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1.0 INTRODUCTION

1.1 Background

On behalf of Raytheon Company (Raytheon), Environmental Resources Management (ERM) has prepared this Scope of Work to conduct additional assessment activities related to the northern portion of the approximately 83-acre property located at 430 Boston Post Road in Wayland, Massachusetts (defined as the "Site," Figures 1 and 2). These activities will be conducted as Preliminary Response Actions pursuant to the Massachusetts Contingency Plan (MCP; 310 CMR 40.0000). This Scope of Work is not required under the MCP, but was prepared in an effort to keep the public and Massachusetts Department of Environmental Protection (DEP or Department) informed regarding ongoing subsurface investigation activities at the Site.

As part of ongoing comprehensive response actions at the Site (RTN #3-13302 and Tier IB Permit No. 133939), a series of groundwater characterization activities were conducted during Summer 2002. These activities were presented to the Department in a "Revised Scope of Work: Additional Site Characterization Activities," dated 20 June 2002. Results of these activities were presented in the Phase IV Remedy Implementation Plan (RIP, 2002). These activities identified the following release conditions to groundwater in excess of applicable Reportable Concentrations (RCGW-1):

- chlorinated volatile organic compounds (CVOCs) tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE) and vinyl chloride (VC) in the northern portion of the Site (hereafter referred to as the Northern Area);
- arsenic in the western portion of the Site (hereafter referred to as the Western Area); and
- methyl tert butyl ether (MTBE) in the southern portion of the Site (hereafter referred to as the Southern Area).

On behalf of Raytheon, ERM submitted a Release Notification Form (RNF, BWSC-103) to the Department on 17 December 2002, pursuant to 310 CMR 40.0315(1). The Department issued a Notice of Responsibility and RTN #3-22408 on 16 January 2003 for the RNF. The two Site boundaries for RTN #3-22408 and RTN #3-13302 (Tier IB Permit No. 133939) are generally co-located, based on data available to date. However, the two RTNs are being treated separately under the MCP to minimize delays in response actions on either portion of the Site.

The investigation activities described in Section 2.0 of this report

1.2 *Purpose and Scope*

The purpose of this document is to present:

- Site characterization data generated since preparation of the Phase IV RIP in December 2002; and

- proposed Site investigation activities focused on further evaluating the nature and extent of CVOC impacts to groundwater in the Northern Area.

The scope of the proposed investigation is to:

- evaluate the potential for CVOCs in groundwater to impact the Baldwin Pond Wellfield; and

- further characterize the nature and extent of CVOC impacts to groundwater.

1.3 *Report Organization*

This Scope of Work is organized as follows:

Section 1.0 *Introduction* – presents the background, purpose and scope of the Scope of Work.

Section 2.0 *Northern Area Assessment Activities* – presents methods, results and discussion related to Northern Area investigation activities conducted since December 2002, as well as a Conceptual Site Model (CSM) and assessment strategy. Groundwater investigation results for CVOCs from January 2003, presented in Section 2.2, are slightly elevated in comparison to the December 2002 field screening data.

Section 3.0 *Wetland Assessment Activities* – presents methods and results related to wetland investigation activities conducted since December 2002.

Section 4.0 *Scope of Work* – presents proposed Site investigation activities to be conducted under RTN #3-22408 during calendar year 2003 prior to submission of the Phase I – Initial Site Investigation report.

2.0 NORTHERN AREA ASSESSMENT ACTIVITIES

This section presents the methods, results and discussion relative to data collected in the Northern Area since December 2002. Previous data were reported in the Phase IV RIP (ERM, 2002). The groundwater investigation results from the January 2003 sampling event, presented in Section 2.2, are slightly elevated in comparison to the December 2002 field screening data.

2.1 Methods

Borehole Advancement and Well Installation

The purpose of this task was to collect soil samples, evaluate subsurface geologic conditions and install permanent monitoring wells. Permanent overburden and bedrock monitoring wells were installed in the Northern Area to determine groundwater flow directions and gradients, and to characterize groundwater chemistry. Monitoring well locations were selected based on VOC field screening data generated during Summer 2002 using the Modified Waterloo Profiler and input from the Town of Wayland (ERM, 2002).

Boreholes were advanced using truck-mounted drill rigs and an all-terrain vehicle (ATV) drill rig. Boreholes were advanced using hollow-stem auger (HSA), drive and wash casing, and air rotary drilling techniques. Soil samples were collected at various intervals in each boring and screened for total VOCs using a photoionization detector (PID) and the jar headspace method. One soil sample from the unsaturated zone from each well cluster was collected and submitted for laboratory analysis for VOCs by EPA Method 8260/5035. The soil sample depth was selected to coincide with the highest PID reading measured above the water table or the sample located immediately above the water table if no PID readings were measured above the instrument detection limit. Soil samples were not collected from below the water table because it is difficult to differentiate between VOCs present in groundwater contained within the soil matrix versus VOCs present in soil only.

Dates of drilling activities and borehole/monitoring well numbers for the Northern Area are presented below (see Figure 3 for locations):

- From 3 December through 28 December 2002, 26 overburden-monitoring wells (MW-261S, MW-262S/M/D, MW-263S/M, MW-264S/M/D, MW-265S/M/D, MW-266S/Ma/Mb/D, MW-267S/M/D, MW-268S/M/D, and MW-269S/Ma/Mb/D) were installed.
- From 31 December 2002 through 3 January 2003, three shallow bedrock

monitoring wells (MW-266B, MW-267B, and MW-268B) were installed.

A combination of single monitoring wells and monitoring well clusters were installed. Multiple data sources were used to determine well screen intervals and lengths, including:

- lithology;
- PID field screening results; and
- Previous Modified Waterloo Profiler field screening data.

Table 1 presents the rationale used in determining each well screen placement.

Surveying and Water Elevation Measurement

To accurately determine groundwater elevations and flow directions, ERM subcontracted Chas. H. Sells, Inc. to survey the locations and elevations of the newly installed monitoring wells in the Northern Area. Elevations were surveyed relative to mean sea level in January 2003. On 6 and 7 January 2003, ERM gauged depths to groundwater in 30 wells (29 new wells plus one existing well) in the Northern Area.

Groundwater Sampling

The purpose of this task was to collect groundwater quality data from the newly installed wells (plus MW-TP-3). Prior to the sampling of each well, ERM gauged the depth to groundwater using an electronic water-level indicator. Groundwater samples were collected using low-flow sampling techniques. Physico-chemical parameters (pH, temperature, specific conductance, dissolved oxygen and oxidation-reduction potential (ORP)) were monitored during purging until equilibration was achieved prior to collecting groundwater samples for laboratory analyses. Groundwater samples were collected and analyzed as detailed below:

- On 6 and 7 January 2003, ERM collected groundwater samples from 28 wells (MW-262 S/M/D, MW-263 S/M, MW-264 S/M/D, MW-265 S/M/D, MW-266 S/Ma/Mb/D/B, MW-267 S/M/D/B, MW-268 S/M/D/B, and MW-269 S/Ma/Mb/D) for laboratory analysis of VOCs by EPA Method 8260.
- On 7 an 8 January 2003, ERM collected groundwater samples from existing well MW-TP-3 and newly installed well MW-261S for laboratory analyses of the following parameters:
    - VOCs by EPA Method 8260
    - Physiologically available cyanide by the DEP Method

- Boron by EPA Method 200.7/6010B
- Phosphorous by EPA Method 365.2
- Chloride by EPA Method 325.2
- Fluoride by EPA Method 300.0
- Ammonia as Nitrogen by EPA Method 350.1
- Nitrate as Nitrogen by EPA Method 350.1
- Aldehydes by EPA Method 8315
- Alcohols by ASTM D 3695
- Glycols by ASTM E 202
- Polychlorinated dibenzo-p-dioxins (PCDDs) by EPA Method 1613b
- Polychlorinated dibenzo-p-dibenzofurans (PCDFs) by EPA Method 8290
- Polychlorinated biphenyls (PCBs) by EPA Method 8082
- Polynuclear aromatic hydrocarbons (PAHs) by EPA Method 8270

- On 31 January, 17 February, and 12 March 2003, ERM collected groundwater samples from well MW-268B for laboratory analyses of VOCs by EPA Method 8260 to further evaluate inconsistent low-level detections of tetrahydrofuran in this well.

Hydrochemical Facies Analysis

ERM conducted a hydrochemical facies analysis (HFA) in the Northern Area in an effort to:

- identify and differentiate sources of VOCs;
- differentiate between plumes or delineate overlapping plumes, if appropriate; and
- evaluate fate mechanisms.

A HFA evaluates degradation pathways of parent VOCs using trilinear diagrams. The advantage of a trilinear diagram is that it allows for simultaneous comparison of the relative molar ratios of three compounds. The HFA process involves two steps. First, a series of “rules” are developed that predict the expected behaviors of three different constituents in groundwater (e.g., TCE, cDCE, and VC) under various fate mechanisms (e.g., biodegradation, sorption or partitioning to the vapor phase). Then, VOC concentration data from the Site are plotted and evaluated to identify the fate mechanisms occurring at the Site. HFA is a useful tool to demonstrate the signature of the source area(s) and the evolution of a groundwater plume as it migrates away from the source area(s). This can be used to track the migration pathway of a plume from its source area. If chemical data are substantially different from the predicted degradation pathway, it may represent the presence of multiple source areas or plumes.

2.2 Results and Discussion

The results presented in this section are for the Northern Area and are based on the Site investigation activities described above.

Borehole Advancement and Well Installation

A summary of monitoring well construction data is presented in Table 2. Monitoring well locations are shown on Figure 3. Soil classification, PID field screening results and monitoring well construction details are presented on boring logs included in Appendix A.

The geologic sequence in the Northern Area is generally reflective of a glaciolacustrine environment. That is, a deep bedrock river valley was dammed by ice or sediment after the Late Wisconsinan ice sheet receded through the area, creating a glacial lake that eventually filled with fine-grained lake bottom sediments. Consistent with this type of environment, the sedimentary deposits are laterally and vertically heterogeneous. The overburden deposits vary from east to west, with generally coarser deposits to the east and finer deposits to the west. The overburden deposits generally dip and thicken to the west, as the depth to bedrock increases significantly.

A series of geologic units were defined based on soil logging conducted during well installation and index of hydraulic conductivity (I_k) data collected using the Modified Waterloo Profiler. Generalized geologic cross-sections for the Northern Area are presented in Figure 4. In the vicinity of MW-261S and B-241, the overburden deposits consist of the following units (from top to bottom, based on geologic logging of MW-262):

- Coarse to fine sand, unsaturated;
- Upper fine sand and silt, saturated, moderate conductivity (this unit generally fines to the west, grading into a silt and clay unit);
- Medium to fine sand, saturated, moderate conductivity (this unit fines to the west, grading into a fine sand and silt unit);
- Middle fine sand and silt, saturated, moderate conductivity;

- Gravel, saturated, high conductivity;
- Lower fine sand and silt, saturated, moderate conductivity, discontinuous (this unit pinches out to the west);
- Till, saturated, moderate conductivity, discontinuous (this unit pinches out to the west); and
- Bedrock.

In the western portion of the Northern Area, the overburden deposits consist of the following units (from top to bottom, based on geologic logging of MW-268):

- Coarse to fine sand, unsaturated;
- Upper fine sand and silt, saturated, moderate conductivity;
- Silt and clay, saturated, low conductivity;
- Lower fine sand and silt, saturated, moderate conductivity;
- Gravel, saturated, high conductivity; and
- Bedrock.

For purposes of discussion, the geologic units for the western portion of the Northern Area will be referenced going forward.

Surveying and Water Elevation Measurement

Groundwater, ground surface, and monitoring well elevation data are presented in Table 3. The groundwater elevations used for this analysis were collected over at three-day period under various atmospheric conditions. As such, the following results should be interpreted as preliminary. A series of comprehensive groundwater gauging rounds are planned to thoroughly evaluate groundwater flow directions at the Site.

Historical groundwater elevation data exist for only one well (MW-TP-3) in the Northern Area. The groundwater elevation measured for this well in January 2003 was more than six feet higher than during the previous monitoring round (10 October 2002) and was also the highest water level recorded to date.

For the purposes of evaluating groundwater flow directions in the Northern Area, ERM prepared two groundwater elevation contour maps representing:

- Wells with screens set across the water table or with the top of the well screen located within five feet of the water table (Figure 5).
- Wells with screens set in the lower fine sand and silt unit (Figure 6). It

is important to note that well screens set within this unit vary significantly in depth. However, head data collected from these wells represent a single hydrologic unit and therefore, represent a single piezometric surface. The lower fine sand and silt unit is particularly significant because it appears to control CVOC migration in the Northern Area.

The January 2003 data set indicates that groundwater flows to the west, potentially controlled by the presence of the Sudbury River.

In addition to evaluating horizontal groundwater flow, ERM calculated vertical hydraulic gradients for well clusters (i.e., two or more wells installed in close proximity to one another) in the Northern Area. The vertical gradients were calculated using groundwater elevation data from the shallowest overburden well and the deepest overburden well at each location. Vertical gradients were also calculated between shallow overburden and bedrock wells at locations MW-266, MW-267, and MW-268. Vertical gradient data are presented in Table 4.

In general, downward vertical gradients were measured across the Northern Area. These data are generally consistent with the regional hydrogeologic setting, which consists of a local groundwater flow divide located coincident with a topographic high east of the Site and a regional discharge boundary (i.e., the Sudbury River) located west of the Site. Vertical gradients are typically downward in the vicinity of a recharge boundary (e.g., area of high ground) indicating that groundwater is seeking to achieve a lower elevation, consistent with the regional water table.

As groundwater flows from the recharge boundary, vertical gradients typically become less downward and transition to upward gradients as groundwater approaches the regional discharge boundary. This transition from downward to upward vertical gradients is observed at two of the westernmost locations (MW-267 and MW-268) in the Northern Area.

Groundwater gauging was conducted in April 2003 as part of the annual monitoring for the Site (see Section 4.3). Groundwater gauging data for April 2003 are presented in Table C-1 of Appendix C.

Soil Sampling

Soil field screening data (i.e., PID headspace measurements) are presented in boring logs in Appendix A. Laboratory analytical results for soil are summarized in Table 5. Laboratory analytical reports are presented in Appendix B.

PID screening values ranged from less than 0.1 parts per million (ppm; i.e., the instrument detection limit) to 147 ppm in the saturated zone. No VOCs were detected in five of the nine soil samples collected from the unsaturated zone.

Groundwater Sampling / Hydrochemical Facies Analysis

The following tables present groundwater analytical and field parameter data:

- Table 6 Summary of Groundwater VOC Analytical Results
- Table 7 Summary of Groundwater Miscellaneous Parameter Analytical Data
- Table 8 Summary of Groundwater Analytical Results for PCDDs/PCDFs
- Table 9 Summary of Groundwater Field Parameter Measurements

Laboratory analytical reports are presented in Appendix B.

Of the 30 Northern Area wells sampled during this event, 18 contained measurable concentrations of 11 different VOCs. Of those 11 compounds, four (PCE, TCE, cDCE and VC) were detected at concentrations above applicable Reportable Concentrations (RCGW-1). The groundwater investigation results from the January 2003 sampling event are slightly elevated in comparison to the December 2002 field screening data. The following table summarizes groundwater VOC analytical results for the January 2003 monitoring round.

Northern Area VOC Results – January 2003

VOC Compound	**Number of Detections (out of 38 analyses)**	**Concentration Range Detections Only (mg/L)**	**Reportable Concentration (RCGW-1) (mg/L)**	**Number of Detections above RCGW-1**
PCE	11	0.73 - 66	5	8
TCE	14	3.7 – 4,400	5	11
cDCE	15	0.85 – 10,000	70	8
Trans 1,2-Dichloroethene	1	1.5	100	0
VC	4	1.3 – 360	2	3
2-Butanone	1	10	400	0
Tetrahydrofuran	3	12	5,000	0
1,2,3-Trichlorobenzene	1	110	NS	NA
1,4-Dichlorobenzene	1	4.4	5	0
Toluene	3	2.7 – 24	1,000	0
Xylenes, p/m	2	0.60 – 0.66	6,000	0

Note:
Number of detections includes five duplicate samples.

NS = No RCGW-1 Standard

NA = Not Applicable

Review of the monitoring well sampling data confirms the Waterloo Profiler field screening data that indicated chlorinated ethenes (i.e., PCE, TCE, cDCE and VC) are the primary constituents of concern in the Northern Area. Of the chlorinated ethenes detected, cDCE was detected at the highest concentration, followed by TCE, VC and PCE. PCE, TCE, cDCE, and VC concentrations in the Northern Area are summarized in plan view on Figure 7 and in cross-sectional view on Figure 8.

A HFA was completed to evaluate potential source areas and fate and transport processes affecting the nature and extent of CVOC impacts in the Northern Area (Figure 9). Both PCE and TCE have been detected in groundwater in the Northern Area. Both compounds are used as chlorinated solvents and could represent the "source" signature. The HFA indicates that TCE was likely the primary compound released along with significantly lesser concentrations of PCE. The TCE signature is most dominant in well MW-261S and Waterloo Profiler boring B-241. These locations also exhibited the highest TCE concentrations in the Northern Area. Therefore, the area around MW-261S and B-241 is interpreted to represent the likely area of historical release (i.e., source area).

The HFA suggests that the TCE plume migrates initially to the northwest and then to the west. This is further supported by the CVOC concentration plots (Figure 7) and the lower fine sand and silt unit groundwater elevation contour map (Figure 6). As the plume migrates downgradient from the source area, the TCE is biologically degraded to cDCE and VC. The HFA indicates that the most downgradient well within the plume (MW-268M) exhibits a chemical signature relatively enriched in cDCE with some VC and relatively depleted in TCE.

Consistent with the Waterloo Profiler field screening data, the monitoring well installation and sampling data indicate that CVOCs are generally confined to the lower fine sand and silt unit in the Northern Area. As noted above, this unit is significantly deeper in the western portion of the Northern Area, reaching a maximum depth of approximately 90 feet below grade at MW-268M. To date, no CVOCs have been detected beneath the gravel unit.

A number of additional parameters were analyzed in wells MW-261S and MW-TP-3. These two wells were selected for analysis of a wide array of organic and inorganic parameters because they are both located in areas of known or suspected historical releases. None of the additional parameters were detected at concentrations exceeding applicable Reportable Concentrations (RCGW-1).

Groundwater sampling was conducted in April 2003 as part of the annual monitoring for the Site (see Section 4.3). April 2003 and historical groundwater parameter monitoring data are presented in Table C-2 of Appendix C. April 2003 and historical groundwater VOC analytical results and groundwater miscellaneous parameter results for the Site are presented in Table C-3 and C-4, respectively, of Appendix C. The April 2003 data are included in these tables.

2.3 Conceptual Site Model (CSM)

Based on data collected to date, ERM has developed a CSM for impacts to groundwater in the Northern Area.

- An apparent historical release of primarily TCE occurred in the vicinity of MW-261S and B-241. The source signature also includes significantly lower levels of PCE. Historically, the area has been filled and only transient equipment testing was known to have been conducted in this portion of the Site. Therefore, the release mechanism was likely transient and no longer exists.

- A residual source of impact to groundwater appears to be present in the low hydraulic conductivity, upper fine sand and silt unit in the vicinity of MW-261S and B-241. However, soil data collected to date have not identified the nature or extent. TCE appears to migrate via flushing by recharge events or diffusion out of the upper fine sand and silt unit into the underlying, higher hydraulic conductivity, medium to fine sand unit. When the TCE reaches the medium to fine sand unit, it migrates via advective groundwater flow initially to the northwest and ultimately to the west.

- The medium to fine sand unit fines and dips to the west becoming the lower fine sand and silt unit in the western portion of the Northern Area. The moderate conductivity lower fine sand and silt unit is bound on top by a lower conductivity silt and clay unit. The relative difference in hydraulic conductivities between the two units, combined with downward vertical hydraulic gradients, have minimized or prevented CVOC impacts to the silt and clay unit along the axis of the plume. The moderate conductivity lower fine sand and silt unit is underlain by a higher hydraulic conductivity gravel unit. This relatively higher conductivity gravel unit appears to minimize downward vertical plume migration, as evidenced by significantly lower or non-detectable CVOC concentrations in and beneath this unit.

- As the TCE migrates away from the source area and vertically downward within the lower fine sand and silt unit, intrinsic biodegradation converts TCE to cDCE and VC, resulting in enrichment of cDCE relative to TCE in the westernmost Northern Area wells. Intrinsic biodegradation, along with a series of physical hydrochemical processes (e.g., advection, dispersion, diffusion and dilution), are collectively referred to as natural attenuation. These processes act to limit the distance over which a CVOC plume can travel by naturally reducing concentrations in groundwater until a steady state condition is achieved. Given the historical nature of the TCE release, it is anticipated that the plume has reached a steady-state condition. However, at this time, the downgradient extent of the CVOC plume has not yet been defined.

- It is currently known that the CVOC plume trends westward and appears to be migrating beneath the wetlands toward the Sudbury River. The Sudbury River is the regional hydraulic discharge boundary. In theory, the plume should migrate upward and discharge to the river and/or its associated wetlands. In order to do so, the plume must migrate at least 90 feet vertically upward through the low hydraulic conductivity silt and clay unit, which is not likely. The following scenarios are being considered to define the downgradient extent of the plume:

1. The silt and clay unit may coarsen to the west beneath the Sudbury River and/or associated wetlands allowing the plume to migrate upward and potentially discharge to the river and/or wetlands.
2. The silt and clay unit remains consistent to the west forcing the plume to remain in the lower fine sand and silt unit. Hydraulic gradients on the west side of the river force groundwater to flow eastward toward the river. Because the plume is unable to discharge upward to the river and is unable to flow up gradient west of the river, it deviates to the north and follows the river valley in the downstream direction. The plume may continue to migrate within the river valley until the overlying silt and clay unit coarsens, allowing upward discharge to the river, or until natural attenuation processes decrease CVOC concentrations to non-detectable levels.

The ongoing Northern Area investigation will evaluate these two alternatives in an effort to define the nature and extent of CVOC impacts to groundwater, as required under Phase II of the MCP process.

2.4 Assessment Strategy

Raytheon proposes to implement a dynamic Site investigation approach to further define the nature and extent of CVOC impacts to groundwater in the Northern Area. This approach involves the following steps:

- Develop a flexible Scope of Work that allows for real time data generation using field screening techniques.
- Evaluate data in real time as it is generated. Update the CSM in real time throughout the investigation process to enable modification of the investigation program, as necessary.
- Install long-term monitoring points in strategically selected locations, based on field screening results, to enable long-term monitoring of groundwater conditions.

This assessment strategy has been shown to be more efficient than a traditional phased approach to define the source, nature and extent of site impacts. Inherent in this approach is the difficulty in defining the exact activities that will be conducted throughout the site investigation process. Some of the tasks presented in this Scope of Work may be deemed unnecessary as the investigation progresses, while alternate tasks may be deemed appropriate. The end result is an assessment strategy that maximizes knowledge of subsurface conditions while minimizing the time necessary to obtain this knowledge.

Raytheon is committed to involving the public in this process through regular communication with the Town's technical representative(s). This investigation will be conducted in accordance with the current Public Involvement Plan (PIP) process that has been established for the Site.

3.0 SITE ASSESSMENT ACTIVITIES – WESTERN AREA (WETLANDS)

This section presents the methods and results for additional sediment sampling activities conducted in the Western Area wetlands during March 2003. This sampling program was conducted to further evaluate the potential source, nature and extent of PCDDs / PCDFs in wetland sediments based on data collected in August 2002 (Table 10). This section presents the methods and results for the March 2003 sampling program.

3.1 Methods

Sampling locations were surveyed (WS-1 to WS-36) (Figure 10) and marked by Chas. H. Sells on 4 March 2003. Because the wetland was completely inundated and covered with ice, sample locations were marked on the ice with a blue flag and location ID. The following locations were inaccessible to the surveyors due to thin ice: WS-3, WS-8, WS-29, WS-33, WS-34 and WS-35.

On 5 March 2003, ERM collected a total of 30 sediment core samples through the ice using hand-held GeoProbe direct-push or hand auger drilling techniques. The locations determined to be inaccessible due to thin ice were not sampled, with the exception of WS-29. On 20 March 2003, the remaining five locations (WS-3, WS-8, WS-33, WS-34 and WS-35) were surveyed and sampled using hand auger drilling techniques.

Sediment core samples were collected from 0 to 4 feet depth at most locations. At a few locations in close proximity to the Sudbury River, collection of sediment samples to a depth of 4 feet was not possible using the direct-push equipment because the sediments were completely saturated and acted as a fluid. At these locations, a hand auger was used to collect a sample from 0 to 2 feet. A summary of sample locations, methods and depths achieved is presented in Table 11.

The sediment samples collected using direct-push techniques were collected directly into Lexan disposal sleeves and characterized for lithology from 0 to 4 feet. Sediment samples were collected for laboratory analysis from depths of 6 to 12 inches at most locations and from 18 to 24 inches at select locations. A summary of samples collected for laboratory analysis is presented in Table 12.

The targeted sampling interval was removed from the sleeve and mixed in a stainless steel bowl with a stainless steel trowel, spoon or nitrile-gloved hands. Each sediment interval was well mixed and collected in the appropriate sample containers provided by the laboratory. Samples that were taken by stainless steel hand auger were collected in a stainless steel bowl and composited over the sampling interval. Samples collected with the hand auger could not be segregated into separate vertical intervals.

Sampling equipment was decontaminated between sampling locations in the following sequence:

1. Liquinox and water
2. Deionized water rinse
3. Methanol
4. Deionized water rinse

Sediment samples collected on 5 and 20 March 2003 (Figure 10), were sent for laboratory analysis of one or more of the following parameters:

- PCDDs / PCDFs by EPA Method 8290 (36 samples);
- PCBs by EPA Method 8082 (12 samples);
- PAHs by EPA Method 8270 (7 samples); and
- Metals (site-specific list of metals; 7 samples).

Specific analyses performed at each sampling location are summarized in Table 12. The sediment samples were submitted to Alpha Analytical Laboratory under chain-of-custody protocol. Two equipment blanks were collected during the sampling event from sampling and compositing tools. Duplicate quality control / quality assurance samples were also collected.

3.2 Results

Table 13a summarizes PCDFs / PCDDs and PCB data and Table 13b summarizes the metals and PAH data from the March 2003 sampling round. Metals, PCB and PAH analytical reports from the March 2003 sampling events are included in Appendix B. PCDDs / PCDFs analytical data for sediment samples collected in August 2002 are also included in Appendix B.

4.0 SCOPE OF WORK

This Scope of Work is designed to further evaluate the following issues:

- potential for CVOCs from the Site to impact the Baldwin Pond Wellfield; and
- downgradient extent of CVOC plume.

The remainder of Section 4.0 presents the proposed activities necessary to evaluate these issues. Results of these activities will be presented in the Phase I – Initial Site Investigation report, which will be submitted to the Department by 17 December 2003.

The majority of the proposed investigation activities will be conducted within wetland areas or wetland buffer zones. Prior to initiating these activities, Raytheon will file a new or amended Notice of Intent (NOI) with the Wayland Conservation Commission. Site investigation activities will be conducted in accordance with the Order of Conditions prepared by the Wayland Conservation Commission. In addition, Raytheon will secure access agreements for all properties for which current access agreements do not exist.

4.1 Task 1: Conduct Vertical Groundwater Profiling

The purpose of this task is to evaluate the potential for CVOC impacts to groundwater in the Northern Area to impact the Baldwin Pond Wellfield. Based on data collected to date, the Northern Area CVOC plume is generally migrating westward toward the Sudbury River. The Baldwin Pond Wellfield is located approximately 3,250 feet north of and perpendicular to the plume axis. However, as noted in the CSM, it is possible that the plume may change direction and travel to the north within the Sudbury River valley. In order for the plume to reach the wellfield, it would have to migrate north within the river valley and be drawn back to the east by the hydraulic influence of the wellfield.

To evaluate this potential scenario, ERM proposes to conduct vertical groundwater profiling using north-south and east-west transects, as shown on Figure 11, that will intersect the CVOC plume if it is migrating toward the wellfield. The vertical groundwater profiling will be conducted using a Modified Waterloo Profiler. This is the same technique that was originally used to locate and delineate the CVOC plume in the Northern Area.

Waterloo Profiler borings will be advanced to refusal at up to 17 locations as shown in Figure 11. Prior to initiating the profiling program, ERM will conduct a series of seismic refraction transects to evaluate the depth to bedrock at or near each of the proposed drilling locations. These data will be used to ensure that the Waterloo Profiler borings are advanced to within close proximity of the bedrock surface.

The Waterloo Profiler produces a detailed log of relative hydraulic conductivity and allows for collection of multiple groundwater samples from discrete intervals during advancement of the borehole. Groundwater samples will be collected during advancement of the borings from higher conductivity zones and analyzed for VOCs. Relative hydraulic head and geochemical parameters will be measured at each sampling interval. The VOC and geochemical data will be used to evaluate vertical variations in aquifer geochemistry. The total number of samples collected from each boring will be based on hydrogeologic conditions encountered at each location.

4.2 Task 2: Advance Soil Borings and Install Monitoring Wells

The purpose of this task is to further delineate the nature and extent of CVOC impacts to groundwater in the Northern Area. ERM proposes to advance three borings and install three monitoring well triplets within the wetlands near the Sudbury River along the apparent axis of the CVOC plume (Figure 11). This drilling program will be conducted in conjunction with the upcoming wetland sediment remediation program, due to a series of synergies that can be gained from conducting the two programs simultaneously (e.g., easy access into wetlands via construction roadway, limit potential impact to the wetlands, wetland restoration activities, if necessary).

A temporary roadway will be constructed to each drilling location using a combination of support systems such as geotextiles and various wood and metal platform devices. This system will be designed to limit the potential damage to the wetlands. An ATV drill rig will be used to advance each boring to the top of bedrock using sonic drilling techniques. Continuous soil samples will be collected and screened in the field for total VOCs using a PID and the jar headspace method. PID screening results were successfully used in the December 2002 Northern Area drilling program to locate the CVOC plume. One shallow soil sample from each boring will be submitted for laboratory analysis of VOCs by EPA Method 8260/5035.

ERM proposes to install three monitoring wells in each boring at the following depths:

- within the upper fine sand and silt unit or the silt and clay unit;

- within the lower fine sand and silt unit at the depth of the highest PID readings; and
- top of till or top of bedrock.

Monitoring wells will be constructed using two-inch ID PVC, 0.010-inch machine slotted, well screen, PVC riser pipe, sand filter pack, bentonite seal, concrete surface seal and locking steel protective standpipes. The deep and shallow well at each location will be installed using a five-foot long well screen. The middle well will be installed using either five-foot or ten-foot long well screens, depending on field screening results. Monitoring wells will be developed following installation.

4.3 Task 3: Survey, Gauge and Sample Monitoring Wells

The purpose of this task is to evaluate groundwater elevations and groundwater quality in the Northern Area. ERM proposes to conduct quarterly groundwater elevation gauging rounds across the entire Site and conduct semi-annual groundwater monitoring rounds in the Northern Area, Western Area and selected wells within the Southern Area.

Groundwater Elevation Gauging

To accurately determine groundwater elevations and flow directions across the Site, ERM recommends conducting quarterly groundwater elevation gauging rounds. ERM will gauge depths to groundwater in all existing Site wells on a single day using electronic water-level indicators. Newly installed monitoring wells will be surveyed relative to mean sea level and locations will be surveyed relative to the existing Site grid. Gauging will be conducted prior to sample collection.

Groundwater Sampling

To evaluate groundwater quality at the Site, ERM recommends conducting semi-annual groundwater monitoring events. Groundwater samples will be collected using low-flow or diffusion bag sampling techniques. For wells sampled using low-flow sampling techniques, physico-chemical parameters (pH, temperature, specific conductance, dissolved oxygen and ORP) will be monitored during purging until equilibration is achieved, at which time groundwater samples will be collected for laboratory analyses. Groundwater samples will be analyzed for one or more of the following parameters, as detailed in Table 14:

- EPA Method 8260 (VOCs)
- EPA Method 8021B (chlorinated compounds only);

- EPA Method 8021B (chlorinated compounds plus MTBE);
- chloride by EPA Method 325.2; and
- arsenic by EPA Method 200.7.

Table 14 presents the annual monitoring plan for the entire site, including RTNs 3-13302 and 3-22408. In general, Northern Area wells will be sampled for VOCs only. Western Area wells will be sampled for VOCs and arsenic. Southern Area wells will be sampled for VOCs (including MTBE). A subset of the Southern Area wells will also be sampled for chloride, in response to a request by an abutting property owner.

Groundwater gauging and sampling was conducted in April 2003 as part of the annual monitoring for the Site. Comprehensive data tables for the Site, which include the April 2003 data, included in Appendix C are as follows:

- Summary of Groundwater Gauging Data;
- Summary of Vertical Hydraulic Gradient Data;
- Summary of Groundwater Field Parameter Measurements;
- Summary of Groundwater VOC Analytical Results; and
- Summary of Groundwater Miscellaneous Parameter Results (April 2003 Data only).

4.4 Task 4: Prepare Phase I – Initial Site Investigation Report and Tier Classification Submittal

The purpose of this task is to comply with requirements of the MCP for completion of a Phase I – Initial Site Investigation report, pursuant to 310 CMR 40.0480. The Phase I report, pursuant to 310 CMR 40.0483(1), will include:

- General Disposal Site Information
- Disposal Site Map
- Disposal Site History
- Site Hydrogeologic Characteristics
- Nature and Extent of Contamination
- Migration Pathways and Exposure Potential
- Evaluation for Immediate Response Actions
- Conclusions

This task also includes completion of a Tier Classification submittal, pursuant to 310 CMR 40.0500. The Tier Classification, pursuant to 310 CMR 40.0510, submittal will include:

- A completed Tier Classification transmittal form;
- A completed Numerical Ranking Scoresheet;
- A LSP Tier Classification Opinion;
- The certification required by 310 CMR 40.0009;
- The certification required by 310 CMR 40.0540(1) for a Tier II disposal site; such certification shall be provided in a Permit Application pursuant to 310 CMR 40.0703(9) for a Tier I disposal site;
- The compliance history required by 310 CMR 40.0540(2) for a Tier II disposal site; such compliance history shall be provided in a Permit Application pursuant to 310 CMR 40.0703(9) for a Tier I disposal site; and
- A Phase II Scope of Work.

4.5 Task 5: Prepare Phase II – Comprehensive Site Investigation Scope of Work

The purpose of this task is to comply with requirements of the MCP for completion of a Phase II – Comprehensive Site Investigation Scope of Work, pursuant to 310 CMR 40.0830. The Phase II Scope of Work will be completed subsequent to the submission of the Phase I report. The Phase II Scope of Work, pursuant to 310 CMR 40.0834(2), will include:

- The scope and nature of investigation and sampling events that will be undertaken to characterize the source, extent, and migration pathways of OHM, and the risk of harm posed to health, safety, public welfare or the environment;
- The name and license number of the LSP representing the person conducting the Comprehensive Response Action; and
- A schedule for implementation of the Phase II – Comprehensive Site Assessment.

4.6 Anticipated Schedule

The proposed schedule for implementation of those activities presented above is detailed in the following table:

Activity	Estimated Timeline
Obtain written access agreements for abutting properties	Spring 2003
Prepare NOI & obtain Order of Conditions	Spring 2003
Prepare for & conduct vertical groundwater profiling program	Summer 2003
Advance soil borings and install monitoring wells	Late Summer 2003*
Conduct quarterly groundwater gauging	Spring, Summer and Fall 2003
Conduct groundwater monitoring	Spring and Fall 2003
Provide Draft Phase I – Initial Site Investigation Report & Tier Classification Submittal for public review	Fall 2003
Submit Phase I – Initial Site Investigation Report & Tier Classification Submittal to the Department	December 2003
Provide Draft Phase II – Comprehensive Site Investigation Scope of Work for public review	Winter 2004
Submit Phase II – Comprehensive Site Investigation Scope of Work to the Department	Spring 2004

Note:
* This task is tied to the timing of the wetland sediment remediation program. If this program is delayed, then the drilling activities will also be delayed.

5.0 REFERENCES

ERM, "Phase I – Initial Site Investigation, Raytheon Electronic Systems, 430 Boston Post Road, Wayland, Massachusetts," May 1996.

ERM, "Phase II – Comprehensive Site Assessment, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts," October 2001a.

ERM, "Phase III – Remedial Action Plan, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts," October 2001b.

ERM, "Phase IV – Remedial Implementation Plan, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts," December 2002.