOON (TUBE)      O = OTHER      G/C OPER.: PC  
 C = CUTTINGS      NOTES: Dig Safe # 92151959

WELL NUMBER - MW 3



**GENERAL NOTES:**

- 1.) SEE "SITE PLAN (FIG. A)" FOR MONITORING WELL LOCATIONS.
- 2.) THE "OTTOWA" FILTER SAND TYPICALLY EXTENDS 1' ABOVE THE TOP OF THE SCREEN.
- 3.) THE BENTONITE SEAL IS TYPICALLY 1" THICK.



Harborline  
Engineering, Inc.

PLAN TITLE:

**MONITORING WELL DETAIL**

DRAWN BY: P. C.

DATE:

FIGURE

REPORT NO. 49220-1492-1494



AMERICAN ENVIRONMENTAL LABORATORIES, INC.

(508) 534-1444

60 Elm Hill Ave. Leominster, MA 01453

LAB ID #MA076

800-LAB-0094

SAMPLE INFORMATION

Requested By: Harborline Engineering  
 Address: 286 Herman Melville Blvd.  
 City: New Bedford, MA 02740  
 Sample ID: PD No: Union St.  
 Matrix: Water  
 Sample Location (if different): See Below

Date Received: 04/20/92  
 Date Analyzed: 04/22/92  
 Collected By: Eugene Carpenter

ATTN: Gene Carpenter

Date Sampled: 04/17/92

PARAMETER	RESULT	MCL	MDL	UOM	METHOD NO.
49220-1492: MW-1 T. Petroleum Hydrocarbon Monitoring Well #1	679		5.0	mg/l	EPA# 418.1
49220-1493: MW-2 T. Petroleum Hydrocarbon Monitoring Well #2	ND		5.0	mg/l	EPA# 418.1
49220-1494: MW-3 T. Petroleum Hydrocarbon Monitoring Well #3	ND		5.0	mg/l	EPA# 418.1

Comments:

Misc

Analyst: Sherri Robichaud

Analyst:

\* = Exceeds EPA Proposed MCL Limits  
 MDL = Minimum Detection Limit  
 MCL LIMIT = Proposed EPA Maximum contaminant level  
 ND = Level present is below detection limit  
 NT = Not Tested

"PLEASE NOTE"  
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REPORT NO. 49220-1094



AMERICAN ENVIRONMENTAL LABORATORIES, INC.

(508) 534-1444

60 Elm Hill Ave. Leominster, MA 01453

LAB ID #MA076 800-LAB-0094

## SAMPLE INFORMATION

Requested By: Harborline Engineering  
 Address: 286 Herman Ave.  
 City: New Bedford, MA 02740  
 Sample ID: PO No: Union St.  
 Matrix: Water (Date Sampled: 4/17/92)  
 Sample Location (if different):

Date Received: 04/20/92  
 Date Analyzed: 04/23/92  
 Collected By: Eugene Carpenter  
 ATTN: Gene Carpenter

MW#3 Monitoring Well #3

PARAMETER	RESULT (ug/l)	MDL (ug/l)
Benzene	ND	5.0
Bromodichloromethane (THM)	ND	5.0
Bromoform (THM)	ND	5.0
Bromomethane	ND	5.0
Carbon Tetrachloride	ND	5.0
Chlorobenzene	ND	5.0
Chloroethane	ND	5.0
2-Chloroethylvinyl ether	ND	10.0
Chloroform (THM)	ND	5.0
Chloromethane	ND	5.0
Dibromochloromethane (THM)	ND	5.0
1,2 Dichlorobenzene	13.6	5.0
1,3 Dichlorobenzene	ND	5.0
1,4 Dichlorobenzene	ND	5.0
1,1 Dichloroethane	ND	5.0
1,2 Dichloroethane	ND	5.0
1,1 Dichloroethene	ND	5.0
Trans-1,2 Dichloroethene	ND	5.0
1,2 Dichloropropane	ND	5.0
Cis-1,3 Dichloropropene	ND	5.0
Trans-1,3 Dichloropropene	ND	5.0
Ethyl benzene	ND	5.0
Methylene Chloride	ND	10.0
1,1,2,2 Tetrachloroethane	ND	5.0
Tetrachloroethene	ND	5.0
Toluene	ND	5.0
1,1,1 Trichloroethane	ND	5.0
1,1,2 Trichloroethane	ND	5.0
Trichloroethene	ND	5.0
Trichloro Fluoromethane	ND	5.0
Vinyl Chloride	ND	5.0
Xylene	ND	5.0

Comments: Sample Dilution: None

EPA 624

Lisa Cormier

Analyst: *LC*

\* = Exceeds EPA Proposed MCL Limits

MDL = Minimum Detection Limit

MCL LIMIT = Proposed EPA Maximum contaminant level

ND = Level present is below detection limit

NT = Not Tested

## \*PLEASE NOTE\*

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AMERICAN ENVIRONMENTAL LABORATORIES, INC.

60 Elm Hill Ave. Leominster, MA 01453

REPORT NO. 49220-1493

(508) 534-1444

LAB ID #MA076

800-LAB-0094

SAMPLE INFORMATION

Requested By: Harborline Engineering
Address: 286 Herman Ave.
City: New Bedford, MA 02740
Sample ID: PO No: Union St.
Matrix: Water (Date Sampled: 4/17/92)
Sample Location (if different):

Date Received: 04/20/92
Date Analyzed: 04/23/92
Collected By: Eugene Carpenter
ATTN: Gene Carpenter

MW#2 Monitoring Well #2

Table with 3 columns: PARAMETER, RESULT (ug/l), MDL (ug/l). Lists various chemical parameters such as Benzene, Bromodichloromethane, etc., with results mostly marked as ND (Not Detected) and MDL values of 5.0 or 10.0.

Comments: Sample Dilution: None

EPA 624

Lisa Cormier

Analyst:

Handwritten signature/initials.

- \* = Exceeds EPA Proposed MCL Limits
MDL = Minimum Detection Limit
MCL LIMIT = Proposed EPA Maximum contaminant level
ND = Level present is below detection limit
NT = Not Tested.

PLEASE NOTE
The results here, can not be reproduced in whole or in part without our prior consent. The results apply only to the actual sample tested. American shall be held harmless from any liability arising out of the use of such results. The integrity of the sample and results is dependent on the quality of sampling.

REPORT NO. 49220-1492



AMERICAN ENVIRONMENTAL LABORATORIES, INC.

(508) 534-1444

60 Elm Hill Ave. Leominster, MA 01453

LAB ID #MA076

800H.AB-0094

## SAMPLE INFORMATION

Requested By: Harborline Engineering  
 Address: 286 Herman Melville Blvd.  
 City: New Bedford, MA 02740  
 Sample ID: PO No: Union St.  
 Matrix: Water (Date Sampled: 4/17/92  
 Sample Location (if different):

Date Received: 04/20/92  
 Date Analyzed: 04/23/92  
 Collected By: Eugene Carpenter  
 ATTN: Gene Carpenter

MW#1 Monitoring Well #1

PARAMETER	RESULT (ug/l)	MDL (ug/l)
Benzene	ND	5.0
Bromodichloromethane (THM)	ND	5.0
Bromoform (THM)	ND	5.0
Bromomethane	ND	5.0
Carbon Tetrachloride	ND	5.0
Chlorobenzene	ND	5.0
Chloroethane	ND	5.0
2-Chloroethylvinyl ether	ND	10.0
Chloroform (THM)	ND	5.0
Chloromethane	ND	5.0
Dibromochloromethane (THM)	ND	5.0
1,2 Dichlorobenzene	ND	5.0
1,3 Dichlorobenzene	ND	5.0
1,4 Dichlorobenzene	ND	5.0
1,1 Dichloroethane	ND	5.0
1,2 Dichloroethane	ND	5.0
1,1 Dichloroethene	ND	5.0
Trans-1,2 Dichloroethene	ND	5.0
1,2 Dichloropropane	ND	5.0
Cis-1,3 Dichloropropene	ND	5.0
Trans-1,3 Dichloropropene	ND	5.0
Ethyl benzene	ND	5.0
Methylene Chloride	ND	10.0
1,1,2,2 Tetrachloroethane	ND	5.0
Tetrachloroethane	ND	5.0
Toluene	ND	5.0
1,1,1 Trichloroethane	ND	5.0
1,1,2 Trichloroethane	ND	5.0
Trichloroethene	ND	5.0
Trichloro Fluoromethane	ND	5.0
Vinyl Chloride	ND	5.0
Xylene	ND	5.0

Comments: Sample Dilution: None

EPA 624

Lisa Cormier

Analyst: 

\* = Exceeds EPA Proposed MCL Limits

MDL = Minimum Detection Limit

MCL LIMIT = Proposed EPA Maximum contaminant level

ND = Level present is below detection limit

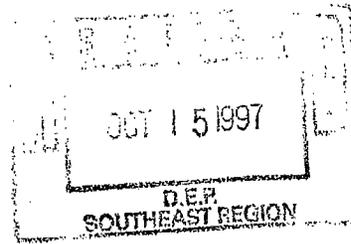
NT = Not Tested

## \*PLEASE NOTE\*

The results here, can not be reproduced in whole or in part without our prior consent. The results apply only to the actual sample tested. American shall be held harmless from any liability arising out of the use of such results. The integrity of the sample and results is dependent on the quality of sampling.



SCANNED



**RESPONSE ACTION OUTCOME STATEMENT  
480 UNION STREET  
NEW BEDFORD, MASSACHUSETTS**

**DEP RIN 4-1265**

SCANNED

**PREPARED FOR:**

**Alan S. Cohen  
6226 Water Lily Lane  
Boynton Beach, Florida 33437-4928**

**PREPARED BY:**

**PRIME Engineering, Inc.  
P.O. Box 1088, 350 Bedford Street  
Lakeville, MA 02347**

**October 13, 1997**

## 1.0 INTRODUCTION

This report presents background information on 480 Union Street, New Bedford, Massachusetts (the Site) and the results of assessment related to the release of oil and/or hazardous material which occurred at the site, and provides the basis for the Response Action Outcome (RAO) Statement which is presented in Section 5.

### 1.1 SITE DESCRIPTION

The property is an irregularly shaped 18,329 square foot parcel located along the southern side of Union Street in New Bedford, Massachusetts. The general locus is shown on the 1985 USGS Topographic Quadrangle Map of New Bedford-North, Massachusetts, which is presented as Figure No. 1 - Site Locus Map. Site coordinates are 41° 37' 58" N latitude by 70° 56' 23" W longitude. Universal Transverse Mercator coordinates are 338,425 meters east by 4,610,600 meters north.

The property is improved with a single story building of concrete block construction, and associated utilities. The property is comprised of a single lot referenced as Lot 9 on the New Bedford Assessors Map No. 45. The general property layout is presented on Figure No. 2 - Site Schematic.

The Site is bordered to the north by Union Street (paved public way), beyond which are multi-family homes and small businesses. The properties to the west, east and south of the subject site are occupied by multi-family residential dwellings. The site is accessed via paved drives that extend from Union Street onto the northern portion of the site.

### 1.2 SITE HISTORY

The following summary of historical property use was taken from a report entitled, "Phase I Site Investigation for the Property Located at 480 Union Street, New Bedford, MA", by Harborline Engineering, Inc. According to this report which included a review of New Bedford Building Department, Bristol County Registry of Deeds and personal recollection of municipal officials and others familiar with the Site, the earliest Site development occurred circa 1915, with the construction of a service garage. According to this report, a total of eight Underground Storage Tanks (USTs) were also installed around this period and were removed when the garage stopped operation in 1958. However, this report indicates definitive records that these tanks were removed was not available. Since 1958 the Site has been utilized for several different retail and commercial activities. The site is currently used as a small convenience store and U-Haul drop-off center.

Harborline's Site history revealed that the Site was used as a garage/service station for approximately 40 years, and suggests that gasoline, oils, and other lubricants were stored on Site.

### 1.3 REGULATORY HISTORY

As part of Harborline's Phase I Investigation of the Site, a series of borings and monitoring wells were installed and the site soils and groundwater were assessed for the presence of oil and/or hazardous material. A total of three test borings were advanced at the site by Harborline. All three borings were completed as monitoring wells.

On April 17, 1992, groundwater samples were collected from all three monitoring wells and analyzed for Volatile Organic Compounds (VOCs) by EPA Method 624 and Total Petroleum Hydrocarbons by EPA Method 418.1. Laboratory analyses of the groundwater samples indicated the presence of TPH (679 ppm) in MW-1 and 1,2 Dichlorobenzene (13.6 ppb) in MW-3. Based on these results, the site was reported to the Massachusetts Department of Environmental Protection (MADEP) and was subsequently listed as a Location to Be Investigated (LTBI). On November 29, 1993, the site was granted a Waiver Approval.

## 2.0 NATURE AND EXTENT OF CONTAMINATION

This section presents the nature and extent of contamination.

### 2.1. Initial Investigation

An exploratory soil boring and soil sampling program was conducted by Harborline Engineering, Inc. at the Site in August, 1992. Harborline oversaw the installation of three borings by Enviro Tech of Boston, Massachusetts. The purpose of the exploratory program was to determine if historical operations at the Site had impacted the soil or groundwater. A total of three exploratory borings, B-1 through B-3, were advanced into overburden with a truck mounted rotary drill rig. The soil borings were advanced to depths of 21.5 feet in B-1, 17.5 feet in B-2, and 19.5 feet in B-3. Soil samples were collected continuously. All three of the soil borings were completed as monitoring wells which are identified as MW-1, MW-2, and MW-3, the locations of which are shown on Figure 2. Soil samples collected were classified in the field in accordance with the Modified Burmister Soil Classification System.

During drilling activities a H-Nu Systems, Inc. Model GP-101 Photo Ionization Detector (PID) was used to screen the headspace of soil samples for the presence of volatile organic compounds. Results of the photoionization screening are shown below in Table 1.

TABLE 2.0  
Summary of Results of Photoionization Screening of Soil Samples  
August 1992

SAMPLE ID	DEPTH	PID READINGS IN PARTS PER MILLION		
		BORING MW-1	BORING MW-2	BORING MW-3
S-1	0' - 2'	1.2	7	10.4
S-2	5' - 7'	4.6	12.4	13.2
S-3	10' - 12'	22	13.2	---
S-4	15' - 17'	65	16.4	---
S-5	19' -21'	---	15.4	13

Due to the low PID readings (i.e. less than 100 ppm), Harborline did not collect soil samples for confirmatory analysis.

On April 17, 1992, groundwater samples were collected from all three monitoring wells and analyzed for Volatile Organic Compounds (VOCs) by EPA Method 624 and Total Petroleum Hydrocarbons by EPA Method 418.1. Laboratory analyses of the groundwater samples indicated the presence of TPH (679 ppm) in MW-1 and 1,2 Dichlorobenzene (13.6 ppb) in MW-3.

Additional groundwater samples were collected by Olde Boston Environmental from these monitoring wells on October 1, 1993, June 17, 1994, and May 22, 1997. On October 1, 1993, samples were collected from MW-1, MW-2, and MW-3. All three of the samples was analyzed for the presence of volatile organic compounds (VOCs) by EPA Method 8260. The samples collected from MW-1 and MW-2 were also analyzed for Total Petroleum Hydrocarbons (TPH) by EPA Method 418.1. The results of the analysis are summarized on Table 2.1 which is presented in the Tables Section at the rear of this Report. A review of the results revealed low levels of VOCs and slightly elevated levels of TPH were present in the groundwater samples collected from MW-1. As a result of these slightly elevated readings, MW-1 was re-sampled on June 17, 1994 and May 22, 1997 and analyzed for VOCs by EPA Method 8260 and TPH by EPA Method 418.1. The results of the laboratory analysis are summarized on Table 2.1.

## **2.2 Recent Exploratory Boring and Soil Sampling Program**

An exploratory soil boring and soil sampling program was conducted by PRIME at the Site in September, 1997. PRIME oversaw the installation of two borings by Geoserach of Leominster, Massachusetts. The purpose of the exploratory boring program was to confirm the results obtained as part of the initial subsurface investigation. A total of two exploratory borings, P-1 and P-2, were advanced into overburden with a truck mounted rotary drill rig. Boring P-1 and P-2 were advanced through the former on-site UST locations. The location of the borings is shown on Figure 2. The soil borings were advanced to depths of 15 feet in B-1 and 12 feet in B-2. Soil samples were collected continuously. Soil samples collected were classified in the field in accordance with the Modified Burmister Soil Classification System.

During drilling activities a Thermo Environmental Photo Ionization Detector (PID) was used to screen the headspace of soil samples for the presence of volatile organic compounds. Results of the photoionization screening are shown on the boring logs which are included in Appendix A. Confirmatory samples were collected for laboratory analysis. A single composite sample from each boring was collected and submitted for confirmatory Extractable Petroleum Hydrocarbons (EPH) and Volatile Petroleum Hydrocarbons (VPH) analysis. A summary of the soil results is presented in Table 2.2. A review of the results reveals the concentration of each of the EPH and VPH analytes is below the applicable MCP Method 1/Method 2 standard (i.e. S-1/GW-2 and S-1/GW-3).

## **2.3 Recent Groundwater Sampling and Analysis Program**

A single groundwater sample was collected from each of the three existing on-site monitoring wells. Low flow sampling methodologies using EPA protocol were utilized to limit the suspended particle concentrations in the collected samples and, thereby eliminated much of the artificial bias that results

from standard purging and sampling techniques. The following low flow sampling technique was utilized: Prior to purging, the groundwater level and total depth of the monitoring well were measured to the nearest 0.01 foot using an electronic water level sensing device. The recorded measurements were used to calculate the volume of standing water in the well. Prior to purging, all wells were examined for the presence of free-phase petroleum product by observing the condition of the water level indicator when it was withdrawn from the well. No measurable free-phase product was observed in any of the wells. Low flow sampling of the monitoring wells was performed in accordance with EPA protocol (SOP #GW 0001). Monitoring wells were purged and sampled using a Grundfos pump and virgin HDPE tubing. Temperature, pH, specific conductivity, and turbidity were recorded at three and five minute intervals. Sampling occurred when field indicator parameters remained within 10% for three consecutive readings, and turbidity had fallen to less than 5 NTU's. Groundwater samples were collected from the monitoring well locations for analysis of EPH and VPH.

All non-disposable down hole equipment was decontaminated prior to submersion with a scrub of Alconox solution and rinses of tap water followed by distilled water. Activities associated with monitoring well sampling were performed in Level D personal protection. The samples were submitted to Toxikon which is a Massachusetts certified analytical laboratory.

The result of the laboratory analysis are summarized on Table 2.3. The complete results are presented in Appendix B. A review of the results reveals that those compounds which were detected were well below MCP Method 2 Risk Standards.

### 3.0 RISK CHARACTERIZATION

The Massachusetts Contingency Plan requires that a risk characterization be performed for a Response Action Outcome Statement. This section presents that risk characterization.

#### 3.1 SELECTION OF RISK CHARACTERIZATION METHOD

A Method 2 Risk Characterization, as described in 310 CMR 40.0980, was used to characterize the risk of harm to health, public welfare and the environment. Method 2 is applicable to this disposal site for the following reasons:

- Oil and/or hazardous materials (OHM) have only been detected in soil and groundwater.
- Not all OHM detected at the site are listed in 310 CMR 40.0974 and 40.0975.
- OHM present on-site are not known to bioaccumulate.
- No environmental receptors have been identified that could be impacted by the disposal site.

#### 3.2 POTENTIAL ROUTES OF EXPOSURE

Potential routes of exposure identified include dermal contact with groundwater and soil, ingestion of soil and inhalation of particulates and OHM vapors during future excavation or construction work

##### 3.2.1. Identification of Exposure Point Concentrations

The exposure point concentrations for soil and groundwater are summarized below.

##### Exposure Point Concentrations in Soil

Exposure point concentrations in soil used in this risk characterization represent the maximum concentration of each study chemical detected in the soil. Two soil samples were collected and analyzed for EPH and VPH. The concentration of EPH and VPH in each of the samples was below the applicable Method 2 standard.

##### Exposure Point Concentrations in Water

Exposure point concentrations in groundwater used in this risk characterization represent the maximum concentration of each study chemical detected in groundwater during the most recent sampling activities. A total of three groundwater samples were collected from the site. All three samples were analyzed for VPH and EPH. The concentration of EPH and VPH in each of the groundwater samples was below the applicable MCP standard.

*Note:* The groundwater and soil results were compared to EPH and VPH standards that will not be officially promulgated until October 31, 1997. This comparison is pursuant to 310 CMR 40.0982 and, as such, is considered a Method 2 Risk Characterization.

### 3.3 SENSITIVE RECEPTORS

This section identifies and describes the potential human and environmental receptors which are likely to be present at the site or in the surrounding environment, and which, as a result, could potentially be exposed to oil and/or hazardous material (OHM).

#### Potential Human Receptors:

Pursuant to 310 CMR 40.0921, the following identifies and describes potential human receptors who are likely to be present at or in the surrounding environment, and who, as a result, could potentially be exposed to the OHM. The following justification is provided for consideration or elimination of potential human receptors:

*Site:* As the site is zoned and used for commercial purposes, residential use of the site, now or in the future, is unlikely. Lifelong residents of the site, women of childbearing age, children (ages 1 to 8) and other sensitive subpopulations are, therefore, not considered potential receptors. The site is currently utilized as a convenience store and U-Haul drop-off facility and, as such, future potential site receptors will likely include only site workers, customers, and trespassers.

*Surrounding Environment:* Contamination originating from the subject site has not been identified in the subsurface soil and groundwater at adjacent properties. As a result, there will be no potential off-site receptors.

#### Potential Environmental Receptors:

Pursuant to 310 CMR 40.0922, the following identifies and describes potential environmental receptors which are likely to be present at or within the surrounding environment and which could potentially be exposed to the OHM. The following justification is provided for consideration or elimination of potential environmental receptors:

*Biota:* No species of concern, Threatened Species, or Endangered Species are known or likely to be located at the site or within a one-half mile radius surrounding the property. As such, the potential for exposure by biota is unlikely.

*Habitats:* Based on a review of a MAGIS Scoring Map compiled for the area surrounding the property, no Areas of Environmental Concern have been identified on the property or within the surrounding environment. The closest water body to the site is the New Bedford Harbor located approximately 1 mile east of the subject site. Based on the distance and the subsurface conditions, groundwater from the site is not expected to impact the harbor.

AN  
elementary  
school  
is within  
500'  
100'

No off-site  
testing has  
been conducted

### 3.4 FORESEEABLE SITE USES AND ACTIVITIES

#### 3.4.1 Site

The anticipated future use of the site will be consistent with the current use.

#### 3.4.2 Groundwater

Based on a review of the Massachusetts Department of Environmental Protection (MADEP) Site Scoring Map, the site is not located within an Interim Wellhead Protection Area or a potential drinking water source area. Groundwater beneath the site is, therefore, not considered a current or potential future source of drinking water.

### 3.5 APPLICABLE SOIL AND GROUNDWATER CATEGORIES

#### 3.5.1 Soil Categories

Pursuant to 310 CMR 40.0933, this section identifies soil categories applicable to the site. The soil at the site is categorized based on available information regarding frequency of use, intensity of use, and accessibility. Soil at the site is not classified as S-1 for the following reasons (310 CMR 40.0933(5)).

- Potentially contaminated soil is located beneath the paved surface and, as such, the soil is considered potentially accessible.
- Soil is not used for growing fruits or vegetables and is not expected to be used for that purpose.
- A child's frequency and intensity of use are low.
- An adult would not have high frequency, high intensity of use.

Soil at the site is not classified as S-2 for the following reasons (310 CMR 40.0933(6)).

- The soil is potentially accessible as described above.
- A child's frequency and intensity of use are low.
- an adult would not have high frequency high intensity use.

Soil at this site is classified as S-3 as it does not meet any of the criteria outlined in 310 CMR 40.0933(5) or 310 CMR 40.0933(6).

*Note:* Although S-3 is the applicable soil category, S-1 was used in the risk characterization in order to consider the most conservative scenario, and eliminate the need for any activity and use limitations.

### **3.5.2 Groundwater Categories**

Pursuant to 310 CMR 40.0932, this section identifies groundwater categories applicable to the site. Based on available information regarding groundwater use at and within the vicinity of the site, groundwater category GW-1 is not applicable to the site. GW-1 is not applicable for the following reasons:

- The site is not located in a Zone II;
- The site is not located within an Interim Wellhead Protection Area;
- The site is not located within a Potential Drinking Water Source Area;
- The site is not located within the Zone A of a Class A Surface Water Body;
- The site is not located over 500 feet of a public water system distribution pipeline; and
- The site is not located within 500 feet of a private supply well used for drinking water.

In accordance with 310 CMR 40.0932(6), groundwater on and within the vicinity of the site is categorized as Groundwater Category GW-2 as groundwater is located within 30 feet of an occupied building or structure and the average annual depth to groundwater is 15 feet or less.

In accordance with 310 CMR 40.0932(3), groundwater on and in the vicinity of the site would also be categorized as Groundwater Category GW-3 because all groundwater is considered a potential source of discharge to surface water.

### **3.6 CHARACTERIZATION OF RISK TO SAFETY**

Pursuant to 310 CMR 40.0960, the risk of harm to safety is characterized by comparison of conditions at the site to applicable or suitably analogous safety standards. No safety standards were identified which were applicable to the soil or groundwater for this site.

There are no open pits, lagoons, rusted or corroded drums or similar hazards to public welfare or safety at the site. Conditions on the property do not pose fire or explosion threats. There is no threat posed by uncontained materials which exhibit the characteristics of corrosivity, reactivity, or flammability as described by 310 CMR 40.0347 from the contaminants on the property.

Pursuant to 310 CMR 40.0960(3), a level of no significant risk to safety has been achieved since conditions do not currently, and will not in the foreseeable future, pose a threat of physical harm or bodily injury.

### **3.7 CHARACTERIZATION OF HARM TO PUBLIC WELFARE**

This section of the risk characterization consists of a qualitative evaluation of the risk posed by the site to public welfare. The risk of harm to public welfare considers the existence of aesthetic degradation, nuisance conditions, loss of property value, and limitations on property use.

The site maintains a low likelihood of adversely impacting public or private properties within the vicinity of the site for the following reasons:

- Site contamination is restricted to subsurface soil.
- Existing data indicates soil contamination has been reduced to below applicable Method 2 standards.
- Since the primary pathway for offsite migration is advective transport of groundwater and since concentrations of OHM were not detected in the on-site groundwater, offsite migration of OHM in groundwater is not considered a concern.

In summary, pursuant to 310 CMR 40.0994(4)(a), a level of no significant risk of harm to public welfare exists.

### **3.8 RISK OF HARM TO HUMAN HEALTH AND THE ENVIRONMENT**

Pursuant to 310 CMR 40.0988, for sites at which a Method 2 Risk Assessment is applicable, the risk of harm to human health and the environment is determined through a comparison of conditions at the disposal site to promulgated MCP Standards and any MCP Method 2 Standards identified pursuant to 310 CMR 40.0980. As discussed in Section 2.2 and 2.3, the exposure point concentrations in the groundwater and soil at the site are below the applicable MCP Method 1 and established Method 2 soil and groundwater standards. Therefore, pursuant to 310 CMR 40.099, the site does not pose risk of harm to human health or the environment.

#### 4.0 COMPONENTS OF THE RESPONSE ACTION OUTCOME STATEMENT

The MCP prescribes the essential components of a Response Action Outcome (RAO) Statement in 310 CMR 40.1056. This section presents each of these elements as listed in that subsection of the MCP.

1A. Site Name, Address, and Tracking Number

480 Union Street  
New Bedford, MA 02745  
RTN: 4-1265

1B. Class of Response Action Outcome

The category of this RAO was determined in accordance with 310 CMR 40.1036. Class B-1 is appropriate to this site for the following reasons:

- A Permanent Solution has been achieved;
- Response actions have not been employed to achieve a condition of No Significant Risk;
- Levels of oil and/or hazardous materials (OHM) at the site have not been reduced to background; and
- No Activity and Use Limitation (AUL) is required to ensure the existence or maintenance of a level of No Significant Risk.

1C. Risk Assessment Method

A Method 2 Risk Characterization has been used to characterize the risk from the Site.

1D. Statement of Need

No additional response actions are needed at the Site. There have been no other RAO Statements that have been filed for the disposal site.

1E. Post-RAO Activities

There is no need for post-RAO operation or maintenance activities.

1F. Activity and Use Limitations

There is no need for an Activity and Use Limitation at this Site.

1G. LSP Opinion

Section 5.0 of this report presents the LSP opinion that the requirements of Response Action Outcome as prescribed in 310 CMR 40.1000 have been met.

1H. RAO Certification

Section 6.0 of this report presents the certification of the Response Action Outcome.

2A. Site Description

Section 1 of this report presents a clear and accurate description of the location and boundary limits of both the site and the property. The site is defined by the legal boundary of the property.

2B. Elimination of Uncontrolled Sources

Not Applicable

2C. Determination of No Significant Risk

Current concentrations of OHM in site soil and groundwater are less than the applicable Method 2 Standards.

- The site does not pose a risk to public health.
- The site does not pose a risk to public safety.
- The site does not pose a risk to public welfare.
- The site does not pose a risk to the environment.
- A condition of No Significant Risk, pursuant to 310 CMR 40.0900, has been satisfied for the site.

2D. Determination of Substantial Hazard

Not Applicable.

2E. Feasibility of Achieving Background Conditions

Reduction of concentrations of oil and hazardous materials in the environment at the property to background levels is not feasible. As discussed below, this conclusion is based on the fact that reduction to background levels is not justified by a cost-benefit analysis under 310 CMR 40.0860(6).

1. Background Conditions

The presumed background concentration of EPH and VPH in the soils and groundwater are assumed to be non-detectable concentrations.

2. Technical Infeasibility of Treatment to Background Conditions

Implementation of available technologies would not achieve background conditions with respect to these contaminants within any reasonable expenditure of time and effort. Overall, continued remediation would be inefficient and costly. The achievement of background levels is, therefore, not feasible.

2F. Activity and Use Limitations

Not Applicable.

2G. Activity and Use Limitation Opinion

Not Applicable.

2H. Operation Maintenance and Monitoring

There is no need for any operation, maintenance or monitoring to confirm or maintain the conditions upon which the RAO is based.

2I. Steps Taken Toward Achieving Permanent Solution

Not Applicable.

3. Fee

Payment of the RAO fee is not required as this site is an approved Waiver Site governed by the Transition Provisions of the MCP.



LICENSED SITE PROFESSIONAL (LSP)  
EVALUATION OPINION TRANSMITTAL FORM  
Pursuant to 310 CMR 40.0600 (Subpart F)

Release Tracking Number

4 - 1265

A. SITE OR LOCATION TO BE INVESTIGATED (LTBI) INFORMATION:

Provide the following information as it appears on the Transition List of Confirmed Disposal Sites and Locations To Be Investigated.

Site or LTBI Name: \_\_\_\_\_

Street: 480 Union Street \_\_\_\_\_ Location Aid: \_\_\_\_\_

City/Town: New Bedford \_\_\_\_\_ ZIP Code: 02740-0000 \_\_\_\_\_

Site Status: (check one)  Location To Be Investigated  Unclassified Disposal Site  Non-Priority Disposal Site without a Waiver

Date First Listed in Above Category: 11/29/93 \_\_\_\_\_

Related Release Tracking Numbers that this LSP Evaluation Opinion Addresses: \_\_\_\_\_

B. LSP EVALUATION OF SITE OR LOCATION TO BE INVESTIGATED: (check one of the following)

Check here if this location is NOT a Site where a Release of Oil(s) or Hazardous Material(s) occurred that is subject to the notification requirements of 310 CMR 40.0300, and no further response actions are required.

Check here if a Release of Oil(s) and Hazardous Material(s) subject to the notification requirements of 310 CMR 40.0300 occurred or may have occurred at this location, but Response Actions completed prior to the date of this LSP Evaluation Opinion meet the requirements of a Class A or Class B Response Action Outcome.

If this LSP Evaluation Opinion is checked, you must meet all appropriate Response Action Outcome requirements described at 310 CMR 40.1000. You must include with this submittal documentation equivalent to a Response Action Outcome, including all supporting materials.

Indicate the class of the equivalent Response Action Outcome:

Class A-1  Class A-2  Class A-3  Class B-1  Class B-2

You may choose to submit a completed Response Action Outcome Statement (BWSC-104) and supporting documentation in lieu of an LSP Evaluation Opinion, provided that you make the submittal prior to the LSP Evaluation Opinion deadline.

Check here if a Release subject to the notification requirements of 310 CMR 40.0300 occurred or may have occurred at this location, and further Response Actions are necessary, pursuant to 310 CMR 40.0000.

If this option is checked you must make one of the following submittals by the applicable LSP Evaluation Opinion deadline: (i) provide a Tier Classification Submittal Transmittal Form (BWSC-107) and, if necessary, a Tier I Permit Application; (ii) provide a Response Action Outcome Statement (BWSC-104); (iii) or provide a Downgradient Property Status Submittal (BWSC-104).

Check here if this location is a Site that is Adequately Regulated, pursuant to 310 CMR 40.0110. Specify which other regulatory authority applies:

- Response Actions at this Site, which are being conducted as a HSWA Corrective Action, are Adequately Regulated, pursuant to 310 CMR 40.0112.
- Response Actions at this Site, which is a 21C facility under the RCRA Authorized State Hazardous Waste Program, are Adequately Regulated under M.G.L. c. 21C and 310 CMR 30.000, pursuant to 310 CMR 40.0113.
- Response Actions at this Site, which is a Solid Waste Management facility, are Adequately Regulated under M.G.L. c. 21H, M.G.L. c. 111, § 150A and/or 310 CMR 19.000, pursuant to 310 CMR 40.0114.

You must attach all supporting documentation for the LSP Evaluation Opinion indicated, including copies of any Legal Notices and Notices to Public Officials required by 310 CMR 40.1400.

C. LSP OPINION:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and (iii) the provisions of 309 CMR 4.03(5), to the best of my knowledge, information and belief, this LSP Evaluation Opinion was developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and the response action(s) upon which this opinion is based, if any, were reasonable and appropriate to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

SECTION C IS CONTINUED ON THE NEXT PAGE.



LICENSED SITE PROFESSIONAL (LSP)  
EVALUATION OPINION TRANSMITTAL FORM  
Pursuant to 310 CMR 40.0600 (Subpart F)

Release Tracking Number

4 - 1265

C. LSP OPINION: (continued)

Check here if the Response Action(s) on which this opinion is based, if any, is (are) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If this box is checked, you MUST attach a statement identifying the applicable provisions thereof.

LSP Name: Richard J. Rheume LSP #: 6837 Stamp:

Telephone: 508-947-0050 Ext.: \_\_\_\_\_

FAX: (optional) 508-947-2004

Signature: Richard J. Rheume

Date: October 7, 1997



D. PERSON SUBMITTING LSP EVALUATION OPINION:

Name of Organization: Alan S. Cohen

Name of Contact: Alan S. Cohen Title: \_\_\_\_\_

Street: 6226 Water Lilly Lane

City/Town: Boyton Beach State: FL ZIP Code: 33437-4928

Telephone: 561-736-2589 Ext.: \_\_\_\_\_ FAX: (optional) \_\_\_\_\_

E. RELATIONSHIP TO SITE OR LOCATION TO BE INVESTIGATED OF PERSON SUBMITTING LSP EVALUATION OPINION: (check one)

RP or PRP Specify:  Owner  Operator  Generator  Transporter Other RP or PRP: \_\_\_\_\_

Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

Any Other Person Submitting LSP Evaluation Opinion Specify Relationship: \_\_\_\_\_

F. CERTIFICATION OF PERSON SUBMITTING LSP EVALUATION OPINION:

I, Alan S. Cohen, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/ is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

By: Alan S. Cohen Title: \_\_\_\_\_  
(signature)

For: ALAN S. COHEN Date: 10/8/97  
(print name of person or entity recorded in Section D)

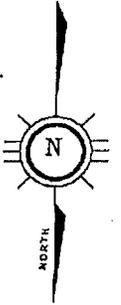
Enter address of the person providing certification, if different from address recorded in Section D:

Street: \_\_\_\_\_

City/Town: \_\_\_\_\_ State: \_\_\_\_\_ ZIP Code: \_\_\_\_\_

Telephone: \_\_\_\_\_ Ext.: \_\_\_\_\_ FAX: (optional) \_\_\_\_\_

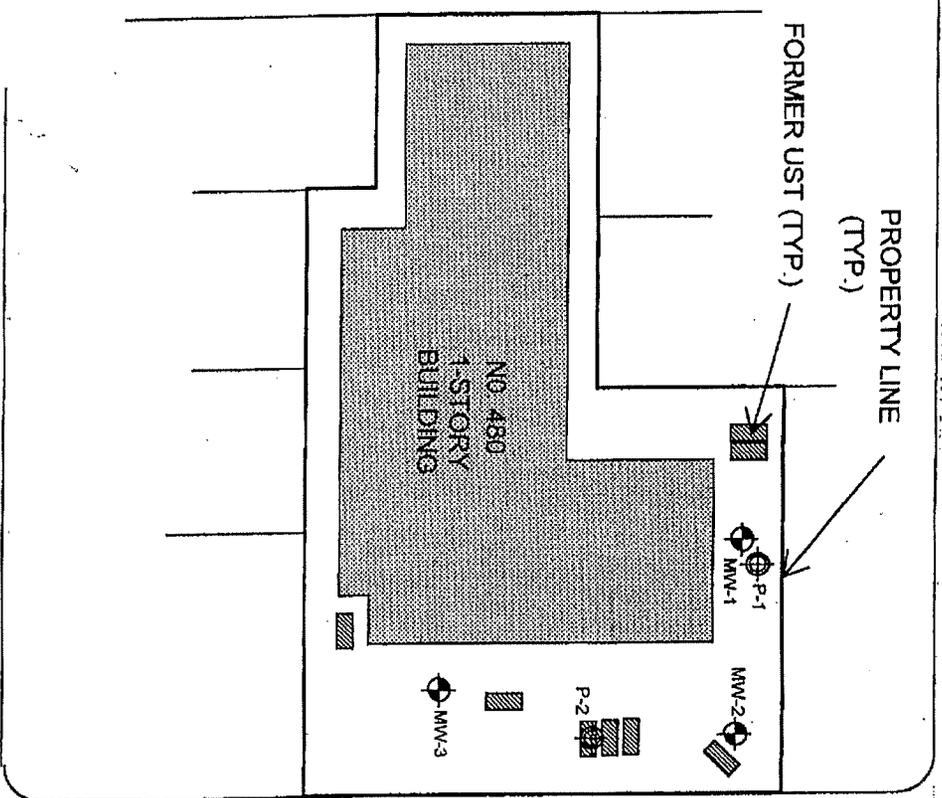
**YOU MUST COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE, AND YOU MAY INCUR ADDITIONAL COMPLIANCE FEES.**



OCEAN STREET

PROPERTY LINE  
(TYP.)

FORMER UST (TYP.)



UNION STREET

ATLANTIC STREET

LEGEND

 BORING LOCATION

**TABLE 2.1**  
**HISTORICAL SUMMARY OF GROUNDWATER ANALYTICAL RESULTS**  
**480 UNION STREET, NEW BEDFORD, MA**

ANALYTES	UNITS	MCP STANDARDS			20-Apr-92			1-Oct-93			17-Jun-94	22-May-97
		GW-2	GW-3		MW-1	MW-2	MW-3	MW-1	MW-2	MW-3	MW-1	MW-1
TPH <sup>sp</sup>	mg/l	1	20		679	ND	ND	63	ND	ND	73	6.65
Benzene	ug/l	2,000	7,000		ND	ND	ND	ND	ND	ND	3j	NS
Toluene	ug/l	6,000	50,000		ND	ND	ND	ND	ND	ND	ND	NS
Ethylbenzene	ug/l	30,000	4,000		ND	ND	140	ND	ND	ND	11	NS
Xylene (total)	ug/l	6,000	50,000		ND	ND	580	ND	ND	ND	53	NS
1,2 Dichlorobenzene	ug/l	10,000	8,000		13.6	ND	ND	ND	ND	ND	ND	NS

NOTE:  
 ND - Not Detected  
 NS - Not Sampled  
 NA - Standard is Not Applicable

TABLE 2.2

SUMMARY OF ANALYTICAL RESULTS FOR  
SOIL SAMPLES COLLECTED ON SEPTEMBER 12, 1997 AT  
480 UNION STREET, NEW BEDFORD, MA

ANALYSIS	UNITS	MCP STANDARDS		SAMPLE	
		S-1/GW-2 STANDARD	S-1/GW.3 STANDARD	P-1	P-2
<b>VPH</b>					
C5-C8 Aliphatics	ug/g	100	100	1.37	14.2
C9-C12 Aliphatics	ug/g	1,000	1,000	ND	26.1
C9-C10 Aromatics	ug/g	100	100	ND	8.1
Total VPH	ug/g	NA	NA	1.37	48.4
<b>VOCs</b>					
MTBE	ug/g	100	100	ND	ND
Benzene	ug/g	40	40	0.063	0.078
Toluene	ug/g	500	500	0.0728	0.268
Ethylbenzene	ug/g	500	500	0.0363	0.161
Xylene (total)	ug/g	500	500	0.147	0.504
Napthalene	ug/g	100	100	0.132	0.5
<b>EPH</b>					
C9-C18 Aliphatics	ug/g	1,000	1,000	ND	ND
C19-C36 Aliphatics	ug/g	2,500	2,500	ND	ND
C11-C22 Aromatics	ug/g	800	800	ND	ND
Total EPH	ug/g	NA	NA	ND	ND
<b>PAHs</b>					
Acenaphthene	ug/g	1,000	1,000	ND	ND
Acenaphthylene	ug/g	100	100	ND	ND
Anthracene	ug/g	1,000	1,000	ND	ND
Benzo(a)Anthracene	ug/g	0.7	0.7	ND	ND
Benzo(a)Pyrene	ug/g	0.7	0.7	ND	ND
Benzo(b)Fluoranthene	ug/g	0.7	0.7	ND	ND
Benzo(g,h,i)Perylene	ug/g	1,000	1,000	ND	ND
Benzo(k)Fluoranthene	ug/g	7	7	ND	ND
Chrysene	ug/g	7	7	ND	ND
Dibenzo(a,h)Anthracene	ug/g	0.7	0.7	ND	ND
Fluoranthene	ug/g	1,000	1,000	ND	ND
Fluorene	ug/g	1,000	1,000	ND	ND
Indeno(1,2,3-cd)Pyrene	ug/g	0.7	0.7	ND	ND
Naphthalene	ug/g	100	100	ND	ND
Phenanthrene	ug/g	1,000	1,000	ND	ND
Pyrene	ug/g	700	700	ND	ND
2-Methylnaphthalene	ug/g	500	500	ND	ND

NOTE:  
ND - Not Detected  
---- - Not Analyzed  
NA - Standard Not Applicable

TABLE 2.3

SUMMARY OF ANALYTICAL RESULTS FOR  
GROUNDWATER SAMPLES COLLECTED ON AUGUST 20, 1997 AT  
480 UNION STREET, NEW BEDFORD, MA

ANALYSIS	UNITS	MCP STANDARDS		SAMPLE		
		GW-2 STANDARD	GW-3 STANDARD	MW-1	MW-2	MW-3
TPH						
TPH	ug/l	1,000	20,000	—	—	—
VPH						
C5-C8 Aliphatics	ug/l	1,000	40,000	11	ND	ND
C9-C12 Aliphatics	ug/l	1,000	20,000	275	10	26.7
C9-C10 Aromatics	ug/l	5,000	4,000	253	ND	21.3
Total VPH	ug/l	NS	NS	539	10	48
VOCs						
MTBE	ug/l	50,000	50,000	ND	ND	ND
Benzene	ug/l	2,000	7,000	ND	ND	ND
Toluene	ug/l	6,000	50,000	2.1	ND	ND
Ethylbenzene	ug/l	30,000	4,000	17.1	ND	ND
Xylene (total)	ug/l	6,000	50,000	71	ND	2.2
Napthalene	ug/l	6,000	6,000	113	2.3	6.6
EPH						
C9-C18 Aliphatics	ug/l	1,000	20,000	690	293	ND
C19-C36 Aliphatics	ug/l	NA	50,000	773	ND	ND
C11-C22 Aromatics	ug/l	50,000	30,000	ND	ND	333
Total EPH	ug/l	NS	NS	1,463	293	333
PAHs						
Acenaphthene	ug/l	NA	5,000	ND	ND	ND
Acenaphthylene	ug/l	NA	3,000	ND	ND	ND
Anthracene	ug/l	NA	3,000	ND	ND	ND
Benzo(a)Anthracene	ug/l	NA	3,000	ND	ND	ND
Benzo(a)Pyrene	ug/l	NA	3,000	ND	ND	ND
Benzo(b)Fluoranthene	ug/l	NA	3,000	ND	ND	ND
Benzo(g,h,i)Perylene	ug/l	NA	3,000	ND	ND	ND
Benzo(k)Fluoranthene	ug/l	NA	3,000	ND	ND	ND
Chrysene	ug/l	NA	3,000	ND	ND	ND
Dibenzo(a,h)Anthracene	ug/l	NA	3,000	ND	ND	ND
Fluoranthene	ug/l	NA	200	ND	ND	ND
Fluorene	ug/l	NA	3,000	ND	ND	ND
Indeno(1,2,3-cd)Pyrene	ug/l	NA	3,000	ND	ND	ND
Napthalene	ug/l	6,000	6,000	ND	ND	ND
Phenanthrene	ug/l	NA	50	ND	ND	ND
Pyrene	ug/l	NA	3,000	ND	ND	ND
2-Methylnapthalene	ug/l	10,000	3,000	ND	ND	ND

NOTE:  
 ND - Not Detected  
 --- - Not Analyzed  
 NA - Standard is Not Applicable

<b>PRIME ENGINEERING, INC.</b> 350 Bedford Street, Lakeville, MA 02347				Client: Alan Cohen		Boring No: P-1	
				Project: 1880101		MW No: NA	
				Location: 480 Union Street New Bedford, MA		Sheet No: 1 of 1	
Engineer: Susan McGrail		Date Start: 9/12/97		Elevation: N/A			
Driller: Tom, Steve		Date Finish: 9/12/97		Water Elev: N/A			
Company: Geosearch		Field Eq: Thermo Env. 580B		Cal Gas: Isobutylene			
Drill Method: HS		Casing Dia: 4.25"		Sample: SS		Wt: 140 lbs	
Fall: 30"							
Sample				Strata Change	Classification and Remarks		
Depth (Feet)	No.	PID Reading	Rec.				
0-2'	SS-1.1	0 ppm	NA		Medium brown fine SAND, trace silt Dry - no odor		
5-7'	SS-1.2	0 ppm	18"/24"		Light brown fine SAND, little silt Dry - no odor		
10-12'	SS-1.3	14 ppm	15"/24"		Light brown very fine SAND, little silt Damp at 12' Slight petroleum odor		
12-14'	SS-1.4	90 ppm	24"/24"		brown fine to medium SAND, trace silt Wet at 13' Distinct petroleum odor		
Bottom of Boring at 14.5'							
Cohesionless Density			Cohesive Consistency			Proportions	
0-4	Very	Loose	0-2	Very	Soft	trace	0 to 10%
5-9		Loose	3-4		Soft	little	10 to 20%
10-29	Md.	Dense	5-8	Med.	Stiff	some	20 to 35%
30-49		Dense	9-15		Stiff	and	35 to 50%
50+	Very	Dense	16-30	Very	Stiff (hard)		

**PRIME ENGINEERING, INC.**  
350 Bedford Street, Lakeville, MA 02347

Client: Alan Cohen  
Project: 1880101  
Location: 480 Union Street  
New Bedford, MA

Boring No: P-2  
MW No: NA  
Sheet No: 1  
of 1

Engineer: Susan McGrail  
Driller: Tom, Steve  
Company: Geosearch

Date Start: 9/12/97  
Date Finish: 9/12/97  
Field Eq: Thermo Env. 580B

Elevation: N/A  
Water Elev: N/A  
Cal Gas: Isobutylene

Drill Method: HS Casing Dia: 4.25" Sample: SS Wt: 140 lbs Fall: 30"

Depth (Feet)	Sample No.	PID Reading	Rec.	Strata Change	Classification and Remarks	
0-2'	SS-2.1	3.5 ppm	NA		Medium brown fine SAND, trace silt Dry - slight odor	
5-7'	SS-2.2	5.4 ppm	18"/24"		Medium brown fine SAND, little silt Dry - slight odor	
10-12'	SS-2.3	121 ppm	15"/24"		Light brown very fine SAND, little silt Wet - distinct petroleum odor	
					Bottom of Boring @ 12'	
Cohesionless Density			Cohesive Consistency		Proportions	
0-4	Very	Loose	0-2	Very	Soft	trace
5-9		Loose	3-4		Soft	little
10-29	Md.	Dense	5-8	Med.	Stiff	some
30-49		Dense	9-15		Stiff	and
50+	Very	Dense	16-30	Very	Stiff (hard)	35 to 50%

SAMPLE ID P-1 FRACTION O1A TEST CODE VPH S NAME VOLATILE PHC  
Date & Time Collected 09/12/97 Category SOIL

**VOLATILE PETROLEUM HYDROCARBONS**

	RESULT	REPORTING LIMIT
C5-C8 Aliphatics	<u>1370</u>	<u>500</u>
C9-C12 Aliphatics	<u>ND</u>	<u>500</u>
C9-C10 Aromatics	<u>ND</u>	<u>500</u>
TOTAL VOLATILE PETROLEUM HYDROCARBONS	<u>1370</u>	<u>500</u>

TARGET VPH ANALYTES

Benzene	<u>63.0</u>	<u>20</u>
Toluene	<u>72.8</u>	<u>20</u>
Ethylbenzene	<u>36.3</u>	<u>20</u>
Xylenes (Total)	<u>147</u>	<u>20</u>
MTBE	<u>ND</u>	<u>20</u>
Naphthalene	<u>132</u>	<u>20</u>

Notes and Definitions for this Report:

UNITS: ug/Kg  
DATE RUN: 09/19/97  
ANALYST: NLC  
INSTRUMENT: V3  
DIL. FACTOR: 1  
MATRIX: SOIL  
%MOISTURE: 7

ND = not detected at detection limit

Received: 09/16/97

TOXIKON CORP.

REPORT

Work Order # 97-09-268

Results by Sample

SAMPLE ID P-2 FRACTION Q2A TEST CODE VPH S NAME VOLATILE PHC  
 Date & Time Collected 09/12/97 Category SOIL

**VOLATILE PETROLEUM HYDROCARBONS**

	RESULT	REPORTING LIMIT
C5-C8 Aliphatics	<u>14200</u>	<u>500</u>
C9-C12 Aliphatics	<u>26100</u>	<u>500</u>
C9-C10 Aromatics	<u>8100</u>	<u>500</u>
TOTAL VOLATILE PETROLEUM HYDROCARBONS	<u>48400</u>	<u>500</u>

## TARGET VPH ANALYTES

Benzene	<u>78.0</u>	<u>20</u>
Toluene	<u>268</u>	<u>20</u>
Ethylbenzene	<u>161</u>	<u>20</u>
Xylenes (Total)	<u>504</u>	<u>20</u>
MTBE	<u>ND</u>	<u>20</u>
Naphthalene	<u>500</u>	<u>20</u>

## Notes and Definitions for this Report:

UNITS: ug/Kg  
 DATE RUN: 09/19/97  
 ANALYST: NLC  
 INSTRUMENT: V3  
 DIL. FACTOR: 1  
 MATRIX: SOIL  
 %MOISTURE: 7

ND = not detected at detection limit

SAMPLE ID P-1 FRACTION 03A TEST CODE EPH 5 NAME EXTRACTABLE PHC  
Date & Time Collected 09/12/97 Category SOIL

**EXTRACTABLE PETROLEUM HYDROCARONS**

	RESULT	REPORTING LIMIT
C9-C18 Aliphatics	<u>ND</u>	<u>100</u>
C19-C36 Aliphatics	<u>ND</u>	<u>100</u>
C11-C22 Aromatics	<u>ND</u>	<u>100</u>
Total EPH Concentration	<u>ND</u>	<u>100</u>

TARGET PAH ANALYTES

Naphthalene	<u>ND</u>	<u>5.0</u>
2-Methylnaphthalene	<u>ND</u>	<u>5.0</u>
Acenaphthylene	<u>ND</u>	<u>5.0</u>
Acenaphthene	<u>ND</u>	<u>5.0</u>
Fluorene	<u>ND</u>	<u>5.0</u>
Phenanthrene	<u>ND</u>	<u>5.0</u>
Anthracene	<u>ND</u>	<u>5.0</u>
Fluoranthene	<u>ND</u>	<u>5.0</u>
Pyrene	<u>ND</u>	<u>5.0</u>
Benzo(a)Anthracene	<u>ND</u>	<u>5.0</u>
Chrysene	<u>ND</u>	<u>5.0</u>
Benzo(b)Fluoranthene	<u>ND</u>	<u>5.0</u>
Benzo(k)Fluoranthene	<u>ND</u>	<u>5.0</u>
Benzo(a)Pyrene	<u>ND</u>	<u>5.0</u>
Indeno(1,2,3-cd)Pyrene	<u>ND</u>	<u>5.0</u>
Dibenz(a,h)Anthracene	<u>ND</u>	<u>5.0</u>
Benzo(g,h,i)Perylene	<u>ND</u>	<u>5.0</u>

Notes and Definitions for this Report:

EXTRACTED 09/18/97  
DATE RUN 09/25/97  
ANALYST DS  
INSTRUMENT HP7  
DIL. FACTOR: 1  
UNITS mg/Kg  
MATRIX: SOIL  
%MOISTURE: 7

ND = not detected at detection limit

SAMPLE ID P-2 FRACTION 04A TEST CODE EPH S NAME EXTRACTABLE PHC  
Date & Time Collected 09/12/97 Category SOIL

**EXTRACTABLE PETROLEUM HYDROCARONS**

	RESULT	REPORTING LIMIT
C9-C18 Aliphatics	<u>ND</u>	<u>100</u>
C19-C36 Aliphatics	<u>ND</u>	<u>100</u>
C11-C22 Aromatics	<u>ND</u>	<u>100</u>
Total EPH Concentration	<u>ND</u>	<u>100</u>

TARGET PAH ANALYTES

Naphthalene	<u>ND</u>	<u>5.0</u>
2-Methylnaphthalene	<u>ND</u>	<u>5.0</u>
Acenaphthylene	<u>ND</u>	<u>5.0</u>
Acenaphthene	<u>ND</u>	<u>5.0</u>
Fluorene	<u>ND</u>	<u>5.0</u>
Phenanthrene	<u>ND</u>	<u>5.0</u>
Anthracene	<u>ND</u>	<u>5.0</u>
Fluoranthene	<u>ND</u>	<u>5.0</u>
Pyrene	<u>ND</u>	<u>5.0</u>
Benzo(a)Anthracene	<u>ND</u>	<u>5.0</u>
Chrysene	<u>ND</u>	<u>5.0</u>
Benzo(b)Fluoranthene	<u>ND</u>	<u>5.0</u>
Benzo(k)Fluoranthene	<u>ND</u>	<u>5.0</u>
Benzo(a)Pyrene	<u>ND</u>	<u>5.0</u>
Indeno(1,2,3-cd)Pyrene	<u>ND</u>	<u>5.0</u>
Dibenz(a,h)Anthracene	<u>ND</u>	<u>5.0</u>
Benzo(g,h,i)Perylene	<u>ND</u>	<u>5.0</u>

Notes and Definitions for this Report:

EXTRACTED 09/18/97  
DATE RUN 09/25/97  
ANALYST DS  
INSTRUMENT HP7  
DIL. FACTOR: 1  
UNITS mg/Kg  
MATRIX: SOIL  
%MOISTURE: 7 %

ND = not detected at detection limit

# TOXIKON

## EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

CLIENT: Prime Engineering  
 SITE: 480 Union St.  
 PROJECT #: 9708393  
 MATRIX: WATER

CLIENT ID: MW-1  
 LAB ID: 9708393.1  
 DATE RECEIVED: 8/21/97  
 DATE EXTRACTED: 8/22/97  
 DATE ANALYZED: 8/26/97

REF METHOD: MADEP EPH

DILUTION FACTOR: 1  
 INJECTION VOLUME ul: 1  
 EXTRACT VOLUME ml: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	
C9-C18 Aliphatics (FID)	690	100	ug/L	
C19-C36 Aliphatics (FID)	773	100	ug/L	
C11-C22 Aromatics (FID) **	ND	100	ug/L	
Total EPH	1463	100	ug/L	
** Excludes Targeted PAH Analytes				
TARGETED PAH ANALYTES				
ANALYTE	CAS #	RESULT	REPORTING LIMIT	UNITS
Acenaphthene	93-32-9	ND	5.0	ug/L
Acenaphthylene	208-96-8	ND	5.0	ug/L
Anthracene	120-12-7	ND	5.0	ug/L
Benzo(a)Anthracene	56-55-3	ND	5.0	ug/L
Benzo(a)Pyrene	50-32-8	ND	5.0	ug/L
Benzo(b)Fluoranthene	205-99-2	ND	5.0	ug/L
Benzo(g,h,i)Perylene	191-24-2	ND	5.0	ug/L
Benzo(k)Fluoranthene	207-08-9	ND	5.0	ug/L
Chrysene	218-01-9	ND	5.0	ug/L
Dibenzo(a,h)Anthracene	53-70-3	ND	5.0	ug/L
Fluoranthene	206-44-0	ND	5.0	ug/L
Fluorene	86-73-7	ND	5.0	ug/L
Indeno(1,2,3-cd)Pyrene	193-39-5	ND	5.0	ug/L
Naphthalene	91-20-3	ND	5.0	ug/L
Phenanthrene	85-01-8	ND	5.0	ug/L
Pyrene	129-00-0	ND	5.0	ug/L
2-Methylnaphthalene	91-57-6	ND	5.0	ug/L

# TOXIKON

## VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

CLIENT: Prime Engineering  
SITE: 480 Union St.  
PROJECT #: 9708393  
MATRIX: WATER

CLIENT ID: MW-1  
LAB ID: 9708393.1  
DATE RECEIVED: 8/21/97  
DATE ANALYZED: 8/28/97  
DILUTION FACTOR: 1  
INJECTION VOLUME ml: 5

REF METHOD: MADEP VPH

PARAMETER	RESULT	REPORTING LIMIT	UNITS
C5-C8 Aliphatics (FID)	11.0	10	ug/L
C9-C12 Aliphatics (FID)	275	10	ug/L
C9-C10 Aromatics (PID)	253	10	ug/L
Total VPH	539	10	ug/L

TARGETED VPH ANALYTES				
ANALYTE	CAS #	RESULT	REPORTING LIMIT	UNITS
Methyl-tert-butylether	1634-04-4	ND	2.0	ug/L
Benzene	71-43-2	ND	2.0	ug/L
Toluene	108-88-3	2.1	2.0	ug/L
Ethylbenzene	100-41-4	17.1	2.0	ug/L
Xylene (total)	1330-20-7	71.0	2.0	ug/L
Naphthalene	91-20-3	113	2.0	ug/L

# TOXIKON

## EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

CLIENT: Prime Engineering  
 SITE: 480 Union St.  
 PROJECT #: 9708393  
 MATRIX: WATER

CLIENT ID: MW-2  
 LAB ID: 9708393.2  
 DATE RECEIVED: 8/21/97  
 DATE EXTRACTED: 8/22/97  
 DATE ANALYZED: 8/26/97

REF METHOD: MADEP EPH

DILUTION FACTOR: 1  
 INJECTION VOLUME  $\mu$ l: 1  
 EXTRACT VOLUME ml: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	
C9-C18 Aliphatics (FID)	293	100	ug/L	
C19-C36 Aliphatics (FID)	ND	100	ug/L	
C11-C22 Aromatics (FID) **	ND	100	ug/L	
Total EPH	293	100	ug/L	
** Excludes Targeted PAH Analytes				
TARGETED PAH ANALYTES				
ANALYTE	CAS #	RESULT	REPORTING LIMIT	UNITS
Acenaphthene	93-32-9	ND	5.0	ug/L
Acenaphthylene	208-96-8	ND	5.0	ug/L
Anthracene	120-12-7	ND	5.0	ug/L
Benzo(a)Anthracene	56-55-3	ND	5.0	ug/L
Benzo(a)Pyrene	50-32-8	ND	5.0	ug/L
Benzo(b)Fluoranthene	205-99-2	ND	5.0	ug/L
Benzo(g,h,i)Perylene	191-24-2	ND	5.0	ug/L
Benzo(k)Fluoranthene	207-08-9	ND	5.0	ug/L
Chrysene	218-01-9	ND	5.0	ug/L
Dibenzo(a,h)Anthracene	53-70-3	ND	5.0	ug/L
Fluoranthene	206-44-0	ND	5.0	ug/L
Fluorene	86-73-7	ND	5.0	ug/L
Indeno(1,2,3-cd)Pyrene	193-39-5	ND	5.0	ug/L
Naphthalene	91-20-3	ND	5.0	ug/L
Phenanthrene	85-01-8	ND	5.0	ug/L
Pryene	129-00-0	ND	5.0	ug/L
2-Methylnaphthalene	91-57-6	ND	5.0	ug/L

TOXIKON

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

CLIENT: Prime Engineering  
 SITE: 480 Union St.  
 PROJECT #: 9708393  
 MATRIX: WATER

CLIENT ID: MW-2  
 LAB ID: 9708393.2  
 DATE RECEIVED: 8/21/97  
 DATE ANALYZED: 8/27/97  
 DILUTION FACTOR: 1  
 INJECTION VOLUME ml: 5

REF METHOD: MADEP VPH

PARAMETER	RESULT	REPORTING LIMIT	UNITS	
C5-C8 Aliphatics (FID)	ND	10	ug/L	
C9-C12 Aliphatics (FID)	10.0	10	ug/L	
C9-C10 Aromatics (PID)	ND	10	ug/L	
Total VPH	10.0	10	ug/L	
TARGETED VPH ANALYTES				
ANALYTE	CAS #	RESULT	REPORTING LIMIT	UNITS
Methyl-tert-butylether	1634-04-4	ND	2.0	ug/L
Benzene	71-43-2	ND	2.0	ug/L
Toluene	108-88-3	ND	2.0	ug/L
Ethylbenzene	100-41-4	ND	2.0	ug/L
Xylene (total)	1330-20-7	ND	2.0	ug/L
Naphthalene	91-20-3	2.3	2.0	ug/L

# TOXIKON

## EXTRACTABLE PETROLEUM HYDROCARBON (EPH) ANALYSIS

CLIENT: Prime Engineering  
 SITE: 480 Union St.  
 PROJECT #: 9708393  
 MATRIX: WATER

CLIENT ID: MW-3  
 LAB ID: 9708393.3  
 DATE RECEIVED: 8/21/97  
 DATE EXTRACTED: 8/22/97  
 DATE ANALYZED: 8/26/97

REF METHOD: MADEP EPH

DILUTION FACTOR: 1  
 INJECTION VOLUME ul: 1  
 EXTRACT VOLUME ml: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	
C9-C18 Aliphatics (FID)	ND	100	ug/L	
C19-C36 Aliphatics (FID)	ND	100	ug/L	
C11-C22 Aromatics (FID) **	333	100	ug/L	
Total EPH	333	100	ug/L	
** Excludes Targeted PAH Analytes				
TARGETED PAH ANALYTES				
ANALYTE	CAS #	RESULT	REPORTING LIMIT	UNITS
Acenaphthene	93-32-9	ND	5.0	ug/L
Acenaphthylene	208-96-8	ND	5.0	ug/L
Anthracene	120-12-7	ND	5.0	ug/L
Benzo(a)Anthracene	56-55-3	ND	5.0	ug/L
Benzo(a)Pyrene	50-32-8	ND	5.0	ug/L
Benzo(b)Fluoranthene	205-99-2	ND	5.0	ug/L
Benzo(g,h,i)Perylene	191-24-2	ND	5.0	ug/L
Benzo(k)Fluoranthene	207-08-9	ND	5.0	ug/L
Chrysene	218-01-9	ND	5.0	ug/L
Dibenzo(a,h)Anthracene	53-70-3	ND	5.0	ug/L
Fluoranthene	206-44-0	ND	5.0	ug/L
Fluorene	86-73-7	ND	5.0	ug/L
Indeno(1,2,3-cd)Pyrene	193-39-5	ND	5.0	ug/L
Naphthalene	91-20-3	ND	5.0	ug/L
Phenanthrene	85-01-8	ND	5.0	ug/L
Pyrene	129-00-0	ND	5.0	ug/L
2-Methylnaphthalene	91-57-6	ND	5.0	ug/L

TOXIKON

VOLATILE PETROLEUM HYDROCARBON (VPH) ANALYSIS

CLIENT: Prime Engineering  
 SITE: 480 Union St.  
 PROJECT #: 9708393  
 MATRIX: WATER

CLIENT ID: MW-3  
 LAB ID: 9708393.3  
 DATE RECEIVED: 8/21/97  
 DATE ANALYZED: 8/27/97  
 DILUTION FACTOR: 1  
 INJECTION VOLUME ml: 5

REF METHOD: MADEP VPH

PARAMETER	RESULT	REPORTING LIMIT	UNITS
C5-C8 Aliphatics (FID)	ND	10	ug/L
C9-C12 Aliphatics (FID)	26.7	10	ug/L
C9-C10 Aromatics (PID)	21.3	10	ug/L
Total VPH	48.0	10	ug/L

TARGETED VPH ANALYTES

ANALYTE	CAS #	RESULT	REPORTING	UNITS
			LIMIT	
Methyl-tert-butylether	1634-04-4	ND	2.0	ug/L
Benzene	71-43-2	ND	2.0	ug/L
Toluene	108-88-3	ND	2.0	ug/L
Ethylbenzene	100-41-4	ND	2.0	ug/L
Xylene (total)	1330-20-7	2.2	2.0	ug/L
Naphthalene	91-20-3	5.5	2.0	ug/L

**APPENDIX B**

Laboratory Analytical SOPs

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**STANDARD OPERATING PROCEDURE**

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**Acid digestion of Aqueous Samples and Extracts for Total Metals Analysis  
By ICP Atomic Emission Spectroscopy - EPA 3010A**

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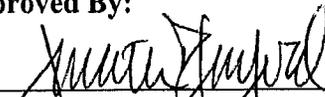
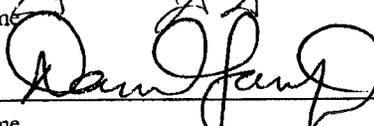
**SOP : AMP0320                      Version: 2.0                      Effective Date: 01/01/05**

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**Approved By:**

	PRESIDENT	01-01-05
Name	Title	Date
	LAB DIRECTOR	01-01-05
Name	Title	Date
	QUALITY ASSURANCE	01-01-05
Name	Title	Date

**2. Scope and Application.**

2.1. This procedure is to be used by trained personnel as a guide for the digestion of aqueous samples, mobility-procedure extracts, and wastes that contain suspended solids for analysis by Inductively coupled plasma (ICP) for the metals listed below. The procedure is used to determine the total amount of metal in the sample.

2.2. This procedure has been modified to include the following metals:

Aluminum	Magnesium
Arsenic	Manganese
Barium	Molybdenum
Beryllium	Nickel
Cadmium	Potassium
Calcium	Selenium
Chromium	Sodium
Cobalt	Thallium
Copper	Vanadium
Iron	Zinc
Lead	Silver
Phosphorus	Titanium
Tin	Lithium
Antimony	Silicon
Sulfur	

**3. Summary of Method.**

3.1. The sample to be analyzed can be a well mixed, homogenous aqueous sample, mobility-procedure extraction sample, or waste that contain suspended solids.

3.2. A mixture of nitric acid and the material to be analyzed is refluxed in a covered Griffin beaker or digestion tube. This step is repeated with additional portions of nitric acid until the digestate is light in color or until its color has stabilized. After the digestate has been brought to a low volume, it is refluxed with hydrochloric acid, cooled and brought up to volume in dilute nitric and hydrochloric acid such that the final dilution contains approximately 3% (v/v) nitric acid and 5% hydrochloric acid. If the sample contains suspended solids, it must be filtered, or allowed to settle.

#### 4. Definitions.

- 4.1. Synonyms and references are given when necessary. See Section 13 for full descriptions of references. Terms generally used by the laboratory are in boldface text. Alternative names not commonly used by the laboratory are italicized.
- 4.2. **May:** This action, activity, or procedural step is neither required nor prohibited.
- 4.3. **May not:** This action, activity, or procedural step is prohibited.
- 4.4. **Must:** This action, activity, or procedural step is required.
- 4.5. **Shall:** This action, activity, or procedural step is required.
- 4.6. **Should:** This action, activity, or procedural step is suggested but not required.
- 4.7. **Dissolved:** Material that will pass through a 0.45  $\mu$ m membrane filter prior to acidification (40 CFR, Methods for Chemical Analysis of Water & Wastes [MCAWW], SW846) This term is not specifically defined in the mercury methods. See next item.
- 4.8. **Total, Total Recoverable:** By inference, they may be presumed to be the concentration of analyte determined on an unfiltered sample following suitable digestion.
- 4.9. **Method Detection Limit (40 CFR 136):** The minimum concentration of an analyte that can be identified and reported with 99% confidence that the analyte concentration is greater than zero. This is determined by carrying a minimum of seven replicates of a sample with a concentration 2.5 to 5 times the MDL through the entire analytical procedure. The MDL is then calculated by multiplying the standard deviations of the analyte concentrations so determined by the appropriate multiplication factor for the number of replicates used (See Appendix B of 40 C.F.R., Part 136, July 1,1991.).

- 4.10. **Preparation Blank, PB** (CLP, GWA QAP), *Laboratory Reagent Blank, Reagent Blank* (SW846): An aliquot of reagent water brought through the entire sample preparation and analysis sequence.
- 4.11. **Laboratory Control Sample, LCS** (SW846, CLP, GWA QAP), *Laboratory Fortified Blank*: A sample of known composition, containing the element(s) of interest, which is carried through the entire sample preparation and analytical sequence.
- 4.12. **Analytical Sample** (CLP): An environmental (client-submitted) sample, a duplicate of an environmental sample, a spiked environmental sample, a Preparation Blank or a Laboratory Control Sample. Used to determine the frequency of instrumental Quality Control sample analysis.
- 4.13. **Preparation Batch**: A group of up to but no more than 20 environmental samples that are processed together under the same conditions and that share the same Quality Control data. Samples that are processed separately but on the same day may be part of the same batch and share the same quality control as long as the same reagents are used and the 20 sample limit has not been exceeded. Samples processed on different days are de facto part of different batches. For solid samples, the three replicates which are digested per sample are counted as one sample in determining batch size.
- 4.14. **Matrix Spike**: An aliquot of a sample to which known quantities of the method analytes are added (spiked) in the laboratory. The matrix spike is digested and analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results.
- 4.15. **Matrix Spike Duplicate**: A second aliquot of the same sample spiked and treated exactly like the matrix spike, and its purpose is to determine the precision of the method.
- 4.16. **Duplicate**: A second aliquot of a sample that is treated the same as the original in order to determine the precision of the method.
- 4.17. **Reagent Water**: The water is treated and deionized to have a resistivity of 18 MegaOhm .cm or greater at 298K (25°C). This water must be free of the analytes of interest.
- 4.18. **Digestion Log Book**: An official record of the sample preparation (digestion).
- 4.19. **Batch Quality Control Element Frequencies**: Every batch must include a Preparation Blank, a Laboratory Control Sample, a Sample Duplicate and a Matrix Spike.

**5. Interferences.**

- 5.1. Labware must be cleaned to avoid contamination; therefore all sample containers must be washed with detergent and rinsed with reagent water.
- 5.2. Reagents used in the digestion procedure must be free of the analytes of interest.
- 5.3. Samples should be homogenized prior to digestion to ensure reproducibility.
- 5.4. Any changes noted during the addition of reagents ( e.g. precipitation) must be discussed with the section manager or supervisor.
- 5.5. Some elements (e.g. elemental arsenic and many of its compounds) are volatile; therefore, samples may be subject to losses during sample preparation. Caution must be employed to ensure that the samples do not boil. Spike samples and other reference samples are processed to assess the degree to which this has occurred.

**6. Safety.**

- 6.1. The toxicity or carcinogenicity of all reagents in this procedure has not been fully established. Extreme caution should be used in handling all chemicals used in this procedure.
- 6.2. To minimize exposure, process samples in an exhaust hood or well-ventilated work space. Protective clothing including lab coat and safety glasses must be worn at all times while the analyst is working in the laboratory. The minimum level of hand protection to be used when handling samples, acids, or hazardous chemicals is a Nitrile glove.
- 6.3. Respirators may be required under certain conditions. Each laboratory employee should be familiar with the location and use of these personal protection devices.
- 6.4. Proper emergency response to spills or injury should be reviewed by the laboratory employee prior to attempting this procedure. This includes location of spill kits, emergency eyewash and showers, fire fighting equipment, as well as evacuation routes.
- 6.5. Material Safety Data Sheets (MSDS) are available for all chemicals used in this procedure. All laboratory employees are required to review these before handling these chemicals.

- 6.6. All acid wastes will be segregated and collected in poly carboys in the laboratory before being transferred to drums located in the hazardous waste room awaiting disposal.
- 6.7. All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against disease causative agents.
- 6.8. Hot plates and block digestors can become extremely hot during and immediately following digestion. Care must be exercised when handling these devices.
- 6.9. All waste containers must be placed in secondary containers.
- 6.10. Appropriately dispose of all empty acid bottles immediately.

**7. Apparatus and Materials.**

- 7.1. Electric hot plates or block digester capable of maintaining temperature of  $95 \pm 5^\circ\text{C}$ .
- 7.2. 50-mL digestion tubes.
- 7.3. Watch glasses; ribbed and non-ribbed.
- 7.4. Qualitative filter paper --Whatman No. 41 equivalent.
- 7.5. Funnels.
- 7.6. 100 mL graduated cylinders or volumetric flasks.
- 7.7. Analytical balance-capable of accurately weighing to the nearest 0.01 g.
- 7.8. Thermometer capable of measuring to at least  $125^\circ\text{C}$  with suitable precision and accuracy.
- 7.9. Fume Hood with adequate ventilation capability.
- 7.10. Assorted calibrated pipettes capable of delivering volumes from 0.010 to 0.10, 0.250 to 1.0, and 0.50 to 5.0 mL.
- 7.11. Repipettors for dispensing acids.
- 7.12. An assortment of high quality disposable pipet tips.
- 7.13. Narrow-mouth storage bottles, FEP (fluorinated ethylene propylene) with screw top closure, 125 mL to 1L capacity.

**8. Reagents and Standards.**

- 8.1. Unless otherwise indicated, only reagent grade chemicals conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society shall be used, when available. Other grades may be substituted, provided it is first determined that the reagent is of sufficient purity for its intended application. Each reagent lot will be tested prior to use.
- 8.2. Reagents labeled "Suitable for Trace Metals Analysis"; for example Baker Instra-Analyzed® reagents are preferable, if available.
- 8.2.1. Laboratory Pure Water, ASTM Type 1, from Millipore Milli-Q water system or equivalent.
- 8.2.2. Nitric Acid, Concentrated, HNO<sub>3</sub>, Baker Instra-Analyzed®, or equivalent (sp.gr. 1.41).
- 8.2.3. Hydrochloric Acid, Concentrated, HCl, Baker Instra-Analyzed®, or equivalent.
- 8.3. Standards - Standard solutions used to prepare LCS, matrix spikes and matrix spike duplicates. The standards may be prepared from pure standard materials, purchased as certified solutions or prepared by dilution of certified solutions. Upon receipt, standards should be verified by comparison with second-source materials prior to initial use. Standards should be checked frequently for stability, and be replaced if comparison with second-source standards indicates a problem.

**9. Sample Collection, Preservation, and Handling.**

- 9.1. Sampling should be conducted by qualified personnel using an established sampling plan.
- 9.2. A minimum of 150 mL of water is required.
- 9.3. While either glass or plastic containers are permitted, plastic is preferable for waters whenever possible. The use of certified, commercially pre-cleaned sample containers is strongly encouraged. Under no circumstance should any containers or labware be cleaned with chromic acid.
- 9.4. Water samples should be preserved with Nitric Acid to a pH < 2 at the time of collection. If this is not possible, the sample should be cooled to 4°C and preserved as soon as possible upon receipt by the laboratory. The preserved sample should be held for at least 16 hours prior to further processing.

- 9.5. Preserved water samples may be stored at room temperature.
- 9.6. Samples must be analyzed within 180 days of collection.

**10. Quality Assurance/Quality Control (QA/QC) Requirements.**

- 10.1. A key ingredient of successful trace metals analysis is cleanliness. Many of the target analytes, including mercury, are widespread in the environment or common in the laboratory and are easily introduced as contaminants. Careful attention to this aspect of the procedures will result in fewer errors and reruns.
- 10.2. In the laboratory, all reagents and solvents are logged into a record book. Lot number, purity, and chemical description are documented. Standard preparation is documented and the records are maintained in a bound notebook. Laboratory log books documenting sample preparation are maintained. Access to all chemicals and standard solutions are controlled.
- 10.3. All laboratory data is checked by a secondary reviewer to ensure that the appropriate methods of analysis were used, that all information pertaining to the preparation and the analysis is recorded.
- 10.4. A batch of samples shall consist of no more than 20 samples of the same matrix.
- 10.5. For the assurance of pipettor performance, a three-point calibration (3 checks at 3 different volumes) must be done quarterly and the standard deviation calculated. A pipettor maintenance service is used for this purpose.
- 10.6. A method blank must be processed with every batch of sample digested. The absolute value of the method blank must be less than the reporting limit.
- 10.7. One method blank spike (MBS) or laboratory control sample (LCS) must be processed with every batch of samples digested. The LCS must recover within  $\pm 20\%$  of its true value or within calculated control limits where appropriate.
- 10.8. One method blank spike duplicate (MBSD) or laboratory control sample duplicate (LCSD) must be processed with every batch of samples digested. The MBSD/LCSD must recover within  $\pm 20\%$  of its true value. The relative percent difference (RPD) must be  $< 20\%$ .
- 10.9. One matrix spike (MS) must be digested to a minimum of 20% of the routine samples. The added concentration must be at the same level as it is in the MBS. The recovery of the matrix spike must fall within  $\pm 25\%$  or

within calculated control limits where appropriate. Each individual project site should have a represented sample prepared as a matrix spike.

10.10. One duplicate sample must be digested to a minimum of 20% of the routine samples. The relative percent difference (RPD) must be < 20% or within calculated control limits where appropriate.

10.11. CORRECTIVE ACTION.

10.11.1. All quality control standards must recover within the criteria of the method referenced. The corrective action listed must be taken if any of the criteria are exceeded:

10.11.2. If for a given batch of samples, the absolute value of the preparation blank exceeds the reporting limit for the analyte(s) of interest, all the samples associated with the blank must be redigested and reanalyzed unless the sample concentrations are greater than 10X the blank level.

10.11.3. If for a given batch of samples, the recovery of the laboratory control sample (LCS) exceeds the method acceptance criteria for the analyte(s) of interest, all the samples associated with the LCS must be redigested and reanalyzed.

10.11.4. If for a given batch of samples, the recovery of the matrix spike and/or matrix spike duplicate (MS/MSD) exceeds the method control limits for the analyte(s) of interest, the recovery of the LCS must be evaluated.

10.11.4.1. If the recovery of the LCS is acceptable, the out-of-control recovery of the matrix spike may be attributed to matrix interferences. Note discrepancies in the project narrative.

10.11.4.2. If the recovery of the LCS is also out of criteria, all the samples associated with the batch must be redigested and reanalyzed.

10.11.5. If for a given batch of samples, the relative percent difference (RPD) exceeds the method control limit, both the sample and the duplicate digestate must be checked for appearance. If there is no apparent differences between the two digestates, the original sample must be checked for homogeneity. Note discrepancies in the project narrative.

- 10.11.5.1. If the sample contains non-filterable residue that settle quickly, this may cause an homogeneity problem.
- 10.11.5.2. If the sample is viscous, this may cause an homogeneity problem.
- 10.11.5.3. If there are two or more distinct phases, this may cause an homogeneity problem.

## 11. Procedure.

### 11.1. For TCLP extracts.

- 11.1.1. Transfer a 50 mL representative aliquot of a well-mixed sample to a digestion tube or a 250-mL beaker.
- 11.1.2. Add 500  $\mu$ L of each of the ICP spiking solutions (QC-18 and QC-10) to the LCS and the matrix spike samples (Appendix A).
- 11.1.3. Add 1.5 mL concentrated nitric acid.
- 11.1.4. Cover with a ribbed watch glass.
- 11.1.5. Place the tube on a block digester set so that the temperature of the sample is maintained at 90-95°C.
- 11.1.6. Cautiously evaporate to a low volume (~10 mL), making certain that the sample does not boil and that no portion of the tube is allowed to go dry.
- 11.1.7. Cover with a non-ribbed watch glass and return to the block digester.
- 11.1.8. Maintain the temperature so that a gentle reflux action occurs (DO NOT BOIL).
- 11.1.9. Continue heating for 30 minutes or until the digestion is complete (generally indicated when the digestate is light in color or does not change in appearance with continued refluxing).
- 11.1.10. Remove sample from block digester.
- 11.1.11. Let cool to room temperature.

11.1.12. Add additional aliquots (1.5 mL each) and repeat steps 11.1.5 to 11.1.11 if necessary until digest is clear.

11.1.13. Add 2.5 mL of concentrated HCl.

11.1.14. Return the sample to the block digester.

11.1.15. Cover with watch glass and let it reflux for an additional 15 minutes.

11.1.16. Remove from block digester and let cool.

11.1.17. Transfer the digestate to a pre-labeled 60-mL polyethylene bottle.

11.1.18. Bring to a final volume of 50 mL.

11.1.19. The sample is now ready for analysis.

11.2. For each batch of digested samples, the following format must be followed:

Method Blank

Laboratory control sample (LCS)

Laboratory Control Sample Duplicate (LCSD)  
(If necessary)

Sample 1

Sample 1D

Sample 1S

Sample 2

Sample 3

Sample 4

Sample 5

Sample 6

Sample 7

Sample 8

Sample 9

Sample 10

Sample 11

Sample 11S

Sample 12

Sample 13

Sample 14

Sample 15

Sample 16

Sample 17

Sample 18

Sample 19

Sample 20

11.3. The block digestors must be cleaned regularly. Clean up spills immediately. Wipe the block digestors with a soft wet cloth after they have been cooled.

11.4. Clean up spills immediately around the balances. Using a soft brush remove any soil that may have been spilled and dispose of properly.

## 12. Data Handling and Calculations.

12.1. Upon completion of the digestion, the samples are transferred to the instrument room. The completed samples must be accompanied by the following:

12.2. A sample preparation sheet, completely filled out.

12.3. Sample storage bottles must indicate:

12.3.1. Method.

12.3.2. Analyst.

12.3.3. Date of preparation.

12.3.4. Sample Identification.

12.3.5. Batch Number.

**13. Instrumental and Method Reporting Limits.**

- 13.1. Due to the nature of the analysis, instrumental and method detection limits are not determined directly for this method. For MDLs, refer to SOP AMA0610, "Determination of Trace Elements by Inductively Coupled Plasma (ICP)".

**14. References.**

- 14.1. "Test Methods for Evaluating Solid Waste," US. EPA OSWER, SW-846, 3rd Ed. Final Update 1, Methods 3010A, July 1992.
- 14.2. U.S. EPA, Contract Laboratory Program, SOW for Inorganic Analysis, ILM04.0.
- 14.3. "Quality Assurance Plan," Groundwater Analytical, Inc.
- 14.4. "Quality Systems Manual," Groundwater Analytical, Inc.

**15. Revisions and Changes**

- 15.1. Initial Version Prepared By:  
Ruddy Ligonde, Inorganic Section Manager, 01/01/01
- 15.2. First Revision Prepared By:  
Daniel Williams, Metals Section Supervisor, 01/01/05

APPENDIX A

Stock Solutions, and Quality Control Samples

**I. Solution Preparation**

Place 50 mL of DI water in a digestion tube. Pipet 500  $\mu$ L of QC Standard 18 + 500  $\mu$ L of QC standard 10. The LCS and Matrix Spike solutions goes through the entire digestion procedure and is brought to a final volume of 50 mL.

The standards used for the LCS and the matrix spikes are purchased from a source independent from those used for the calibration standards. Find below tables of the primary standards used:

Ultra Scientific QC Standard-18			
Analyte	Solution	Concentration (mg/L)	Final Sample Concentration (mg/L)
Antimony	QC-18	100	1.0
Arsenic	QC-18	100	1.0
Beryllium	QC-18	100	1.0
Cadmium	QC-18	100	1.0
Chromium	QC-18	100	1.0
Cobalt	QC-18	100	1.0
Copper	QC-18	100	1.0
Lead	QC-18	100	1.0
Lithium	QC-18	100	1.0
Manganese	QC-18	100	1.0
Molybdenum	QC-18	100	1.0
Nickel	QC-18	100	1.0
Selenium	QC-18	100	1.0
Strontium	QC-18	100	1.0
Titanium	QC-18	100	1.0
Thallium	QC-18	100	1.0
Vanadium	QC-18	100	1.0
Zinc	QC-18	100	1.0

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APPENDIX A

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Ultra Scientific QC Standard 10			
Analyte	Solution	Concentration (mg/L)	Final Sample Concentration (mg/L)
Aluminum	QC-10	1000.0	10.0
Calcium	QC-10	1000.0	10.0
Magnesium	QC-10	1000.0	10.0
Potassium	QC-10	1000.0	10.0
Sodium	QC-10	1000.0	10.0
Barium	QC-10	500.0	5.0
Boron	QC-10	500.0	5.0
Iron	QC-10	500.0	5.0
Silver	QC-10	100.0	1.0
Silicon	QC-10	50.0	0.50



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**STANDARD OPERATING PROCEDURE**

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**Mercury Analysis in Water by  
Semi-Automated Cold Vapor Atomic Absorption Spectroscopy**

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SOP: AMA0810

Version: 1.2

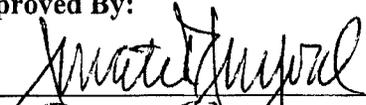
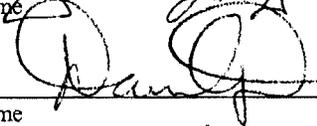
Effective Date: 07/07/2008

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**Approved By:**

	PRESIDENT	07-07-08
Name	Title	Date
	LAB DIRECTOR	07-07-08
Name	Title	Date
	QUALITY ASSURANCE	07-07-08
Name	Title	Date

## 2. Scope and Application

- 2.1. This procedure describes the analysis of trace levels of Mercury by Cold Vapor Atomic Absorption (CVAA) Spectroscopy.
- 2.2. Depending on the sample pretreatment, this method may be used for the analysis of Total (Total Recoverable) and Dissolved Mercury in ground water, surface water, drinking water, wastewater and Toxicity Characteristic Leaching Procedure (TCLP) Extracts.
- 2.3. This method can be used for the analysis of Mercury in water samples from the reporting limit, 0.0002 mg/L, to 0.005 mg/L. This range can be extended by sample dilution when necessary.

## 3. Summary of Method

- 3.1. Digested samples are introduced into the mixing coils of the instrument via a peristaltic pump. The sample is then mixed with a solution of stannous chloride and hydrochloric acid. Any mercury in the sample is thereby reduced to free mercury metal. The mixture is combined with a stream of argon gas. After passing through a gas liquid separator and a drying tube, the resulting mercury vapor is carried into a dedicated atomic absorption spectrophotometer operating at 253.7 nm with a sample cell whose configuration and dimensions have been optimized for mercury analysis.
- 3.2. This method is chemically identical with the analytical portions of EPA methods 245.1, 245.5, and 7040A. The stannous chloride reduction and the instrumental analysis have been automated. The mechanical differences in sample introduction and analysis result in one variation from the manual methods that must be noted. During Manual Cold Vapor analysis, the resulting atomic vapor is recirculated in a closed system until a steady state is reached. The observed concentration is therefore dependent on the total amount of mercury in the digested sample as presented to the instrument. In the method described herein, the atomic vapor flows through the sample cell until a steady state is reached, in a manner analogous to flame atomic absorption (FLAA). The quantification of the samples is carried out by the instrument's software from the relative absorbances of the sample and standards.

## 4. Definitions:

- 4.1. Some of the following are named differently in different sources. Similar names may be defined differently in different sources. Synonyms and references are given when necessary. See Section 13 for full descriptions of references. Terms generally used by the laboratory are in boldface text. Alternative names not commonly used by the laboratory are italicized.
- 4.2. **Dissolved**: Material that will pass through a 0.45  $\mu\text{m}$  membrane filter prior to acidification (40 CFR, Methods for Chemical Analysis of Water & Wastes [MCAWW], SW846) This term is not specifically defined in the mercury methods. See next item.
- 4.3. **Total, Total Recoverable**: These terms, like "Dissolved", are not specifically defined in the mercury methods. By inference, they may be presumed to be the concentration of analyte determined on an unfiltered sample following suitable digestion.
- 4.4. *Instrument Detection Limit, IDL (245.x)*: The concentration equivalent of an analyte signal equal to three times the standard deviation of the calibration blank signal at the selected absorbance line.
- 4.5. **Instrument Detection Limit, IDL (CLP)**: Three times the standard deviation of seven replicates of a standard with a concentration 3-5 times the IDL, determined on three non-successive days.
- 4.6. **Method Detection Limit (245.x, 40 CFR)**: The minimum concentration of an analyte that can be identified and reported with 99 % confidence that the analyte concentration is greater than zero. This is determined by carrying a minimum of seven replicates of a sample with a concentration 2.5 to 5 times the MDL through the entire analytical procedure. The MDL is then calculated by multiplying the standard deviations of the analyte concentrations so determined by the appropriate multiplication factor for the number of replicates used. (See Appendix B of 40 C.F.R., Part 136, July 1,1991.)
- 4.7. **Calibration Blank and Calibration Standard(s)**: Acidified aliquots of reagent water and Mercury solutions of known concentration(s) used to calibrate instrument response. Also used in 245.x to describe initial and continuing calibration checks. All standards in Mercury Analysis are digested.
- Note**: The Calibration Blanks and Standards for Mercury, as well as the ICB/CCB and ICV/CCV samples described below, differ from other Trace Metals methods. These are the only metals standards and Instrumental QC samples that are digested.
- 4.8. **Initial Calibration Blank, ICB and Continuing Calibration Blank, CCB (CLP, GWA QAP)**: Digested aliquots of reagent water. Analyzed at

the beginning and end of, as well as periodically during, the analysis of environmental samples. Used to verify the absence of either instrumental drift or analyte carryover.

- 4.9. **Initial Calibration Verification, ICV and Continuing Calibration Verification, CCV (CLP, GWA QAP):** Digested mercury solutions of known concentration prepared from a source independent of the calibration standards. Analyzed at the beginning and end of, as well as periodically during, the analysis of environmental samples. Used to verify the instrument response and its ability to quantify accurately.
- 4.10. **Preparation Blank, PB (CLP, GWA QAP), *Laboratory Reagent Blank (245.x)*, *Reagent Blank (SW846)*:** An aliquot of reagent water brought through the entire sample preparation and analysis sequence.
- 4.11. **Laboratory Control Sample, LCS (SW846, CLP, GWA QAP), *Laboratory Fortified Blank (245.x)*:** A sample of known composition, containing the element(s) of interest, which is carried through the entire sample preparation and analytical sequence.
- 4.11.1. Since the calibration verification standards are digested they can, in principle, be substituted for the Preparation Blank and Laboratory Control Samples. It is the policy of the laboratory, however, to prepare specific samples for these purposes.
- 4.12. ***Quality Control Sample, QCS (245.x)*:** A solution of known Mercury concentration, prepared independently of the laboratory, used to verify performance. Also used synonymously with ICV.
- 4.13. **Analytical Sample (CLP):** An environmental (client-submitted) sample, a duplicate of an environmental sample, a spiked environmental sample, a Preparation Blank or a Laboratory Control Sample. Used to determine the frequency of instrumental Quality Control sample analysis.
- 4.14. **Preparation Batch (CLP, GWA QSM):** A group of up to, but no more than, 20 environmental samples that are processed together under the same conditions and that share the same Quality Control data. Samples that are processed separately, but within a 24-hour period, may be part of the same batch and share the same quality control as long as the same reagents are used and the 20-sample limit has not been exceeded.
- 4.15. **Batch Quality Control Element Frequencies:** Every batch must include a Preparation Blank, a Laboratory Control Sample, a Sample Duplicate and a Matrix Spike.

## 5. Interferences

- 5.1. Sources of interference in the determination of total mercury by Cold Vapor Atomic Absorption are primarily due to:
    - 5.1.1. The presence of sulfide, chloride, copper, or tellurium may cause interference with the determination of mercury by this method.
    - 5.1.2. Sulfide interferences can be eliminated by the addition of potassium permanganate; however, it is worth mentioning that concentrations as high as 20 mg/L of sulfide (as sodium sulfide) do not interfere with mercury recovery.
    - 5.1.3. Interference caused by chlorides (seawaters, brines, and industrial effluents) can be eliminated by the addition of extra potassium permanganate (as much as 25mL). During the oxidation step, chlorides are converted to free chlorine, which will absorb radiation at 253 nm. This free chlorine can be eliminated, before mercury is reduced, by adding an excess of hydroxylamine sulfate.
  - 5.2. Organic compounds having broad band UV absorbance (~ 253.7 nm)
  - 5.3. Volatile materials, which absorb at 253.7 nm, will cause positive interference.
  - 5.4. Physical interferences may be introduced in the determination of total mercury if excessive foaming or precipitation occurs. Excessive foaming can be controlled by the addition of an Antifoam Emulsion to all standards and samples. Precipitation must be removed by the digestion procedure or by a suitable separation method.
  - 5.5. All solutions used with the FIMS-100 instrument (samples, carrier solutions, reducing agents) must be free of solid particles since they must be transported through narrow tubing and valve openings.
  - 5.6. Careful operation of the instrument, proper sample preparation technique, and good laboratory cleanliness practices are the most important prerequisites for minimizing contamination. High purity deionized water, chemicals, and inert gas should be used.
6. **Safety**
- 6.1. The toxicity or carcinogenicity of all reagents in this procedure has not been fully established. Extreme caution should be used in handling all chemicals used in this procedure.

- 6.2. To minimize exposure, process samples in an exhaust hood or well-ventilated workspace. When working with samples and chemicals, wear gloves to minimize contact and possible absorption. Always wear appropriate eye protection.
- 6.3. Proper emergency response to spills or injury should be reviewed by the laboratory employee prior to attempting this procedure. This includes location of spill kits, emergency eyewash and showers, fire fighting equipment, as well as evacuation routes.
- 6.4. Material Safety Data Sheets (MSDS) are available for all chemicals used in this procedure. All laboratory employees are required to review these before handling these chemicals.
- 6.5. Mercury and its compounds are highly toxic, cumulative poisons. All known mercury containing standards and samples must be handled with appropriate caution. Adequate ventilation and/or provisions for scrubbing the resulting vapors (activated charcoal, permanganate scrubber solution) must be provided.

## 7. Apparatus and Materials

- 7.1. Flow Injection Mercury System Spectrophotometer (FIMS):
- 7.2. The Optical Unit: The upper part of the FIMS. It contains the radiation source (Hg lamp), the FIMS-cell compartment and the photodiode detector.
- 7.3. FIMS-CELL: The inner diameter is 4mm, and the optical path length is 260mm. The mercury vapor flows into the FIMS-cell where the absorption of mercury is measured.
- 7.4. Gas/Liquid Separator: Used to separate the gas and liquid in the mixture that leaves the manifold.
- 7.5. FIAS Valve: A 5-port valve with two positions. The FILL position where the sample is drawn into the sample loop, and where the carrier stream flows continuously in the manifold. The INJECT position where the sample loop is switched into the carrier stream and the sample is transported to the manifold.
- 7.6. Peristaltic Pump: Used to transport the various liquids through the system. The pump is operated at 120 rpm.
- 7.7. Pump Magazines: A total of four, used to hold the pump tubes. The pressure adjustment lever regulates the pressure applied to the pump tubes.

- 7.8. Manifold: Blocks having three channels that are interconnected. In the manifold two fluid streams are mixed to initiate a reaction, or to dilute one of the streams. The blocks are made of an inert, translucent plastic
- 7.9. Radiation Source: A low pressure mercury lamp
- 7.10. Detector: A photocell with maximum sensitivity at 254 nm.
- 7.11. PTFE-Membrane
- 7.12. Pump Tubes: A variety of pump tubes with differing diameters made of acid and solvent resistant materials.
- 7.13. Sample Loops: Made from PTFE tube, with screw connectors, volume 500  $\mu$ L.
- 7.14. Connection and Reaction Tubes: Made from PTFE tubes
- 7.15. Adapters and Connectors: Used to connect the different types and sizes of the connector and pump tubes.
- 7.16. Argon: carrier gas
  - 7.16.1. Purity 99.996 %
  - 7.16.2. Recommended flows are between 40 mL/min and 250 mL/min at a gas inlet pressure between 320 kPa and 400 kPa.
  - 7.16.3. The outlet gauge pressure should be approximately 360 kPa (52 psig).
- 7.17. AS-90 Autosampler
- 7.18. Dell Pentium III computer
- 7.19. Hewlett Packard DeskJet 810C Printer
- 7.20. Blow and vent system to provide adequate ventilation of toxic fumes
- 7.21. Assorted calibrated pipettes capable of delivering volumes from 10-100  $\mu$ L, 0.25- 1.0 mL, 0.50 - 10 mL.
- 7.22. An assortment of high quality disposable pipet tips.
- 7.23. Labware- All reusable labware should be sufficiently clean for the task objective. Several procedures found to provide clean labware include washing with a detergent solution, rinsing with tap water, soaking for

overnight in 25 % (v/v) nitric acid, rinsing with reagent water and storing clean. Ideally, ground glass surfaces should be avoided to eliminate a potential source of random contamination. When this is impractical, particular attention should be given to all ground glass surfaces during cleaning

- 7.24. Glassware – volumetric flasks, graduated cylinders, funnels and centrifuge tubes (glass and/or metal-free plastics).
- 7.25. Narrow-mouth storage bottles, FEP (fluorinated ethylene propylene) with screw top closure, 125 mL to 1L capacity.

## 8. Reagents and Standards

- 8.1. Unless otherwise indicated, only reagent grade chemicals conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society shall be used, when available. Other grades may be substituted, provided it is first determined that the reagent is of sufficient purity for its intended application. Each reagent lot will be tested prior to use.
- 8.2. Reagents labeled “Suitable for Mercury Analysis” or “Suitable for Trace Metals Analysis”; for example Baker Instra-Analyzed® reagents are preferable, if available.
  - 8.2.1. Laboratory Pure Water, ASTM Type 1, from Millipore Milli-Q water system or equivalent.
  - 8.2.2. Stannous Chloride, Dihydrate, Crystal –  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ .
  - 8.2.3. Hydrochloric Acid, Concentrated - HCl.
  - 8.2.4. Potassium Permanganate,  $\text{KMnO}_4$  Baker Instra-Analyzed®, or equivalent.
  - 8.2.5. Magnesium Perchlorate, anhydrous, crystal -  $\text{Mg}(\text{ClO}_4)$ .
  - 8.2.6. Sulfuric Acid, Concentrated,  $\text{H}_2\text{SO}_4$ , Baker Instra-Analyzed®, or equivalent.
  - 8.2.7. Nitric Acid, Concentrated,  $\text{HNO}_3$ , Baker Instra-Analyzed®, or equivalent.

- 8.3. Standards - Standard solutions may be prepared from pure standard materials, purchased as certified solutions or prepared by dilution of certified solutions. Upon receipt, standards should be verified by comparison with second-source materials prior to initial use. Standards should be checked frequently for stability, and be replaced if comparison with second-source standards indicates a problem.
- 8.4. Commercial Stock Mercury standards - These materials are diluted to make stock solutions that are in turn diluted to prepare calibration standards. Mercury standards are available in a variety of concentrations, typically from 100 to 1000 µg/L. The dilutions used to prepare calibration standards and quality control samples will depend on the exact concentrations of commercial standards used.

## **9. Sample Collection, Preservation, and Handling**

- 9.1. Sampling should be conducted by qualified personnel using an established sampling plan.
- 9.2. A minimum of 100 mL of water is required. If other metals in addition to Mercury are to be determined on the same sample, a minimum of 150 mL is needed. Since less than one gram of soil is needed for this procedure, the determining factor in how much soil should be collected will probably depend on other considerations. While either glass or plastic containers are permitted, plastic is preferable for waters whenever possible. The use of certified, commercially pre-cleaned sample containers is strongly encouraged. Under no circumstance should any containers or labware be cleaned with chromic acid.
- 9.3. Water samples should be preserved with Nitric Acid to a pH < 2 at the time of collection. If this is not possible, the sample should be cooled to 4 °C and preserved as soon as possible upon receipt by the laboratory. The preserved sample should be held for 16 hours prior to further processing.
- 9.4. Preserved water samples may be stored at room temperature.
- 9.5. Samples must be analyzed within 28 days of collection.

## **10. Quality Assurance/Quality Control (QA/QC) Requirements**

- 10.1. A key ingredient of successful trace metals analysis is cleanliness. Many of the target analytes, including mercury, are widespread in the environment or common in the laboratory and are easily introduced as contaminants. Careful attention to this aspect of the procedures will result in fewer errors and reruns.

- 10.2. The instrument is calibrated daily, as described in Section 9, prior to sample analysis.
- 10.2.1. The correlation coefficient for the calibration curve should be 0.995 or greater. Calibration must use calculated intercept.
- 10.2.2. The calculated concentration of the Calibration Blank should differ from zero by less than the absolute magnitude of the reporting limit (i.e., greater than -0.0002 mg/L but less than 0.0002 mg/L.).
- 10.2.3. The RSD of each individual standard should be less than 10%. The instrument is capable of RSD values less than 5 %, therefore, while RSD values between 5 % and 10 % may be used, the analyst should check for problems and perform any necessary maintenance or corrective procedures, if possible.
- Note:** The RSD guidelines for the individual calibration standards are laboratory policy rather than method specific and are based on the expected performance characteristics of the Perkin Elmer FIMS 100.
- 10.3. One Preparation Blank and one Laboratory Control Sample are to be prepared per batch of samples digested.
- 10.4. One Matrix Spike and one Sample Duplicate are to be prepared per batch of samples digested.
- 10.5. Initial Calibration Checks:
- 10.5.1. Depending on the reference, ICV control limits vary from between 85 % to 115 % recovery (CLP) to 90 % to 110 % (245.x). The more restrictive of these criteria will be applied. The software is able to flag values outside user-defined control limits. The instrumentation is quite capable of performing within a window of 90 % to 110 %. While recoveries outside of this range but within the 85 % to 115 % window may be considered reportable, the analyst is encouraged to determine if there is a problem associated with the analysis.
- 10.5.2. The ICB must not differ from zero by more than the absolute value of the reporting limit, i.e., it must read between -0.0002 and 0.0002 mg/L. The software can also flag ICB and CCB readings outside user-defined control limits. No sample results may be reported unless they are preceded by valid ICV and ICB samples.

- 10.6. Continuing Calibration Verification: The analysis of the CCV solution immediately following the calibration must verify that the instrument is within  $\pm 5\%$  of calibration. Subsequent analyses of the CCV solution must be within  $\pm 10\%$ . No results may be reported which are not bracketed by acceptable CCV/CCB samples.
- 10.7. Since ICV and ICB samples may be substituted for LCS/PB samples, the same criteria apply for LCS recovery and PB results.
- 10.8. Matrix Spike Recoveries should be between 70 and 130 %. Spike Duplicates or Sample Duplicates should yield a Relative Percent Difference of less than 20 %. Failure of either of these criteria does not invalidate the result if the sample is associated with an acceptable LCS. A narrative addressing the situation should however accompany the report.
- 10.9. The measured sample concentration must not exceed that of the high standard. Unlike manual cold vapor analysis, wherein the entire digested sample is used for analysis, this method uses a subsample of the digested material and therefore, it is usually possible to dilute and rerun an over range sample without redigesting.
- 10.10. In the laboratory, all reagents and solvents are logged into a record book. Lot number, purity, and chemical description are documented. Standard preparation is documented and the records are maintained in a bound notebook. Laboratory logbooks documenting sample preparation are maintained. Access to all chemicals and standard solutions are controlled.
- 10.11. All laboratory data is checked by a secondary reviewer to ensure that the appropriate methods of analysis were used, that all information pertaining to the preparation and the analysis is recorded.
- 10.12. A batch of samples shall consist of no more than 20 samples of the same matrix.
- 10.13. A method blank must be processed with every batch of sample digested. The absolute value of the method blank must be less than the reporting limit.
- 10.14. One method blank spike (MBS) or laboratory control sample (LCS) must be processed with every batch of samples digested. The MBS must recover within  $\pm 15\%$  of its true value.
- 10.15. One method blank spike duplicate (MBSD) or laboratory control sample duplicate (LCSD) must be processed with every batch of samples digested. The MBSD/LCSD must recover within  $\pm 15\%$  of its true value. The relative percent difference (RPD) must be  $< 10\%$ .

- 10.16. One matrix spike (MS) must be analyzed to a minimum of 10 % of the routine samples. The added concentration must be at the same level as it is in the MBS. The recovery of the matrix spike must fall within  $\pm 30$  %.
- 10.17. One duplicate sample must be analyzed to a minimum of 5 % of the routine samples. The relative percent difference (RPD) must be  $< 10$  %.
- 10.18. Initial calibration verification standard (ICV) shall be analyzed immediately after calibration before the analysis of any samples. The ICV must recover within  $\pm 10$  % of its true value.
- 10.19. An initial calibration blank (ICB) shall be analyzed at the beginning of the analytical run but after the ICV. The absolute value of the ICB must be less than the reporting limit.
- 10.20. Continuing calibration verification standard (CCV) shall be analyzed at the beginning, after every ten samples, and at the end of the analytical run. The first CCV must recover within  $\pm 5$  % of its true value. Subsequent CCVs must recover within 10 % of its true value.
- 10.21. A continuing calibration blank (CCB) shall be analyzed after the CCV at the beginning, periodically after every ten samples and at the end of the analytical run. The absolute value of the CCB must be less than the reporting limit.
- 10.22. Linear dynamic range (LDR) must be established and kept on file. LDR must be established when beginning the use of the method and on a quarterly basis. If the determined concentrations are not within  $\pm 10$  % of the stated values, laboratory performance is unacceptable. Samples analyzed must be less than the established LDR, or they must be diluted.
- 10.23. Corrective Action
- 10.23.1. All quality control standards must recover within the criteria described in the table below to be acceptable. The corrective action listed must be taken if any of the criteria are exceeded:

**Table 10.1 Quality Control Criteria**

QC Standards	Criteria	Corrective Action if QC does not recover within criteria.
ICV	± 10 %	1. Stop the analysis 2. Reanalyze 3. Redigest the samples
ICB/CCB	≤RL	1. Stop the analysis 2. Reanalyze 3. Redigest the samples
CRA	± 20 %	1. 20 % recovery is recommended, but corrective action is based on the analyst's discretion.
1rst CCV	± 5 %	1. Stop the analysis 2. Correct the problem 3. Recalibrate and reanalyze
CCV (subsequent)	± 10 %	1. Stop the analysis 2. Correct the problem 3. Recalibrate and reanalyze
Method Blank (MB)	≤RL	1. Redigest all reportable samples for which the results are less than 10x the method blank level. 2. Samples with non-detected analytes may be accepted if the MB is contaminated
LCSW	± 15 %	1. Redigest all samples associated with an MBS not within quality control limits. 2. Samples with non-detected analytes may be accepted if MBS recovery is high.
MS/MSD	± 30 %	1. Check the recovery of MBS and CCVs. 2. Redigest, if necessary 3. Flag data for possible interference
DUPLICATE (RPD)	± 10 %	1. Redigest and reanalyze
LDR	± 10 %	1. If LDR standard recoveries are unacceptable, select a lower calibration range.
LINEAR RANGE (during analyses)		1. If samples exceed the pre-established upper limit (LDR), redigest samples at dilutions, and reanalyze.

**11. Procedure**

11.1. All samples (Waters, Solids, TCLP Extracts) must be digested prior to analysis.

- 11.2. The instrument is calibrated daily prior to any analysis. This is accomplished using a Calibration Blank and at least three Calibration Standards. Calibration Standard concentrations and preparations are discussed in Appendix A.
- 11.3. All mercury standards must be digested with the samples using the same type and percentage reagents.
- 11.4. Sample Preparation
- 11.4.1. All standards must be logged in the mercury digestion book: Standards must be made with the same type and percentage of all reagents used to prepare the samples.
- 11.4.2. Transfer 0.0, 0.020, 0.050, 0.100, 0.250, and 0.500 mL of the mercury mid-stock working standard, containing 0.250 ppm of mercury to a series 40-mL vial, dilute to 25 mL.
- 11.4.3. Prepare Calibration Standards, Calibration Verifications, Preparation Blanks and Laboratory Control Samples as discussed in Appendix A.
- 11.4.4. For each environmental sample, add 25 mL to a 40-mL vial, or other suitable container.
- 11.4.5. Prepare any necessary sample duplicates. Prepare any necessary Matrix Spikes as described in Appendix A.
- 11.4.6. Add approximately 1.25 mL Concentrated H<sub>2</sub>SO<sub>4</sub> and 0.625 mL Concentrated HNO<sub>3</sub>, followed by 3.75 mL 5 % KMnO<sub>4</sub>, to all samples, standards and QC samples. Wait at least 15 minutes following the addition of the KMnO<sub>4</sub>. Adjusting the dispensers for these exact volumes is not essential, but it is important that the adjustment is not changed in the course of the procedure.
- 11.4.7. Add an additional 3.75 mL 5 % KMnO<sub>4</sub> to any sample in which the purple color, indicative of excess permanganate, fails to remain after 15 minutes. Add additional permanganate in 1.25 mL increments until the purple color persists at least 15 minutes. Dilute any sample that does not maintain its purple color 15 minutes after the addition of a total of 7.5 mL KMnO<sub>4</sub> and proceed as described above until the sample meets the criteria of this section.

11.4.8. After the purple color has persisted for at least 15 minutes, add 2 mL of 5 % Potassium Persulfate to all samples, standards and QC samples.

11.4.9. Cap the vials, place them in a suitable rack and heat them in a water bath, or equivalent, maintained at 95 °C for 2 hours.

11.4.10. Allow the samples to cool. Shortly before analysis, add 1.5 mL hydroxylamine hydrochloride solution to each sample and mix well. If the digested samples are not to be analyzed immediately, wait until just prior to analysis to add this solution.

11.4.11. If any sample requires additional permanganate, the analyst has two options.

11.4.11.1. Add the same amount of permanganate to all samples and standards that will be analyzed together. This ensures that all samples and standards have the same final volume and may share the same calibration.

11.4.12. Prepare an additional Calibration Verification standard and two additional Calibration Blanks along with a standard at the same concentration as the Reslope Standard. Add the same total amount of permanganate to these solutions and to all samples, which required additional permanganate. Analyze all samples, which used the normal amounts of reagents until all required instrumental QC requirements are met. Use one of the additional Blanks and the second Reslope Standard to adjust the slope of the calibration curve. Analyze the sample(s), that required additional permanganate along with the second Calibration Verification solution and Calibration blank to which additional permanganate was also added. Follow the same protocols for Initial and Continuing Calibration Verifications.

#### 11.5. Standard Preparation

11.5.1. All standards must be logged in the mercury digestion book: Standards must be made with the same type and percentage of all reagents used to prepare the samples.

- 11.5.2. Transfer 0.0, 0.020, 0.050, 0.100, 0.250, and 0.500 mL of the mercury mid-stock working standard, containing 0.250 ppm of mercury to series 40-mL vials, dilute to 25 mL.
- 11.5.3. Add 5 mL of concentrated sulfuric acid, and 2.5 mL of concentrated nitric acid mixing after each addition.
- 11.5.4. Add 15 mL of potassium permanganate solution (sewage samples may require additional permanganate).
- 11.5.5. Mix well and add additional portions of potassium permanganate solution, if necessary, until the purple color persists for at least 15 minutes.
- 11.5.6. Add 8 mL of potassium persulfate to each bottle and heat for 2 hours in a water bath at 95 °C.
- 11.5.7. Cool and add 6 mL of sodium chloride-hydroxylamine hydrochloride to reduce the excess permanganate.
- 11.5.8. The mercury standards concentrations are obtained according to the following equation:

$$Final\ concentration = \frac{initial\ concentration \times initial\ volume}{final\ volume}$$

- 11.5.9. Refer to the tables below to prepare the standards for mercury analysis.

**Table 11.1. Mid-Stocks 1ppm standard for mercury analysis**

Mid-Stock Solutions	Initial Conc. (ppm)	Initial Volume (mL)	Final Volume (mL)	Final Conc. (ppm)
Working Standard Mid Stock	1000	0.025	100	0.250
ICV Mid Stock Solution (2 <sup>nd</sup> Source)	1000	0.1	100	1.0

**Table 11.2. Use the Mid stocks above to make the following standards:**

Standards	Initial Conc. (ppm)	Initial Volume (mL)	Final Volume (mL)	Final Conc. (ppb)
Std1	0.250	0.020	25	0.2
Std2	0.250	0.050	25	0.5
Std3	0.250	0.100	25	1.0
Std4	0.250	0.250	25	2.5
Std5	0.250	0.500	25	5.0
ICV (2 <sup>nd</sup> Source)	1.0	0.0625	25	2.5
CRA	0.250	0.020	25	0.2
CCV	0.250	0.250	25	2.5

11.6. Mercury analysis

- 11.6.1. While the samples are cooling, turn on the ventilation system, the argon gas (52 psig), the spectrophotometer, the computer and the printer and allow the system to warm up.
- 11.6.2. Listed below is a step-by-step guide through using the FIMS system for mercury analysis.
- 11.6.3. Log on to the Network by using the pre-determined password.
- 11.6.4. In the Program Manager, double-click on the AA WinLab icon.
- 11.6.5. Wait for the main screen to appear
- 11.6.6. Disconnect the sample transfer tube joining the gas/liquid separator to the FIMS-cell
- 11.6.7. Slowly adjust the carrier gas flow to the pre-determined setting (50)
- 11.6.8. Open the "Results" Window.
- 11.6.9. Open the Method to be used either for soil or for waters.
- 11.6.10. Set up the correct tubing on the magazines and lock into place.
- 11.6.11. Start the pump for the carrier and reductant solutions (the flow rates have been pre-set). The carrier solution flow rate is 9-11 mL/min; the reductant flow rate is 5-7 mL/min).

- 11.6.12. Check that the rate at which the liquid leaves the gas/liquid separator is slightly greater than the rate at which it enters (pre-set).
- 11.6.13. (To prevent liquid from wetting the filter in the gas/liquid separator, the carrier and reductant lines can be removed temporarily so that all the liquid in the lines is removed prior to analysis).
- 11.6.14. Click on Sample Information and list the samples in the order to be analyzed.
- 11.6.15. Save the file as saver.sif. The sample information files are saved temporarily for the current analytical run.
- 11.6.16. Under Automated Analysis (AUTO) list the sample positions e.g. 10-30
- 11.6.17. Go to BROWSE on the Sample File field and then recall the temporary sample information file.
- 11.6.18. Under "RESULTS DATA SET NAME", click on BROWSE
- 11.6.19. At RESULTS NAME, type in the desired filename to save the data, e.g. 010101S (first run of January 01, 20001 for soil samples) and click OK.
- 11.6.20. To Analyze samples and standards, go to AUTOMATED ANALYSIS (AUTO)
- 11.6.21. Choose Analyze
- 11.6.22. The software allows the following three options for analysis:
- 11.6.22.1. Select "Analyze All" to run calibration plus samples.
  - 11.6.22.2. Select "Calibrate" to run the standards and calibrate only.
  - 11.6.22.3. Select "Analyze Samples" to run all samples in the SIF. Scheduled quality control samples will also be analyzed.
- 11.6.23. Carefully monitor analysis.

11.6.24.A typical mercury analytical run must follow the format outlined below:

Calibration Blank  
S1  
S2  
S3  
S4  
S5  
S6  
ICV  
ICB  
CRA  
CCV  
CCB  
Preparation Blank  
LCS or Blank Spike  
LCSD or Blank Spike Duplicate  
Sample-1  
Sample-1S(matrix spike)  
Sample-2  
Sample-3  
Sample-4  
Sample-5  
Sample-6  
CCV  
CCB  
Sample-7  
Sample-8  
Sample-9  
Sample-10  
Sample-11  
Sample-11S  
Sample-12  
Sample-14  
Sample-15  
Sample-16  
CCV  
CCB  
Sample-17  
Sample-18

Sample-19  
Sample-20  
CCV  
CCB

11.7. Basic Maintenance

11.7.1. To avoid contaminating samples, and for safety reasons, the work area should be kept absolutely clean, and spills should be wiped up immediately.

11.7.2. Only fully trained analysts should use the following maintenance procedures. See Section for more in-depth information.

11.7.3. Spectrometer Maintenance - Occasionally, the windows may need to be cleaned. Care should be taken not to scratch or touch the surface of the quartz windows. Scratched windows must be replaced.

11.7.3.1. Remove the FIMS-cell from the cell compartment of the spectrometer.

11.7.3.2. Carefully remove the windows from the FIMS-cell.

11.7.3.3. Wash the windows with deionized water and allow them to dry.

11.7.3.4. If windows are still dirty, clean windows with a soft, lint-free cloth sparingly moistened with a spectroscopic-grade alcohol.

11.7.3.5. Wash the FIMS-cell with deionized water and allow it to dry.

11.7.3.6. If the cell is still dirty, soak it in a soapy solution for a couple of hours to remove the apparent film that adheres to the walls.

11.7.3.7. Let dry.

11.7.3.8. Re-install the cell in the spectrometer and measure the absorbance.

#### 11.7.4. Gas/Liquid Separator and Manifold

11.7.4.1. As a routine maintenance, the fluid system must be rinsed after each analysis to avoid build up.

11.7.4.2. To perform a more thorough maintenance procedure, follow the steps outlined below:

11.7.4.3. Separate the manifold and separator blocks

11.7.4.4. Disconnect the tubes from the manifold and separator blocks

11.7.4.5. Unscrew the separator cover and remove the PTFE filter

11.7.4.6. Pump deionized water through each channel of the blocks

11.7.4.7. Rinse the manifold and separator blocks with 1:1 hydrochloric acid

11.7.4.8. Rinse the manifold and separator components thoroughly with deionized water

#### 11.7.5. Changing the Separator Filter

11.7.5.1. Unscrew the separator cover and remove the old filter

11.7.5.2. Insert a new filter with the smooth side down

11.7.5.3. Replace the cover

#### 11.7.6. FIAS-Valve

11.7.6.1. As a routine maintenance, the fluid system must be rinsed after each analysis to avoid build up.

11.7.6.2. Disconnect all the tubes from the valve

11.7.6.3. Pump deionized water through each channel of the valve.

11.7.6.4. To perform a more thorough maintenance procedure, follow the steps outlined below:

11.7.6.5. Disconnect all the tubes from the valves

11.7.6.6.Remove the valve from the pump unit

11.7.6.7.Dismantle the valve

11.7.6.8.Clean the individual parts of the valve with deionized water

11.7.6.9.Pump deionized water through each channel of the valve components. If necessary, use a nylon filament and compressed air to unblock the channels of the valve

11.7.6.10.Reassemble the valve

11.7.6.11.Attach the valve to the pump unit.

11.7.6.12.Occasionally a plastic syringe can be used to force water through the valve at the sample in-let valve. Detach the sample in and out lines from the valve, and simply force water into the in-let valve.

11.7.6.13.See Sections 2.5.2-2.5.5 of the Maintenance manual for more in-depth instructions.

#### 11.7.7. Carrier Gas System Non Return Valve

11.7.7.1.Dismantle the valve if liquid enters it.

11.7.7.2.Rinse with deionized water

11.7.7.3.See Section 2.6 of the Maintenance manual for more information

#### 11.7.8. Air Filter

11.7.8.1.Air filters must be checked regularly to ensure that the components of the spectrometer are properly cooled.

11.7.8.2.Switch off FIMS

11.7.8.3.Pry up and remove the filter cover

11.7.8.4.Remove the filter, if necessary,

11.7.8.5. Replace with correct filter, and press the cover firmly back into place.

11.7.9. Source Lamp - Occasionally the lamp may fail or the intensity may be outside recommended limits

11.7.9.1. Switch instrument off

11.7.9.2. Disconnect the line cord from the line power supply

11.7.9.3. Remove the two screws holding the lamp cover

11.7.9.4. Pull off the cover

11.7.9.5. Put the lamp extractor under the lamp and carefully pull the lamp out of the socket.

11.7.9.6. Using a lint free cloth to hold the new lamp, push it into the lamp socket until it locks into place

11.7.9.7. Replace the lamp cover

11.7.9.8. Secure the cover with the two screws

11.7.10. Changing the Fuse

11.7.10.1. Switch instrument off

11.7.10.2. Disconnect the line cord from the line power supply

11.7.10.3. Remove the power plug from the socket on the rear of the instrument

11.7.10.4. Squeeze the two lugs on each side of the fuse holder and gently pull the fuse holder out of the socket.

11.7.10.5. Remove both fuses, discard if blown

11.7.10.6. Insert new fuses (Check that the fuses have the correct rating, 6.3A Part Number B015-5576)

11.7.10.7. Align the lug at the top of the fuse holder with the slot in the socket

11.7.10.8. Push the fuse holder into the socket until the lug snaps into place.

#### 11.7.11. Fluid System Maintenance

11.7.11.1. Pump Tubes: To reduce wear and tear, place one drop of silicone oil on the tube. Release the pressure on the tubes at the end of the analysis.

11.7.11.2. Pump Rollers: Wipe with a dry lint free cloth

11.7.11.3. All Tubes: Check daily for kinks. Replace if necessary

11.7.11.4. Waste Bottle: Empty regularly, never allow it to overflow. Dispose of waste properly

11.7.12. Prior to the analysis of any environmental samples, the calibration must be verified through the analysis of the Initial Calibration Verification and Initial Calibration Blanks described above.

11.7.13. The Continuing Calibration Verification and Continuing Calibration Blank samples are analyzed following every tenth determination of an analytical sample. The CCV/CCB are also analyzed following the last sample in the analytical session.

11.7.14. If it is necessary to repeat the analysis of any environmental samples, e.g., for dilution into the calibration range of the instrument or because of a failed calibration verification, it is not necessary to repeat the analysis of the associated Preparation Blank(s) and Laboratory Control Sample(s) provided the initial analyses of these samples meet the instrumental quality control requirements outlined in the following section.

11.7.15. If redigestion is needed for any sample(s), new Quality control samples may be required following the guidelines for Batch Quality Control.

## 12. Data Handling and Calculations

12.1. Data is exported in a folder set up in a network drive for easy access by report generation personnel. The data file has to be reformatted as outlined below:

- 12.1.1. Click on the AA WINLAB logo
- 12.1.2. Under FILE, choose UTILITIES
- 12.1.3. REFORMAT
- 12.1.4. Open Design
- 12.1.5. Click on Data Format to name design
- 12.1.6. Choose "EXPORT"
- 12.1.7. Click OK to keep
- 12.1.8. Browse TO CHOOSE FILE
- 12.1.9. Highlight file and click OK
- 12.1.10. The directory path is preset.
- 12.1.11. Click on the "Save Result" Key to export the data.
- 12.2. Run logs for each analysis is also produced by reformatting the data file as outlined below:
  - 12.2.1. Click on the AA WINLAB logo
  - 12.2.2. Under FILE, choose UTILITIES
  - 12.2.3. REFORMAT
  - 12.2.4. Open Design
  - 12.2.5. Click on Data Format to name design
  - 12.2.6. Choose "Run log"
  - 12.2.7. Click OK to keep
  - 12.2.8. Browse TO CHOOSE FILE
  - 12.2.9. Highlight file and click OK
  - 12.2.10. The directory path is preset.

12.2.11. Click on the "Save Result" Key to reformat the data file.

12.2.12. Minimize the AA Winlab window

12.2.13. From the desktop, click on the AA INSTRUMENT RUNLOG logo

12.2.14. Click on OK to create a CSV file

12.2.15. Select workbook by filling in the filename e.g. M000421A

12.2.16. Wait for file to be recalled

12.2.17. Click on YES to replace file at c:\aauser\reports

12.2.18. Wait for run-log to be printed

12.2.19. Exit file when completed

12.3. The concentration of the sample, as presented to the instrument, is calculated by its data handling software using the observed absorbance. It will be necessary to convert this value to the concentration of the sample as received by the laboratory. Since all standards and samples are digested so that the same total amount of reagents is added to each digest, no "initial" and "final" volumes are needed in the calculations for water samples.

12.4. Any dilutions necessary to bring the result within the calibration range and any correction for the dry weight of the sample, when appropriate, are also used to calculate the reported value. Results are rounded to three significant figures after calculation and prior to reporting.

12.5. Water Samples (Including TCLP extracts) results may be calculated as

$$\text{Sample Conc. (mg/L)} = \frac{\text{Instrument Readout} \left( \frac{\mu\text{g}}{\text{L}} \right) \times \left( \frac{\text{Final Volume (mL)}}{\text{Initial Volume (mL)}} \right) \times \text{Dilution Factor}}{1000}$$

follows:

12.6. The instrument dilution factor may be calculated as follows:

$$\text{Dilution Factor (DF)} = \left( \frac{\text{Final Volume (mL)}}{\text{Initial Volume (mL)}} \right)$$

(Used only for dilutions of sample over Calibration Range)

- 12.7. The recovery of the quality control samples ICV, R.L. CCV is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Measured value}}{\text{True value}} \times 100$$

- 12.8. The recovery of the matrix spike is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Sample Spike Result} - \text{Sample Result}}{\text{Spike True Value}} \times 100$$

- 12.9. The relative percent difference RPD is calculated as follows:

$$\% \text{ RPD} = \frac{\left( \frac{|\text{Sample Result} - \text{Duplicate Result}|}{\left( \frac{\text{Sample Result} + \text{Duplicate Result}}{2} \right)} \right) \times 100$$

**Note:** The units in the equation above may not appear to yield the result shown. Since mg/L is equivalent to  $\mu\text{g/mL}$ , entering the units as indicated will give a concentration in  $\mu\text{g/g}$ , which is in turn equivalent to mg/Kg.

### 13. Instrumental and Method Reporting Limits

- 13.1. The Instrument Detection Limit, determined as three times the standard deviation of seven replicates of a 0.0001 mg/L mercury standard, run on three non-successive days, is 0.000067 mg/L (0.067  $\mu\text{g/L}$ ).
- 13.2. The Instrument Detection Limit, determined as three times the standard deviation of seven replicates of a blank, is 0.00002 mg/L (0.02  $\mu\text{g/L}$ ).
- 13.3. The method detection limit, determined as 3.143 times the standard deviation of seven replicates of a 0.0001 mg/L mercury standard, is 0.0000370 mg/L (0.0370  $\mu\text{g/L}$ ).

- 13.4. Reporting Limits: Whenever possible, Groundwater Analytical, Inc. uses the Contract Required Detection Limit (0.0002 mg/L) from the Contract Laboratory Program (CLP) as the reporting limit for Mercury, unless specific project requirements indicate otherwise. Sample specific reporting limits are calculated from these values in the same manner as described above for the reported results.

#### 14. References

- 14.1. "Test Methods for Evaluating Solid Waste," US. EPA OSWER, SW-846, 3rd Ed. Final Update 1, Methods 7470 and 7471, November 1990.
- 14.2. "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," EPA 40 CFR Part 136, October 26, 1984.
- 14.3. "Methods for Chemical Analysis of Water And Wastes," EPA-600/ 4-79-020", March 1983.
- 14.4. "Methods for the Determination of Metals in Environmental Samples," Supplement 1, EPA Methods 245.1 Revision 3.0, EPA-600/ R-94/111, May 1994.
- 14.5. "Quality Assurance Plan," Groundwater Analytical, Inc., current version.
- 14.6. U.S. EPA, Contract Laboratory Program, SOW for Inorganic Analysis, ILM04.0.
- 14.7. FIMS (Flow Injection Mercury System): Installation Maintenance System Description: PERKIN ELMER , June 1994
- 14.8. FIMS: Setting Up and Performing Analyses: PERKIN ELMER, March 1994

#### 15. Revisions and Changes

- 15.1. The Initial Version was prepared for a Leeman PS 200.
- 15.2. The Second Version was prepared for the PE FIMS
- 15.3. First Revision Prepared By:  
Ruddy Ligonde, Inorganic Section Manager, January 25, 2001.
- 15.4. Second Revision Prepared By:

John Kowalski, Inorganics Manager, March 10, 2008.

Added calibration treatment to Section 10.2.1 (calculated intercept)

15.5. Third Revision Prepared By:

John Kowalski, Inorganics Manager, July 7, 2008.

Modified Definition of Preparation Batch.

Corrected Method Reference.

Corrected Matrix Spike acceptance criteria to  $\pm 30$  % throughout document.

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APPENDIX A

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Stock Solutions, Calibration Standards and Quality Control Samples

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**1. Solution Preparation**

The amounts used in preparing the following solutions are not the only ones that will result in the correct concentrations in the Calibration Solutions and the Quality Control solutions. While these guidelines are recommended, an experienced analyst may vary them if necessary. While the expiration times listed below should be valid, the analyst may choose to prepare all stock solutions fresh prior to analysis.

Note: If a group of samples contains only solids, do not add water to the standards prior to digestion. Proceed with the normal solid digestion protocol and add sufficient water to the standards after digestion to bring the volume to 100 mL. This also applies to the Calibration Verification Standard described below.

**2. Intermediate Stock Solutions**

Using an Eppendorf (or equivalent) micro pipettor whose calibration has just been verified, add 0.100 mL of certified 1000 mg/L commercial AA grade Mercury standard from Fisher to a 100 mL Class A Volumetric Flask containing approximately 30 mL of 2 % HNO<sub>3</sub>. Dilute to the mark with 2% HNO<sub>3</sub>. Store in plastic only. This solution may be used until exhausted or a freshly prepared independent calibration solution indicates a problem. This solution contains 1.0 mg/L Mercury. It may be used as an intermediate standard to prepare working calibration standards.

Using an Eppendorf (or equivalent) micro pipettor whose calibration has just been verified, add 0.100 mL of the 1000 mg/L Mercury standard from JT Baker to a 100 mL Class A Volumetric Flask containing 30 mL of 2 % HNO<sub>3</sub>. Dilute to the mark with 2 % HNO<sub>3</sub>. Store in plastic only. This solution may be used until exhausted or a freshly prepared independent calibration solution indicates a problem. This solution contains 1.0 mg/L (1000 µg/L) Mercury. This solution may be used as an intermediate standard solution to prepare the ICV, the LCS and the matrix spikes.

**3. Calibration Standards**

Using Eppendorf (or equivalent) micro pipettors whose calibrations have just been verified, add, in turn, 0.020 mL, 0.050 mL, 0.100 mL, 0.250 mL, 0.500

## Appendix A

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mL, of the 1.00 mg/L Mercury solution described above to a series of 300 mL BOD bottles. Add sufficient Laboratory Pure Water to each bottle to bring the volume to 100 mL. This results in solutions of 0.0002, 0.0005, 0.0010, 0.0025 and 0.0050 mg/L Mercury respectively. Proceed with digestion as described in Sample and standard Preparation section.

#### 4. Calibration Verification Standard

Using an Eppendorf (or equivalent) micro pipettor whose calibration has just been verified, add 250  $\mu$ L of the 1.00 mg/L Mercury solution described above to a BOD bottle. Add sufficient Laboratory Pure Water to each bottle to bring the volume to 100 mL. These solutions contain 0.0025 mg/L Mercury. Proceed with digestion as described in Sample and standard Preparation section.

#### 5. Laboratory Control Samples

These solutions are prepared using 100  $\mu$ L of the 1.00 mg/L solution used for the initial calibration verification Standard. For the water LCS, add 100-mL water prior to digestion. This results in an LCS that contains 0.0010 mg/L Mercury. For the "Solid" LCS, add the same amount of mercury stock solution to the digestion vessel as the water LCS and proceed with the digestion procedure for solids. This solution contains the equivalent of 0.166 mg/Kg mercury in a 0.6g sample that is 100 % solids (i.e., moisture-free).

#### 6. Matrix Spikes

Add 100  $\mu$ L of the same 1.00 mg/L Mercury solution used for the Calibration Verification Samples and the Laboratory Control Sample to 25 mL of aqueous sample or 0.6 g of solid sample. This results in a spike level of 0.0010 mg/L for aqueous samples. The spiking level for solid samples will be approximately 0.166 mg/Kg. The actual spike level will depend on the amount of solid sample used and its dry weight. Proceed with digestion as described in Sample and standard preparation section.

Appendix A

**Table 1 Solution Preparation Summary**

Stock Solutions		
Concentration	Calibration Stock Solutions	QC Stock Solution
1 ppm	0.100 mL of 1000 ppm to 10 mL	
250 ppb	25 µL of 1000 ppm to 100 mL	
1 ppm		1 mL of 100 ppm to 100 mL
Calibration Standards		
Concentration	Waters	Solids
0.2 ppb	20 µL of 250 ppb to 25 mL	20 µL of 1 ppm to 100 mL
0.5 ppb	50 µL of 250 ppb to 25 mL	50 µL of 1 ppm to 100 mL
1.0 ppb	100 µL of 250 ppb to 25 mL	100 µL of 1 ppm to 100 mL
2.5 ppb	250 µL of 250 ppb to 25 mL	250 µL of 1 ppm to 100 mL
5.0 ppb	500 µL of 250 ppb to 25 mL	500 µL of 1 ppm to 100 mL
QC Solutions		
	Waters	Solids
ICV/CCV (2.5 ppb)	62.5 µL of 1 ppm to 25 mL Water	250 µL of 1 ppm in 100 mL
LCS (1 ppb)	25 µL of 1 ppm to 25 mL Water	100 µL of 1 ppm in 100 mL
Matrix Spike (1 ppb)	25 µL of 1 ppm to 25 mL Sample	100 µL of 1 ppm to 0.6 g Sample

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**Appendix B**

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**Sample and Reagent Amounts for Digestions using  
Semi-Automated Methods of Analysis**

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**Table 2. Sample and Reagent Amounts (Note 1)**

	Semi-Automated Analysis	
	Waters	Solids
Sample	25.0 mL	0.6 g
Sulfuric Acid	1.25 mL	5.0 mL
Nitric Acid	0.625 mL	2.0 mL
Potassium Persulfate	2.0 mL	
Potassium Permanganate	3.75 mL	15.0 mL
Hydroxylamine Hydrochloride	1.5 mL	6.0 mL
Final Sample Volume	Note 2	25 mL
Stannous Chloride	Note 3	Note 3

Note 1-The number of decimal places shown in some instances is greater than necessary, for purposes of comparison. The precision of the addition of the reagents is more significant.

Note 2-Final volume is dependent on the amount of Permanganate required.

Note 3-The stannous chloride is added automatically by the instrument as described in the appropriate analytical SOP.

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Appendix C

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Typical Digestion Batch

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Waters

- Calibration Blank
- Standard 1 (0.0002 mg/L)<sup>1</sup>
- Standard 2 (0.0005 mg/L)<sup>1</sup>
- Standard 3 (0.0010 mg/L)<sup>1</sup>
- Standard 4 (0.0025 mg/L)<sup>1</sup>
- Standard 5 (0.0050 mg/L)<sup>1</sup>
- ICV/CCV (0.0025 mg/L)<sup>1</sup>
- ICB/CCB
- One PB, LCS, Sample Duplicate and Matrix Spike.
- Twenty (or fewer) Analytical Samples. These do not include the PB, LCS, Sample Duplicate or Matrix Spike.

Solids

- Calibration Blank
- Standard 1 (0.0002 mg/L)<sup>2</sup>
- Standard 1 (0.0005 mg/L)<sup>2</sup>
- Standard 2 (0.0010 mg/L)<sup>2</sup>
- Standard 3 (0.0025 mg/L)<sup>2</sup>
- Standard 4 (0.0050 mg/L)<sup>2</sup>
- ICV/CCV (0.0025 mg/L)<sup>2</sup>
- ICB/CCB
- One PB, LCS, Sample Duplicate and Matrix Spike.
- Twenty (or fewer) Analytical Samples. These do not include the PB, LCS, Matrix Spike or Matrix Spike Duplicate.

Note 1 – Effective concentration for calibration purposes: The actual concentration is less because of dilution with digestion reagents. All samples and standards are diluted in the same manner. The sample concentrations are equivalent to the instrument concentrations if there is no dilution and if final volumes are identical.

Note 2 – Actual concentrations in the calibration standards: The observed instrumental concentrations are used to calculate the sample concentrations.