SUPPLEMENTAL NORTHWEST CORNER INVESTIGATION WORK PLAN

ATLANTIC RICHFIELD COMPANY
28100 TORCH PARKWAY
MAIL CODE 2S
WARRENVILLE, ILLINOIS 60555

FORMER ANACONDA WIRE AND CABLE PLANT SITE
HASTINGS-ON-HUDSON, NEW YORK

NYSDEC SITE # 3-60-022

by

Haley & Aldrich of New York
Rochester, New York

for

Atlantic Richfield Company
Warrenville, IL 60555

File No.: 28612-300
January 2007

HALEY& ALDRICH

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LIST OF ACRONYMS AND ABBREVIATIONS

AR	Atlantic Richfield Company
AWC	Former Anaconda Wire and Cable
CPT	Cone Penetrometer Test
DNAPL	Dense Non-Aqueous Phase Liquid
Ft bgs	Feet below the ground surface
Haley & Aldrich	Haley & Aldrich of New York
HASP	Health and Safety Plan
LIF	Laser Induced Fluorescence
LRM	Liquid Rubbery Matrix
LRMRP	Liquid Rubbery Matrix Recovery Plan
MW	Monitoring Well
NYSDEC	New York State Department of Environmental Conservation
OU-1	Operable Unit No. 1
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RDWP	Remedial Design Work Plan
RIR	Remedial Investigation Report
RM	Rubbery Matrix
SAP	Sampling and Analysis Plan
TCL	Target Compound List
VOCs	Volatile Organic Compounds
WP	Work Plan

1. INTRODUCTION

1.1 General

Haley & Aldrich of New York (Haley & Aldrich) has prepared this Supplemental Northwest Corner Investigation Work Plan (WP) for Atlantic Richfield Company (AR), for Operable Unit Nos. 1 (OU-1) and 2 (OU-2) of the Former Anaconda Wire and Cable (AWC) Plant Site as requested by the New York State Department of Environmental Conservation (NYSDEC) on 29 November 2006. The goal of this WP is to support selection of the bulkhead alignment by a phased assessment of PCB Material in the vicinity of the currently proposed northern bulkhead alignment. The goals are further described in Section 2.

This WP has been prepared to present the exploratory nature of this investigation. Much of the investigation approach is contingent upon data currently being gathered to support the selection of appropriate exploration methods for this investigation. Given the nature of this exploration, a flexible and adaptive approach will enable field data to be readily integrated into the exploration.

1.2 Site Information

The Site is located approximately 15 miles north of New York City at 1 River Street in the Village of Hastings-on-Hudson, in Westchester County, New York. Operable Unit 1 encompasses approximately 28 acres of land and is covered by large buildings, concrete foundation slabs, and pavement with smaller areas of gravel. Operable Unit 2 consists of a portion of the Hudson River that borders the OU-1 shoreline and contains timber pilings and timber or steel bulkheads, rip-rap slope, dock platforms, one former and two current boat slips.

1.3 Technical Lexicon

Information collected during prior investigations at the site has indicated the presence of a polychlorinated biphenyl (PCB) material (PCB Material) containing PCBs dissolved in what appears to be a petroleum based solvent or volatile organic compounds (VOCs) (OU-1 Remedial Investigation Report (RIR) prepared by IT Corporation in October 2000), in the area referred to as the Northwest Corner. Investigators have characterized the material based primarily on visual appearance, with the term “rubbery matrix” applied to materials appearing in solid form and “liquid rubbery matrix” applied to material that is observed as liquid droplets (IT Corporation, October 2000).

For purposes of this work plan, the following terminology will be used:

¾ Rubbery Matrix (RM): PCB Material that behaves more as a solid while retaining some elasticity. Although this material may have been released on Site in a liquid form, it is currently found in a solid state.

¾ Liquid Rubbery Matrix (LRM): PCB Material that behaves as a liquid. The term “flowable dense non-aqueous phase liquid (DNAPL)” has been previously applied to

this material because its behavior is consistent with DNAPL. However, the term DNAPL is most often associated with other types of chlorinated solvents that have different physical properties (e.g. density) and therefore may behave differently in the subsurface. To clarify the type of material that is the subject of this supplemental investigation, the term Liquid Rubbery Matrix (LRM) will be used in this work plan.

¾ **PCB Material: The primary distinction between RM and LRM observed visually is viscosity and mobility in the environment. When appropriate, the term PCB Material will be used to include both RM and LRM.**

1.4 Previous Investigations

During previous site investigations RM was reported at several boring locations and LRM was observed at one monitoring well location (MW-12), as shown on Figure 1. When these borings were advanced, the sampling plan did not anticipate the presence of LRM, and did not include procedures for screening soil and sediment samples in the field to determine whether rubbery material was in a solid or flowable state in that sample.

According the OU-1 RI Report and confirmed by subsequent investigations, the RM is brown to grey in color and has an elastic consistency. The OU-1 RI Report indicates that when observed in boring locations, the RM was found as thin strings or as rubber-band like material. The OU-1 RI Report also indicates that during the installation of MW-12, LRM was observed (as evidenced by liquid droplets on the sampling equipment) and was described as "highly viscous DNAPL…brown to black in color" (IT Corporation, October 2000). The LRM in MW-12 was found to "harden rapidly when exposed to air" (IT Corporation, October 2000).

These observations have shown that LRM in MW-12 hardens and solidifies when it is exposed to air for a period of time, indicating that special procedures may be required to preserve samples in the field and in the laboratory to accurately identify samples of PCB Material in a solid state and in liquid state.

1.4.1 LRM Initial Monitoring Event

On 29 November 2006, the NYSDEC requested the LRM to be recovered from MW-12. Monitoring well MW-12 is located in the northwest corner of the Site, approximately 20 feet east of the shoreline (Figure 1). MW-12 was installed in March 1998. MW-12 was completed to a depth of 36 feet below ground surface (bgs) with a screen that is 3 feet long. During well installation the LRM was observed (as evidenced by liquid droplets on the sampling equipment) with ash and fine sand in the Fill unit between 32 and 35 ft bgs. The LRM was not reported in the soil log entries for the underlying marine silt layer. During a monitoring event completed in November 2006, 32 inches of the LRM was observed at the bottom of MW-12.

1.4.2 LRM Recovery Event

On 10 January 2007, LRM was recovered from MW-12 as specified in the Liquid Rubbery Matrix Recovery Plan prepared by Haley & Aldrich dated January 2007 (Appendix A). During this event, the following observations of the physical characteristics of the LRM were made:

- The LRM adhered to materials including:
  - Steel rods used for LRM depth measurements;
  - Stainless steel bailer cups used for LRM recovery;
  - Stainless steel spatulas used for sample collection;
  - Nitrile gloves used during the field events;
  - Polyvinyl chloride (PVC) gloves used during the field events;
  - Plastic sheeting used for ground surface protection during the field events;
  - Laboratory glassware used for sample collection;
  - Tyvek® personal protective suits used during the field events; and
  - Monitoring well outer casing.
- The LRM became more viscous when exposed to the atmosphere for a period of time.
- The LRM appeared to become significantly less adhesive when immersed in methylene chloride.
- The LRM appeared to become darker brown in color, slightly less adhesive and slightly less elastic when immersed in hexane.
- Initial laboratory observations indicated that the LRM became more viscous but remained adhesive when sealed in a nitrogen environment and continued to retain those properties during physical testing.

1.4.2.1 Sample Analyses

In addition to the LRM recovery, it was determined that additional information was required to evaluate LRM characteristics in preparation for this investigation. Information needed for this investigation includes evaluation of field exploration methods and full physical and chemical characterization of the LRM. The evaluations are described below and are summarized in Table 1 of Appendix A.

- Physical and chemical characteristics of the LRM;
- Fluorescence response to the LRM and RM for evaluation of Laser Induced Fluorescence (LIF).

- **Effectiveness of field tests, including field test kits, for identifying the presence of LRM; and**

- **Determination of wettability of LRM to steel.**

Preliminary results of the fluorescence response analysis and evaluation of field test kits have been received to date. These results confirm that field test kits will not be useful for this investigation due to the dark color of the LRM. In addition, preliminary data suggest that LRM does have a distinct fluorescence response. These preliminary data have been used to identify appropriate exploration methods for this investigation. However, final data resulting from these analyses may impact the field exploration locations and field exploration methods.

2. INTENT AND APPROACH

2.1 Investigation Goals

The overall goal of the investigation is to support the selection of the final bulkhead alignment, so as to minimize:

1. Creation of pathways for downward movement of PCB Material
2. "Drag-down" of PCB impacted soils and/or PCB Material during construction of the bulkhead.

The currently proposed northern bulkhead alignment, located north of the North Boat Slip, is shown in the 50% Design Report for OU-1 prepared by Haley & Aldrich dated July 2006.

The goal of this investigation will be met by collecting data of sufficient quality and quantity to support an evaluation of the presence of PCB Material along and in the vicinity of the northern bulkhead alignment.

2.2 Investigation Objectives

The specific data objectives of this work plan include:

Assess PCB Material Presence
Exploration locations will be completed in a phased approach, beginning with Phase 1 locations, as described below and illustrated in Figure 1. Completion of subsequent phases of exploration will be contingent upon results of the previous phase(s). This investigation approach is described further in Section 3.1.2.

¾ Phase I - Approximately 20 feet inboard from the currently proposed northern bulkhead alignment.

¾ Phase II – Approximately 20 feet and 40 feet outboard from the currently proposed northern bulkhead alignment

¾ Phase III - At the currently proposed northern bulkhead alignment.

Confirm Fill/Marine Silt Interface
Data obtained from this investigation will also be used to confirm stratigraphy in the vicinity of the currently proposed northern bulkhead alignment, with the intent of confirming top of Marine Silt elevations (IT Corporation, 2000) and determining the correlation between stratigraphy and the vertical extent of PCB Material. Further discussion of this portion of the investigation is found in Section 3.1.4.

2.3 Work Plan Approach

This Work Plan has been prepared to describe the proposed investigation activities to evaluate the presence of PCB Material.

Addenda to the existing Health and Safety Plan (HASP), Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), found in the Remedial Design Work Plan (Parsons, 2005), will be prepared upon NYSDEC approval of the investigation approach set forth and receipt of laboratory data to confirm applicability of selected field exploration methods.

2.4 Work Plan Organization

The Work Plan is organized as follows:

- **Section 1 – Introduction;**
- **Section 2 – Intent and Approach;**
- **Section 3 –Investigation Activities;**
- **Section 4 – Project Organization; and**
- **Section 5 – Schedule**

3. INVESTIGATION ACTIVITIES

3.1 Introduction

The following tasks have been identified to meet the goals and objectives discussed in Section 2.1.

3.1.1 Task 1: Field Reconnaissance, Utility Clearance and Field Marking

Proposed exploration locations shown on Figure 1 will be confirmed in the field and utility clearance will be completed prior to the commencement of the subject investigation. Exploration locations indicated on Figure 1 are subject to change based on access and site features such as utilities or subsurface obstructions. The distance of the exploration locations from the currently proposed bulkhead will be field adjusted to allow safe work adjacent to the river.

3.1.2 Task 2: PCB Material Delineation

The horizontal and vertical extent of the PCB Material located in the vicinity of the currently proposed northern bulkhead alignment will be evaluated by phased completion of exploration locations, as shown on Figure 1. The exploration locations are based on a 50 foot x 50 foot grid overlain on the site. Grid lines are labeled C through T (south to north) and 4 through 8 (west to east).

Proposed exploration locations will be biased towards areas where PCB Material has been observed.

A combination of visual and analytical field exploration methods will be used to delineate PCB material in the area of the currently proposed northern bulkhead alignment.

3.1.2.1 Exploration Locations

<u>Phase I</u>

Twenty-four exploration locations will be advanced using a traditional drilling method (mud-rotary, hollow-stem auger, geoprobe or other) on land to investigate the presence of PCB Material inboard of the bulkhead. These locations will be spaced approximately 50 feet apart and 20 feet east of the currently proposed bulkhead alignment with the exception of the former boat slip area (N, O, and P grid lines) and area where LRM was previously found at the fill/silt interface (P, Q, R and S grid lines). Exploration locations in this area will be spaced 25 feet apart in the north to south direction. All exploration locations will be advanced a minimum of 1 foot into the Marine Silt layer.

Phase II

Phase II will be conducted, if appropriate, following the evaluation of the data collected during Phase I. The current Phase II concept is to advance exploration locations in the area of gridlines #4 and #5 (Figure 1) to investigate previously reported sediment concentrations of PCBs in this area. These locations would be spaced approximately 50 feet apart from I through O and approximately 25 feet apart from P through S in the north to south direction. These locations would be offset approximately 20 feet (gridline #5) and 40 feet (gridline #4) outboard from the currently proposed northern bulkhead alignment, and advanced a minimum of 1 foot into the Marine Silt layer. The current concept is to advance one exploration location in the area of S6 and S7. Additional exploration locations may be added to define the boundaries of any LRM that is detected in the Phase I portion of the investigation or that is detected while Phase II is underway. Specific placement of exploration locations during this phase will be contingent upon data collected during Phase I.

Phase III

Phase III will be conducted, if appropriate, following the evaluation of the data collected during Phase II. The current Phase III concept is to advance exploration locations along the currently proposed northern bulkhead alignment to investigate the presence of PCB Material. These locations would be spaced approximately 50 feet apart, except in the P through S grid lines, where exploration locations may be spaced 25 feet apart. All borings will be advanced a minimum of 1 foot into the Marine Silt layer. All exploration locations will be advanced a minimum of 1 foot into the Marine Silt layer. Specific placement of exploration locations during this phase will be contingent upon data collected during Phase II.

3.1.2.2 Field Exploration Methods

Considered Methods

Several field exploration methods were evaluated for use during this investigation. These methods include visual observation, ROST™ Laser Induced Fluorescence Cone (LIF) (in-situ and ex-situ), ex-situ hydrophobic dye testing, and in-situ camera deployed on a Cone Penetrometer Test (CPT) rig. Based upon the current understanding of the PCB material, our preferred method of exploration is visual observation of cores with ex-situ LIF and soil sampling for chemical analysis of soil samples to confirm field observations.

During the LRM recovery on 10 January 2007, LRM samples were collected and sent to Kemron Environmental Services of Atlanta, Georgia to evaluate physical properties. As described in Section 1.4, specific analyses were requested to provide information to assist in assessing the field exploration methods under evaluation for the subject investigation, including fluorescent

response and response to hydrophobic dye such as Sudan IV. Based upon laboratory observations, the use of a hydrophobic dye test kit and in-situ camera cannot be applied due to the dark color of the material.

Selected Methods

Based upon initial laboratory observations, the following three methods have been chosen to be implemented at each exploration location to determine presence of LRM/RM.

Visual Observation

Exploration locations will be advanced using traditional drilling methods to a minimum of 1 foot into the Marine Silt layer, as described above. Continuous soil sampling will be performed and samples will be visually observed for presence of LRM/RM. Soil samples will be inspected with the use of a stainless steel spatula to observe evidence of adhesion to the spatula. Visual observations will be recorded both in writing and photographically.

The use of stereomicroscope has been reported to be applicable in this type of investigation. The use of this technology for this investigation is currently being evaluated.

Stratigraphy will also be confirmed using visual observation, as described in Section 3.1.4.

Laser Induced Fluorescence (LIF)

<u>Technical Overview</u>
The ROST™ Laser Induced Fluorescence Cone (LIF) is a hydrocarbon contamination detection system that provides qualitative indication of the relative presence of fluorescing chemicals. The LIF probe uses a pulsed laser to generate ultraviolet light that stimulates fluorescence in-situ. The return fluorescence can be sampled at specified wavelengths (ROST™ system), displayed as total spectra, or displayed as the most intense wavelength within the spectra.

<u>Site Applicability</u>
Due to the nature of the material, LIF deployed on a CPT rig could provide a false-positive response. As such, it is believed the ex-situ application of the LIF will provide a more accurate evaluation of the state of the subsurface as it relates to presence of the PCB Material.

Fluorescence response was one of the analyses performed to evaluate LRM characteristics and preliminary data indicates that LRM has a distinct response when introduced to ultraviolet light. RM has also been submitted for fluorescence response but preliminary data have not yet been received.

The LIF method will be field verified to evaluate the effectiveness of this method relative to site conditions. The verification test will consist of the following and is illustrated in Figure 1:

1. One exploration location will be advanced in an area where it is known that PCB Material does not exist. This would act as a background location providing a baseline spectrum of background materials.
2. One exploration location will be advanced near a location where RM was previously observed. This will establish a baseline spectrum or fingerprint of the RM to compare to spectra from subsequent locations.
3. One exploration location will be advanced near MW-12 where there is known presence of LRM. This will establish a baseline spectrum or fingerprint of the LRM to compare to spectra from subsequent locations.

3.1.3 Laboratory Verification Sampling

To confirm that both visual observations and LIF readings provide quality data, these methods will be supplemented by collecting and analyzing soil samples from a randomly chosen subset of exploration locations where LRM/RM is observed and also from exploration locations where LRM/RM is not observed. Soil samples will be analyzed for Total PCBs and Target Compound List (TCL) volatile organic compounds plus10 tentatively identified compounds (VO + 10). This list of analyses may be altered based on final results of the analyses described in Table 1 of Appendix A.

Representative soil sample will be collected from the following intervals for verification of field method results:

1. Where a high fluorescence response on the LIF spectrum is present or positive visual observation (LRM/RM present), as applicable.
2. Where a low fluorescence response on the LIF spectrum is present, as applicable.
3. Where an anomalous response on the LIF spectrum is present, as applicable.
4. Directly above the Marine Silt layer.

3.1.4 Task 3: Fill/Marine Silt Interface Confirmation

It has been previously suggested (IT Corporation, 2000) that "the most elevated PCB concentrations….are associated with a rubbery matrix or liquid rubbery matrix typically found at depth at the fill/Marine-Grey Silt interface." (IT Corporation, 2000). However, Figures 2A and 2B show that the PCB Material has been encountered both at the Fill/Marine Silt interface as well as further up in the Fill stratum.

To further assess existence of stratigraphic low areas in the Fill/Marine Silt interface and the relationship to LRM or RM, a secondary objective of the exploration program

will be to confirm stratigraphy near the currently proposed northern bulkhead alignment.

Stratigraphy of the area in the vicinity of the currently proposed bulkhead alignment will be completed by visually observing continuous soil samples collected during Task 2. Soil stratigraphy will be logged as specified in the SAP (Appendix A, RDWP).

3.1.5 Task 4: Exploration Locations Survey

Land-based explorations will be surveyed to obtain elevation and location information. Locations of water explorations will be determined using a GPS unit. If Phase II is required and exploration locations are completed in the river, then mudline elevation will be determined using a tide gauge that will be installed temporarily at the Site. Locations of the borings expected to be advanced at the shoreline will be determined using GPS, or estimated based on surrounding borings and site features, as appropriate.

4. PROJECT ORGANIZATION

The field investigation team will consist of the following:

- ¾ **Project Manager: Wayne C. Hardison, Haley & Aldrich**
- ¾ **Project Coordinator: Ban N. Aragona, Haley & Aldrich**
- ¾ **Senior Field Professional/Site Manager: To be determined, Haley & Aldrich**
- ¾ **Field Professionals: To be determined, Haley & Aldrich**
- ¾ **Health and Safety Professional: To be determined, ENSR**

The Data Release Report will be prepared by the above team, with assistance from OU-2 Project Manager Dave Hagen (Haley & Aldrich). Input from OU-2 Supplemental Feasibility Study technical experts will also be solicited.

5. SCHEDULE

The following is a proposed schedule of events subsequent to NYSDEC approval of this work plan:

- **Confirmation of selected exploration methods will commence following the receipt of results of the analyses described in Section 1.4 (expected by mid-February 2007).**
- **Commencement of the field investigation will occur 30 to 60 days following the selection of an exploration method and is contingent upon the availability of subcontractors and suitable site and weather conditions.**
- **The Phase I field event is expected to continue for 45 to 60 days upon commencement. This time frame may be extended as needed to accommodate site and weather conditions.**
- **Completion of data evaluation will occur over a 45 to 60 day period following the completion of the field event. This may be contingent upon laboratory turn around time and completion of data validation.**
- **A Data Release Report will be prepared to summarize the findings of the subject investigation. This will occur 60 days following the completion of data evaluation.**

REFERENCES

1. **IT Corporation (2000). *Remedial Investigation Report,* Harbor-at-Hastings Site, Hastings-on-Hudson, New York, NYSDEC Site Code #3-60-022, dated 27 October 2000.**

2. **Parsons (2005). *Remedial Design Work Plan,* Former Anaconda Wire & Cable Plant Site, Operable Unit No. 1, dated September 2004, Revised May 2005.**

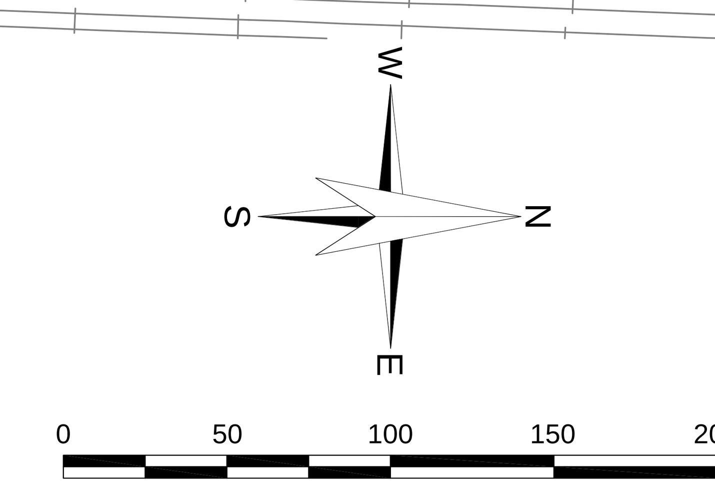
3. **Haley & Aldrich of New York (2006). *50% Design Report for Operable Unit NO.1 (OU-1),* dated July 2006.**

LEGEND:

- LIF VERIFICATION LOCATION
- PHASE I EXPLORATION LOCATION
- PHASE II EXPLORATION AREA
- PHASE III EXPLORATION AREA
- MW-12 LIQUID RUBBERY MATRIX OBSERVED
- RB-02 RUBBERY MATRIX OBSERVED
- BULKHEAD ALIGNMENT (AS PROPOSED IN 50% DESIGN)

NOTES:

1. EXPLORATION LOCATIONS ARE BASED ON SURVEY CONDUCTED BY BOSWELL ENGINEERING IN NOVEMBER 2005. ADDITIONAL LOCATION INFORMATION PROVIDED BY ENVIRONMENTAL STANDARDS, INC. AND LEGACY SURVEY INFORMATION WAS PROVIDED IN THE ATLANTIC RICHFIELD COMPANY FORMER AWC PLANT SITE REMEDIAL DESIGN INFORMATION REQUEST PREPARED BY PARSONS IN JULY 2005.
2. BASE MAP PROVIDED BY BOSWELL ENGINEERING DRAWING NO. 04-209-MW (01/27/2006).
3. THE "LIQUID RUBBERY MATRIX OBSERVED" AND THE "RUBBERY MATRIX OBSERVED" SYMBOLS WERE USED ONLY AT LOCATIONS WHERE THE BORING LOG DESCRIPTION INCLUDES THE WORD "RUBBERY". NO OTHER INTERPRETAION WAS ATTEMPTED FOR VARIOUS DIFFERENT BUT POTENTIALLY APPLICABLE BORING LOG DESCRIPTIONS .



HALEY & ALDRICH

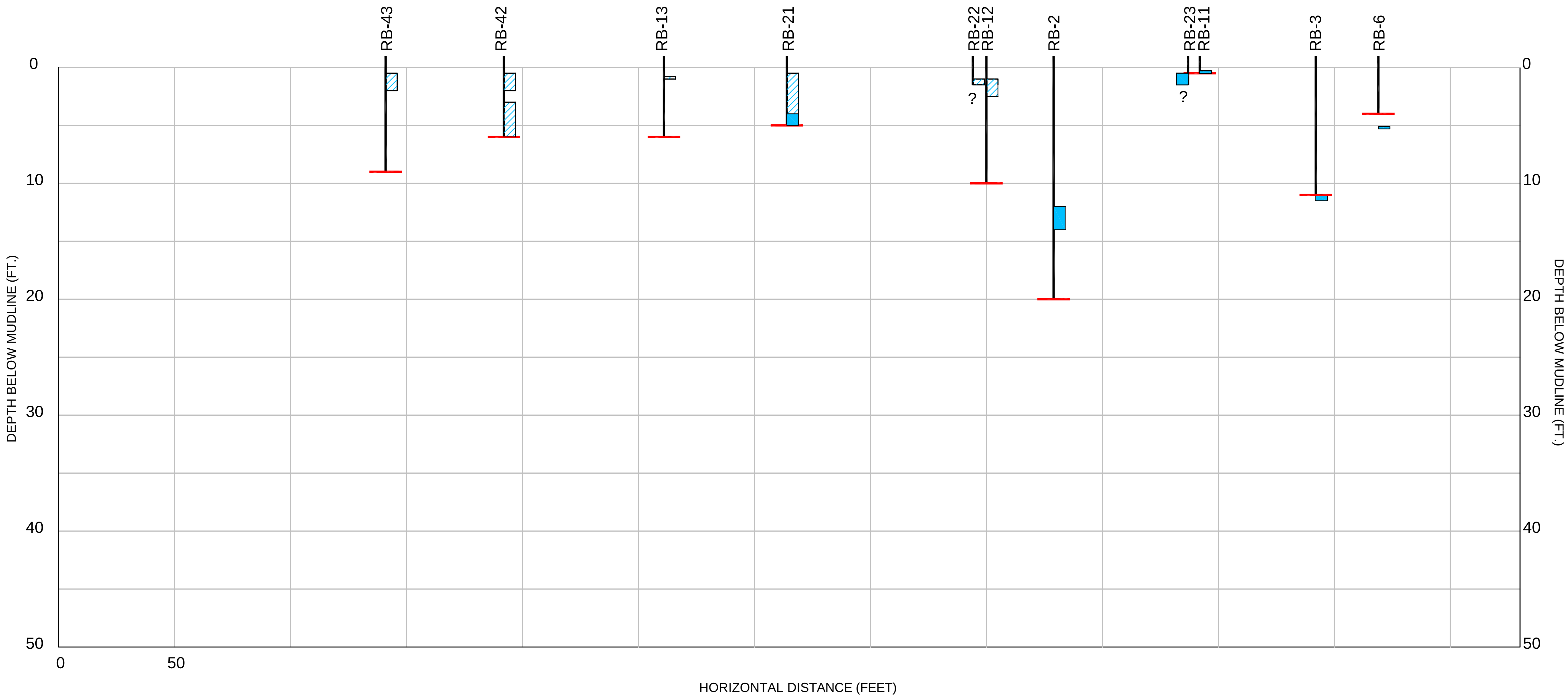
OU-1 REMEDIATION
NYSDEC SITE #3-60-022
1 RIVER STREET
HASTINGS-ON-HUDSON, NEW YORK

SUPPLEMENTAL NORTHWEST CORNER INVESTIGATION - EXPLORATION LOCATIONS

SCALE: AS SHOWN
JANUARY 2007

FIGURE 1

G:\28612\300 LRM DELINEATION\28612-116-DNAPL LOCATION PLAN.DWG



LEGEND

- DEPTH OF MARINE SILT
- ZONE OF PCB MATERIAL OBSERVED
- ZONE OF "TRACE" PCB MATERIAL OBSERVED
- ? DEPTH TO MARINE SILT NOT DETERMINED

NOTES

1. PROFILE IS BASED ON A FLAT PROJECTION OF BORINGS ONTO AN ARBITRARY NORTH-SOUTH LINE.
2. SOME BORINGS WERE SHIFTED SLIGHTLY ALONG THE HORIZONTAL AXIS FOR CLARITY PURPOSES.
3. PROFILE IS FOR REFERENCE PURPOSES ONLY AND IS BASED ON INFORMATION SUMMARIZED FROM BORING LOGS PREPARED BY OTHERS.
4. THE "PCB MATERIAL OBSERVED" DESIGNATION WAS USED ONLY AT LOCATIONS FOR WHICH THE BORING LOG DESCRIPTION INCLUDES THE WORD "RUBBERY". NO OTHER INTERPRETAION WAS ATTEMPTED FOR VARIOUS OTHER DIFFERENT BUT POTENTIALLY APPLICABLE BORING LOG DESCRIPTIONS.

HORIZ. 0 50 100
VERT. 0 10 20
SCALE IN FEET

HALEY & ALDRICH

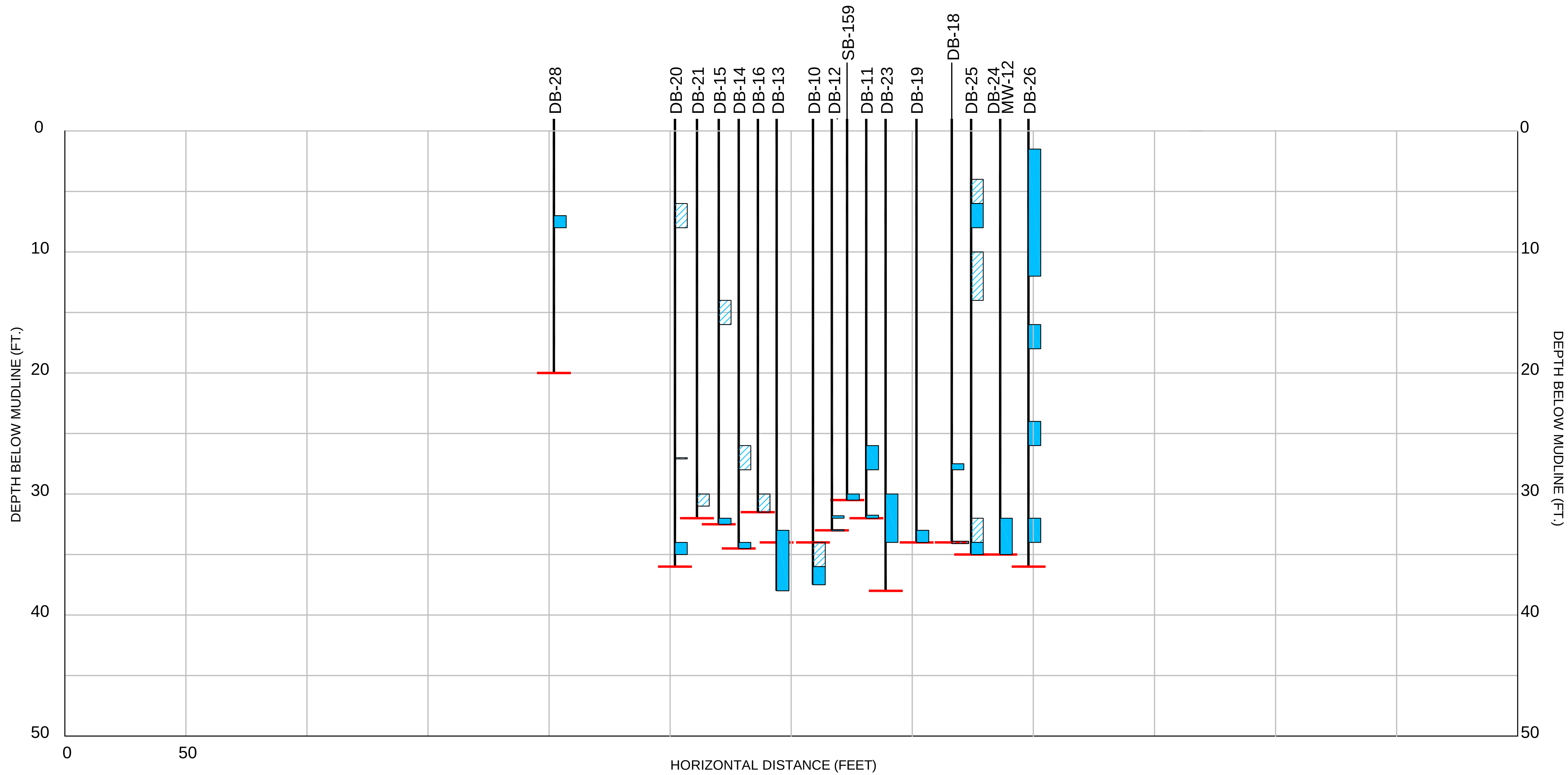
OU-1 REMEDIATION
NYSDEC SITE #3-60-022
1 RIVER STREET
HASTINGS-ON-HUDSON, NEW YORK

WATER SUBSURFACE PROFILE SHOWING ZONES OF LRM/RM ENCOUNTERED IN BORINGS

SCALE: AS SHOWN
JANUARY 2007

FIGURE 2A

G:\28612\300\28612-002-0B01-DNPL.DWG



LEGEND

NOTES

1. PROFILE IS BASED ON A FLAT PROJECTION OF BORINGS ONTO AN ARBITRARY NORTH-SOUTH LINE.
2. SOME BORINGS WERE SHIFTED SLIGHTLY ALONG THE HORIZONTAL AXIS FOR CLARITY PURPOSES.
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HORIZ. 0 50 100
VERT. 0 10 20
SCALE IN FEET

HALEY & ALDRICH

OU-1 REMEDIATION
NYSDEC SITE #3-60-022
1 RIVER STREET
HASTINGS-ON-HUDSON, NEW YORK

LAND SUBSURFACE PROFILE
SHOWING ZONES OF LRM/RM
ENCOUNTERED IN BORINGS

SCALE: AS SHOWN
JANUARY 2007

FIGURE 2B

G:\28612\300\28612-002-0B01-DNPL.DWG

APPENDIX A

LIQUID RUBBERY MATRIX RECOVERY PLAN

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LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

HSSEP	**Health, Safety, Security, and Environment Plan**
IT	**IT Corporation**
JSA	**Job Safety Analysis**
LMP	**LRM Monitoring Procedure**
LRM	**Liquid Rubbery Matrix**
LSP	**LRM Sampling Procedure**
MW-12	**Monitoring Well 12**
O&M	**Operations and Maintenance**
PCB	**Polychlorinated Biphenyl**
PCN	**Polychlorinated Naphthalene**
PCT	**Polychlorinated Terphenyl**
PFD	**Personal Floatation Device**
PID	**Photoionization Detector**
PPE	**Personal Protective Equipment**
RP	**Liquid Rubbery Matrix Recovery Plan**
RSD Report	**Recovery System Design Report**
SVOCs	**Semi-Volatile Organic Compounds**
USCG	**U.S. Coast Guard**
VOCs	**Volatile Organic Compounds**

1. INTRODUCTION

1.1 RP Goals and Objectives

The liquid rubbery matrix (LRM) recovery plan (RP) was prepared to describe the activities intended to evaluate character and recoverability of the LRM observed in monitoring well 12 (MW-12) in order to design an effective recovery system.

Specifically, the RP will:

- **Determine the physical and chemical characteristics of the LRM;**
- **Evaluate the effectiveness of field test kits for identifying the presence of LRM in soil samples;**
- **Evaluate the effectiveness of technologies for delineating the vertical and horizontal extent of LRM in the subsurface;**
- **Evaluate the recoverability of the LRM within the vicinity of MW-12; and**
- **Design an effective and efficient method for removing the LRM at or near MW-12.**

1.2 LRM Recovery and Design Plan Organization

The RP is organized as follows:

- **Section 1 – Introduction**
- **Section 2 – Health and Safety**
- **Section 3 – RP Field Activities**
- **Section 4 – LRM Characterization and Recoverability**
- **Section 5 - Reporting**
- **Section 6 – References**

2. HEALTH AND SAFETY

2.1 Health, Safety, Security and Environment Plan

Health and safety requirements applicable to all persons entering the secured location or involved in field activities are described in the Site-specific Health, Safety, Security and Environment Plan (HSSEP). A Job Safety Analysis (JSA) has been prepared for the field activities described in this Work Plan and is provided in the HSSEP. Personal Protective Equipment (PPE) will be in accordance with the site-specific HSSEP and JSA.

2.2 Limiting Weather Conditions

To prevent cold stress, frost bite, or other injuries and property damage associated with cold weather, a set of minimum weather condition requirements has been established for the field activities described in the RP. If the weather conditions on the day of scheduled field activities do not meet the minimum requirements, field activities will be delayed and rescheduled for a later date. The weather conditions required to conduct field activities are as follows:

- **Temperature of 32°F or above**
- **Wind speed of 20 mph or below**
- **Wind chill of 20°F or above**
- **No heavy snow, rain, or freezing rain**

2.3 Site Conditions

The ground surface in the vicinity of MW-12 is uneven with some vegetation and debris. Prior to the LRM removal and sampling event, the ground surface in the vicinity of MW-12 will be leveled and cleared of debris and vegetation. This will reduce potential slip, trip, and fall hazards and improve access to well.

The shoreline and rip rap is located approximately 15 feet west of MW-12. Field activities will be conducted on the east side of the monitoring well and care will be taken to avoid working near the shoreline or rip rap. Field personnel will not be permitted on the rip rap or within 10 feet of the shoreline. U.S. Coast Guard (USCG) approved Personal Flotation Devices (PFDs) including life vests, float coats, and floatation suits must be worn by all persons working near or around the shoreline. Ring buoys with at least 90 feet of line will be located within 20 feet of the shoreline. A buddy-system will be implemented so field personnel are able to monitor and assist each other when working near or around the shoreline.

3. RP FIELD ACTIVITIES

The fieldwork described in the RP will be implemented in two phases. The first phase (Field Event 1) will consist of a two day field event and will focus on the recovery and sampling of LRM. The second phase of the RP (Field Event 2) will be a prolonged field event and will consist of measuring fluid levels in MW-12 on a periodic basis to monitor the recharge of LRM.

3.1 Field Event I: LRM Removal and Sampling

3.1.1 Task 1: Measure Initial Fluid-levels in MW-12

Fluid-levels will be measured prior to LRM removal to establish the pre-existing condition in MW-12. Due to the high viscosity of the material, the LRM-thickness in the well will be measured using a series of threaded stainless-steel rods. The fluid-level measurement procedure is described in detail in the LRM Sampling Procedure (LSP) document, provided in Attachment 1.

3.1.2 Task 2: Collect Samples for LRM Characterization

Samples of LRM will be collected from MW-12 to evaluate the physical and chemical properties of the fluid. Due to the high viscosity of the fluid, the LRM will be sampled using a modified bailer device attached to a series of stainless-steel threaded rods. The LRM sampling procedure is outlined in detail in the LSP, provided in Attachment 1.

3.2 Field Event II – LRM Recovery Monitoring

LRM will continue to be evacuated from the well until all accessible LRM is removed. Fluid-levels in MW-12 will be measured and recorded immediately following the removal of LRM. The volume of LRM removed will be estimated and recorded. Fluid levels will be measured in MW-12 on a periodic basis as described in the LRM Monitoring Procedure (LMP) document, provided in Attachment 2.

4. LRM CHARACTERIZATION AND RECOVERABILITY

4.1 Chemical Characterization

A suite of chemical analyses will be conducted on the LRM to identify the chemical composition of the material. This chemical profile will be useful for evaluating remediation methods and determining appropriate disposal methods for the LRM. The chemical profile may also be useful in future subsurface investigations for identifying the presence of LRM or LRM by-products. The LRM will be analyzed for polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs), polychlorinated naphthalenes (PCNs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and mercury. Laboratory method descriptions for chemical analyses are presented in Table 1.

4.2 Physical Characterization

A number of laboratory tests will be conducted on the LRM to identify the physical properties of the material. LRM physical properties to be tested include viscosity, density, conductivity, fluorescent response, and wet-ability to steel. Viscosity and density results will provide information for evaluating potential recovery and remediation methods. Fluorescent response and conductivity results will provide information for assessing exploration methods for future subsurface investigations. The wet-ability to steel experiment will provide information for determining how LRM will react when in contact with steel. Laboratory method descriptions for physical analyses are provided in Table 1.

The IT Corporation (IT) collected samples of the LRM and analyzed it for various parameters including viscosity and specific gravity (IT, October 2000). The material was determined to have a specific gravity of 1.281 grams per cubic centimeter (g/cc) and viscosities of 51,680, 19,590, 2,603, and 395 CentiPoises (cp) at temperatures of 10.0, 21.0, 38.0, and 60.0 °C (IT, October 2000).

4.3 Field Test Kit Evaluation

Several field test kits will be evaluated to determine their effectiveness in identifying LRM constituents in the soil. Field test kits that successfully identify LRM constituents in the soil matrix will be considered for use in future subsurface investigations. Field test kits that fail to identify LRM constituents will not be considered for future subsurface investigations. The following test kits will be evaluated:

- Sudan IV® Test Kit – Screens soil for the presence of petroleum products
- Chlor-N-Soil Test Kit – Screens soil for the presence of PCBs
- Hanby Soil Test Kit – Screens soil for the presence of petroleum products

Field test kits will be evaluated in the laboratory. Method descriptions for each test kit are provided in Table 1.

4.4 LRM Recoverability

Long-term monitoring of the LRM thickness in MW-12 following the evacuation event will provide a general understanding of the recoverability of the material in the well. If LRM recharge occurs in the well over time, an approximate recovery rate may be calculated. The LRM recoverability combined with the results of the chemical and physical analyses will be used in the evaluation of various recovery methods and technologies.

5. REPORTING

5.1 Recovery System Design Report

The Recovery System Design Report (RSD Report) will present data that have been gathered as part of the RP. The RSD Report will present an analysis of the data that was gathered and will present a design of the recommended recovery method. The RSD Report will be submitted to the NYSDEC and will contain the following:

¾ Recovery System Design and Drawings

¾ Recovery System Specifications

¾ Recovery System Operating Procedures

¾ Operation and Maintenance Schedule

REFERENCES

1. **IT Corporation (2000). Remedial Investigation Report, Harbor-at-Hastings Site, Hastings-On-Hudson, New York, NYSDEC Site Code #3-60-22.**

TABLE 1
SUMMARY OF PHYSICAL AND CHEMISTRY ANALYSES

PHYSICAL ANALYSES		
Parameter	**Sample Matrix**	**Method Description**
Density	LRM	Seven (7), 15-gram LRM samples will be collected and exposed to room temperature. Density testing will be conducted at specific time intervals by measuring the displacement of water achieved by 15 grams of LRM. Density testing will be performed at 0, 1, 2, 3, 4, 24, and 48 hours to observe any changes in density over time.
Viscosity	LRM	LRM viscosity will be tested by ASTM method D2196 using a Rotational (Brookfield) Viscometer at temperatures of 10, 21, 38, and 60 ^{o}C.
Conductivity	LRM & Groundwater	Conductivity of the LRM will be measured using a conductivity meter. A groundwater sample will be collected from the Site and also tested for conductivity.
Fluorescence	LRM	LRM will be subjected to a Ultraviolet Visible Spectrometer to measure absorbance. The characteristic fluorescence response wavelengths of the LRM will be determined using a fluorometer.
Wet-ability	LRM & Soil	The wet-ability experiment will be conducted within an aquarium or equivalent containing a layer of soil saturated with water overlying a layer of soil saturated with LRM to mimic site conditions. A piece of steel similar to what will be used in the field will be immersed in the soil and then removed to observe if any LRM adhered to the steel. This will be measured by visual observation and wipe sample collection. Soil collected from the Site will be used in this experiment.
OilScreenSoil (Sudan IV)® Test Kit	LRM & Soil	The OilScreenSoil (Sudan IV)® Field Test Kit will be tested for its effectiveness in identifying the presence of the LRM in soil. LRM mixed with soil collected from the Site will be added to the sample container with water and then shaken vigorously. Petroleum products will be dyed red in the sample container.
Dexsil Chlor-N-Soil PCB Screening Kit	LRM & Soil	The Dexsil Chlor-N-Soil PCB Screening Kit will be tested for its effectiveness in identifying the presence of the PCBs in soil. A sodium reagent will be added to LRM mixed with soil collected from the Site to dissociate the PCBs and freeing the chloride ions. The chloride ions will react with mercury ions to form a mercury chloride extract. Diphenylcarbazone is added to the extract, which reacts with free mercuric ions to form a purple color. The less purple color, the greater the concentration of PCBs.
Hanby Soil Test Kit	LRM & Soil	The Hanby Soil Field Test Kit will be tested for its effectiveness in detecting the concentrations of petroleum products in soil. LRM mixed with soil collected from the Site will be weighed and added to a beaker. A solvent will be added and mixed with the soil will produce an extract, which will be poured into a test tube. A catalyst will be added and mixed in with the extract to produce a color. The test tube color is compared with the color ID card to determine the approximate concentration of the petroleum products.

TABLE 1
SUMMARY OF PHYSICAL AND CHEMISTRY ANALYSES

CHEMISTRY ANALYSES		
Parameter	**Sample Matrix**	**Method Description**
Target Compound List (TCL) plus Tenatively Identified Compounds (TICs) Volatile Organic Compounds (VOCs)	LRM	EPA SW-846 Method 8260
TCL plus TICs Semi-volatile Organic Compounds (SVOCs)	LRM	EPA SW-846 Method 8270
Polychlorinated biphenyls (PCBs)	LRM	EPA SW-846 Method 8082
Polychlorinated naphthalenes (PCNs) and Polychlorinated terphenyls (PCTs)	LRM	GC-MS-SIM PCB analysis
Target Analyte List (TAL) Metals	LRM	EPA SW-846 Method 6010
Mercury	LRM	EPA SW-846 Method 7471

ATTACHMENT 1

LIQUID RUBBERY MATRIX SAMPLING PROCEDURE

1. LIQUID RUBBERY MATRIX SAMPLING PROCEDURE

Samples of Liquid Rubbery Matrix (LRM) will be collected from well MW-12 to evaluate the physical and chemical properties of the fluid. Due to the high viscosity of the fluid, the LRM will be sampled using a modified bailer device attached to a series of stainless-steel threaded rods. The LRM removal and sampling equipment and procedures are described below.

1.1 EQUIPMENT

- **PPE in accordance with HSSEP**
- **First Aid Kit**
- **Eye Wash**
- **Field book, forms, and project plans**
- **Digital Camera**
- **Video Camera**
- **Decontamination supplies**
- **Plastic sheeting**
- **PID with 10.6 eV lamp**
- **Water-level indicator**
- **6 foot lengths of 3/8 inch stainless-steel threaded rods**
- **3/8 inch stainless-steel couplings**
- **Stainless-steel modified bailer sampling devices**
- **Stainless-steel spatulas for filling sample containers**
- **Shovel**
- **Disposable polyethylene bailer**
- **Clamps to secure rods to well casing**
- **Nitrogen tank and regulator**
- **Compressed gas tubing**
- **Parafilm**
- **Laboratory coolers and sample containers**

1.2 HEALTH AND SAFETY

Health and safety requirements applicable to all persons entering the secured location or involved in field activities are described in the Site-specific HSSEP.

1.3 AIR MONITORING

Air monitoring will be conducted during all field activities with a photoionization detector (PID) equipped with a 10.6 eV lamp.

1.4 FLUID LEVEL MEASUREMENTS

The following procedure will be used to measure fluid levels in well MW-12:

- **The electronic water-level probe will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **The static water-level will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the casing.**
- **The threaded steel rods will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **The LRM-level will be measured by lowering a series of 6 foot threaded stainless-steel rods connected by stainless-steel couplings. Lower the stainless-steel rods until the bottom of the lowest rod encounters the bottom of the well. Remove the stainless-steel rods and measure the LRM thickness to the nearest 0.04 foot.**
- **Record measured fluid levels on the appropriate field forms.**

1.5 LRM REMOVAL AND SAMPLE COLLECTION

The following procedure will be used to remove and collect samples of LRM from well MW-12:

1.5.1 Removing LRM from Monitoring Well

- **The threaded stainless-steel rods will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **The stainless-steel sampling devices will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **Attach sampling device to the end of a 6 foot stainless-steel threaded rod. The sampling devices varying in length from 3 inches to 6.25 inches. The 6.25 inch sampling device will be used to start purging the LRM. The shorter sampling devices will be used as the level of LRM in the well is reduced during purging activities.**
- **Lower the sampling device and rod down the well until the upper end of the threaded stainless-steel rod is approximately 6 inches above the top of casing.**
- **Use the clamping device to secure the rod to the well casing. Attach a 6 foot stainless-steel rod extension to the rod in the well using a stainless-steel coupling. Release the**

clamping device while holding the rod and gently lower the sampling device down the well. When the end of the rod extension is approximately 6 inches above the top of casing, secure the rod with the clamping device and repeat the required steps to attach the rod extension. Continue this procedure until the sampling device encounters the LRM.

- **Once the LRM has been encountered, push the sampling device into the LRM until it is completely submerged. Allow three to five minutes for the LRM to displace the groundwater and fill the sampling device.**
- **Gently raise the steel rods until the sampling device is approximately 1 foot below the water-level in the well.**

1.5.2 Collecting LRM Sample

Collecting LRM Samples for Chemical Analysis

- **Raise the sample device out of the water and remove from the well.**
- **Remove the sample device from the stainless-steel rod and place into 2.5 liter amber sample container.**
- **Samples will be collected in 2 sets of 5 separate sample containers for chemical analysis. The following is a list of the sample containers and associated preservatives for chemical analysis:**
    - **One 40 ml amber vial with methanol – 1 gram (1/3 teaspoon)**
    - **One 40 ml amber vial with methyl chloride – 1 gram (1/3 teaspoon)**
    - **One 40 ml amber vial with hexane – 1 gram (1/3 teaspoon)**
    - **Two hot block tubes with deionized water – 1 gram (1/3 teaspoon)**
- **Transfer approximately 1 gram of sample from sampling device to appropriate sample container using a stainless-steel spatula.**
- **Place sample container in laboratory cooler and pack with foam to assure that samples stay upright.**
- **STL will pick up the remaining samples for chemical analysis at noon on Thursday, January 11.**

Collecting LRM Samples for Physical Analysis

- **Raise the sample device out of the water and remove from the well.**
- **Remove the sample device from the stainless-steel rod and place into appropriate sample container.**

- **Eight (8) samples will be collected for physical analysis and placed in sample containers filled with nitrogen gas or deionized water.**
    - **Four (4) of the LRM samples will be placed in sample containers filled with nitrogen gas.**
    - **Four (4) of the LRM samples will be placed in sample containers filled with deionized water.**
- **Fill headspace with appropriate substance, close sample container, and seal lid with parafilm.**
- **Place sample container in laboratory cooler and pack with foam to assure that samples stay upright.**
- **Samples for physical analysis will be shipped FedEx ground to Kemron.**

1.5.3 Additional Sample Collection

- **Collect one groundwater sample in a 1 liter sample bottle using a polyethylene disposable bailer.**
- **Collect one surface soil sample in a 2.5 liter sample bottle using a shovel or hand auger.**
- **Ship soil and groundwater samples to Kemron.**

ATTACHMENT 2

LIQUID RUBBERY MATRIX MONITORING PROCEDURE

2. LIQUID RUBBERY MATRIX MONITORING PROCEDURE

Liquid rubbery matrix (LRM) levels will be monitored periodically to determine the rate of recovery following the removal of LRM from MW-12. Due to the high viscosity of the fluid, the LRM will be gauged using a series of stainless-steel threaded rods. The LRM recovery monitoring equipment, procedure, and schedule are described below.

2.1 EQUIPMENT

- **PPE in accordance with HSSEP**
- **Recovery Monitoring Field Form**
- **Decontamination supplies**
- **Water-level indicator**
- **6 foot lengths of 3/8 inch stainless-steel threaded rods**
- **3/8 inch stainless-steel couplings**
- **Clamps to secure rods to well casing**

2.2 HEALTH AND SAFETY

Health and safety requirements applicable to all persons entering the secured location or involved in field activities are described in the Site-specific HSSEP.

2.3 FLUID LEVEL MEASUREMENTS

The following procedure will be used to measure fluid levels in well MW-12.

- **The electronic water-level probe will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **The static water-level will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the casing.**
- **The threaded steel rods will be decontaminated with a detergent solution, tap water rinse, and distilled water rinse.**
- **The LRM-level will be measured by lowering a series of 6 foot threaded stainless-steel rods connected by stainless-steel couplings. Lower the stainless-steel rods until the bottom of the lowest rod encounters the bottom of the well. Remove the stainless-steel rods and measure the LRM thickness to the nearest 0.04 foot.**
- **Record measured fluid levels on the appropriate field form.**

2.4 RECOVERY MONITORING SCHEDULE

Fluid level measurements will be taken once a week following the removal of LRM from well MW-12. Recovery monitoring will continue until LRM thickness has ceased to significantly increase in the well. Fluid level data will be recorded on the recovery monitoring field form and reported by Haley & Aldrich via e-mail on a weekly basis.