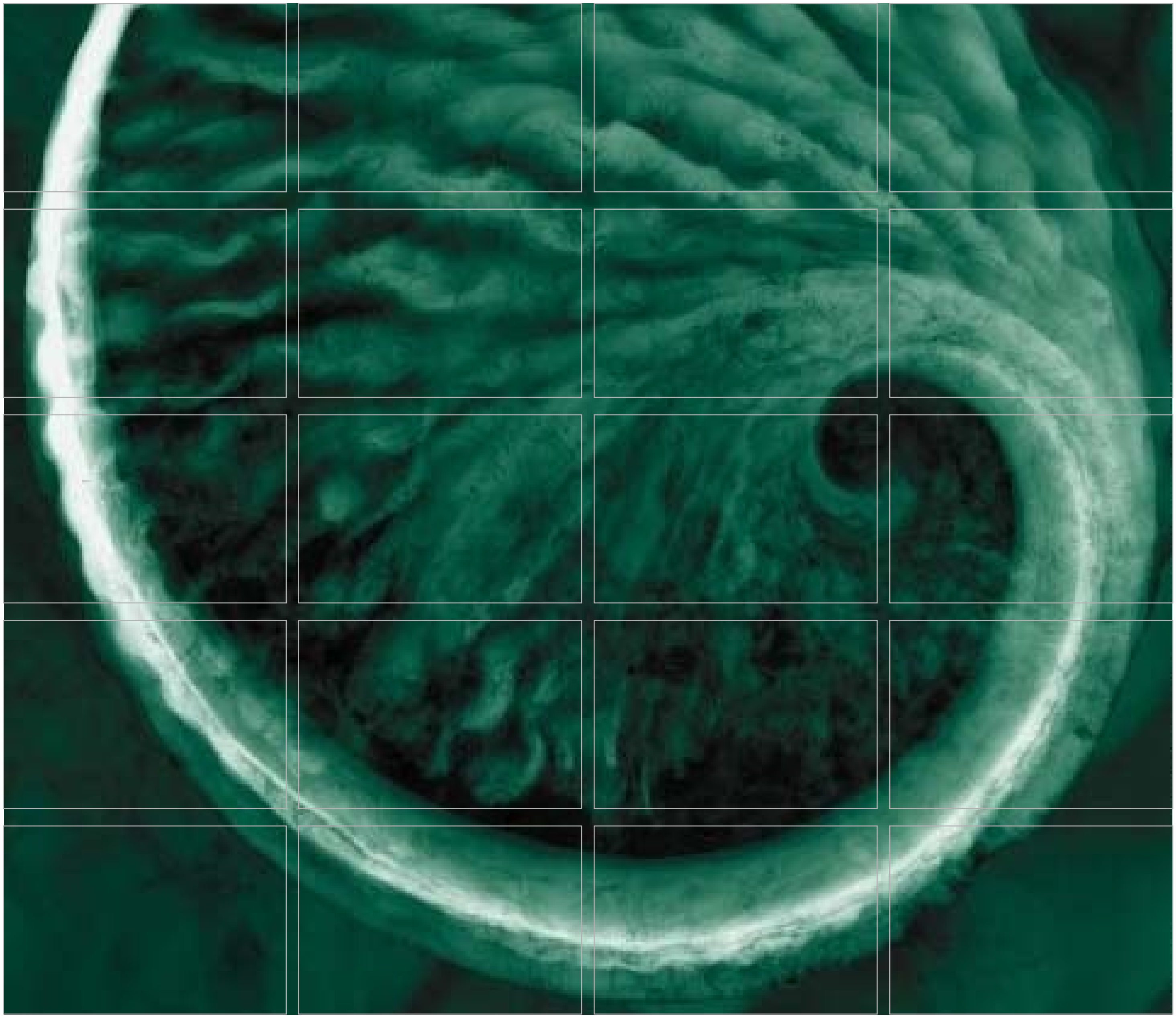

Raytheon Company

Phase IV – Remedy Implementation Plan

Former Raytheon Facility
430 Boston Post Road
Wayland, Massachusetts

RTN 3-22408
Tier 1B Permit Number W045278
ERM Reference 0043601

11 August 2006

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FINAL REPORT

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
BVW	Bordering vegetated wetland
BWSC	Bureau of Waste Site Cleanup
cDCE	cis-1,2-dichloroethene
CMR	Code of Massachusetts Regulations
Commission	Town of Wayland Conservation Commission
CVOC	Chlorinated volatile organic compounds
yd^3	Cubic yards
DEP	Massachusetts Department of Environmental Protection
DHE	Dehalococcoides ethenogenes
EPA	United States Environmental Protection Agency
EPH	Extractable petroleum hydrocarbon
ERM	Environmental Resources Management
IC	Ion chromatography
LSP	Licensed Site Professional
MCP	Massachusetts Contingency Plan
MIP	Membrane interface probe
MMCL	Massachusetts Maximum Contaminant Levels
MNA	Monitored natural attenuation
MTBE	Methyl-tert-butyl ether
MW	Monitoring well
NOI	Notice of Intent
NOR	Notice of Responsibility
NPDES	National Pollution Discharge Eliminations System
OHM	Oil and/or hazardous materials
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PID	Photoionization detector

PLFA	Phospholipid fatty acid
PP13	Priority Pollutant 13 Metals
RAO	Response Action Outcome
RAPS	Response Action Performance Standard
RCS-1	Reportable concentration for Category S-1 soils
RGP	Remediation General Permit
RIP	Remedy Implementation Plan
RNF	Release Notification Form
RTN	Release Tracking Number
SPCC	Spill prevention control and countermeasures
SVOC	Semi-volatile organic compound
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching protocol
TKN	Total Kjeldahl nitrogen
TOC	Total organic carbon
TSS	Total suspended solids
μg/g	Micrograms per gram
μg/L	Micrograms per liter
VC	Vinyl chloride
VOC	Volatile organic compound

EXECUTIVE SUMMARY

BACKGROUND

On behalf of Raytheon Company (Raytheon), Environmental Resources Management (ERM) has prepared this Phase IV– Remedy Implementation Plan (Phase IV) for the Northern Area source area (Source Area) of an approximately 83-acre property located at 430 Boston Post Road in Wayland, Massachusetts (defined as the "Site", Figure 1). The Site, surrounding properties and physical features are shown in Figure 2.

The Phase IV is part of the 5-phase process required under the Massachusetts Contingency Plan (MPC; 310 CMR 40.0000) for assessment and remediation of releases of oil and/or hazardous materials to the environment. The Phase IV presents the information, plans and reports related to the design, construction and implementation of the remedial actions selected in the Phase III – Remedial Action Plan (Phase III; ERM 2006). The Phase III identified "Excavation of Source Area Saturated Soils" and "Bioremediation in Groundwater" as the preferred remedial approaches for abatement of Site impacts. These approaches will be employed to reduce Source Area soil concentrations of residual and sorbed chlorinated volatile organic compounds (CVOCs).

This report also presents the results of soil and groundwater investigations conducted after submission of the Phase III to provide better data for design of the remedial approaches.

SOURCE AREA SOIL REMEDIATION

Impacted soil in the Source Area will be excavated and disposed of off site. The depth below ground surface to which the soil has been impacted extends to approximately 25 feet. To achieve this depth while minimizing the surface area to be disturbed, a circular cofferdam, 80 feet in diameter, has been designed utilizing sheet piling and cast-in-place concrete walers. The walers, built with electrical strain gauges, will be constructed at three depths within the cofferdam to provide resistance to the force of the earth and groundwater outside of the structure. Daily monitoring of the strain gauges will provide a measure of safety for excavation operations as they are conducted within the cofferdam. In this configuration the cofferdam will allow the removal of approximately 4,700 cubic yards (yd^3) of soil. The soil will be screened with a photoionization detector immediately upon removal from the excavation and staged according to contaminant levels. It is has been calculated, using analytical data from soil borings collected in January and April 2006, that up to 4,000 yd^3 of remediation waste may be generated by this process.

Soil sampling at the bottom of the excavation will be conducted once the target depth is achieved. These samples will be used to establish residual concentrations of VOCs in the Source Area. An infiltration gallery, described below, will be constructed in the pit and the excavation will be filled with a combination of "clean" fill from off site, and the "clean" soil generated during excavation activities. The excavation area will be graded to match pre-remedial topography, covered with topsoil and seeded with an appropriate seeding mix. It is anticipated that soil remediation activities will be complete in early 2007.

SOURCE AREA GROUNDWATER REMEDIATION

Activities associated with groundwater remediation in the Source Area will commence with the construction of an infiltration gallery at the bottom of the excavation. The gallery will be used to passively introduce quantities of substrate to the groundwater to stimulate the naturally-occurring biological processes that transform CVOCs into neutral byproducts. A treatability study conducted to evaluate the potential for enhancing intrinsic bioremediation at the Site suggested that the addition of a carbon substrate such as lactate or soybean oil may be successful in reducing CVOC concentrations.

The results of groundwater monitoring following completion of the soil remediation activities will be used to determine the type and dosage of substrate for addition to the subsurface. It is anticipated that substrate injections will begin in 2008. Fourteen monitoring wells have been selected to monitor the effectiveness of the bioremediation program.

1.0 INTRODUCTION

1.1 BACKGROUND

On behalf of Raytheon Company (Raytheon), Environmental Resources Management (ERM) has prepared this Phase IV– Remedy Implementation Plan (RIP) (Phase IV) report, pursuant to 310 Code of Massachusetts Regulations (CMR) 40.0874, for portions of the Former Raytheon Facility located at 430 Boston Post Road in Wayland, Massachusetts (Site) (Figure 1). The Site layout is shown in Figure 2.

On 17 December 2002, Raytheon submitted a Release Notification Form (RNF, Bureau of Waste Site Cleanup Form 103[BWSC-103]) to the Massachusetts Department of Environmental Protection (DEP), pursuant to 310 CMR 40.0315(1), for three identified reportable conditions (ERM, 2002). The three reportable conditions were identified based on the detection of constituents in groundwater at concentrations in excess of applicable Reportable Concentrations (RCGW-1) and include the following:

- Chlorinated volatile organic compounds (CVOCs): tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), and vinyl chloride (VC) in the Northern Area;
- Methyl-tert-butyl ether (MTBE) in the Southern Area; and
- Arsenic in the Western Area.

The DEP issued a Notice of Responsibility (NOR) and Release Tracking Number (RTN) 3-22408 on 16 January 2003 for these release conditions. A Phase I - Initial Site Investigation (Phase I) report, including a Tier Classification Submittal, was submitted to the DEP on 17 December 2003 (ERM, 2003). The Site is classified as Tier IB, Permit Number W045278.

As detailed in the Comprehensive Site Assessment (Phase II) report (ERM, 2005a), Raytheon anticipates filing a Downgradient Property Status for MTBE and a partial Response Action Outcome (RAO) for arsenic. These releases are not discussed in this Phase IV RIP.

The Phase IV is the fourth part of a five-phase process required under the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000) for assessment and remediation of a release(s) of oil and/or hazardous materials (OHM) to the environment. Cleanup will be initiated under the Phase IV to abate OHM impacts to Site soil and groundwater that pose a potential risk to human health and the environment, as identified in the Phase II. The technologies utilized as part of Phase IV are those selected in the Phase III – Remedial Action Plan (Phase III) (ERM, 2005b). The Phase IV includes design, construction and implementation of the Comprehensive Remedial Response Action identified in Phase III. The Phase IV Transmittal Form BWSC-108 and public notification are included as Appendix A.

Data from assessment activities, presented in the Phase II, suggest the presence of residual and sorbed volatile organic compounds (VOCs) located in the Northern Area soils that represent the source of dissolved phase impacts to groundwater in the Northern Area. The Phase III identified "Excavation of Source Area Saturated Soils" and "Bioremediation in Groundwater" as the preferred remedial approaches for abatement of Site impacts. The Phase III also indicated that pre-remedial characterization activities would need to be conducted to identify CVOC concentrations in the Source Area saturated soil.

From 31 January to 1 February 2006, and on 14 April 2006, ERM conducted soil investigations to further evaluate the feasibility of Excavation of Source Area Saturated Soils. Twenty-two soil borings were advanced to a maximum depth of 30-feet below ground surface (bgs). Samples were collected and submitted for analytical analysis of VOCs by United States Environmental Protection Agency (EPA) Method 8260B. The results of these investigations are presented in Section 2.2.

Pursuant to 310 CMR 40.0874, this RIP documents the engineering concepts and design criteria to be used for the design and construction of the Comprehensive Response Action for the Site. Following construction and implementation of the remedy, an As-Built Construction Report, Final Inspection Report and Phase IV Completion Statement will be prepared in fulfillment of remaining Phase IV requirements.

1.2 PURPOSE & SCOPE

The purpose of the RIP is to ensure that the information, plans and reports related to the design, construction and implementation of the selected remedial action alternative are sufficiently developed and documented to support implementation of the Comprehensive Response Action. In accordance with 310 CMR 40.0874, the RIP includes the following:

- A list of relevant contacts including:
  1) Names, addresses, and telephone numbers of the responsible party, potentially responsible party or other persons responsible for submittal of the RIP;
  2) Name, address, and telephone number of the licensed site professional (LSP); and
  3) Identification of those persons who will own, operate and/or maintain the selected remedial action alternative during and following construction.
- Engineering concepts and design criteria to be used for the design and construction of the Comprehensive Response Action including:
  1) Goals of the remedial action, including performance requirements of the remedial systems, and/or the requirements for achieving a Response Action Outcome under 310 CMR 40.1000;
  2) Any significant changes in or new information related to disposal site conditions which were not included in previous submittals;
  3) Disposal site maps showing existing disposal site features and proposed locations of activities associated with the remedial action;
  4) A description of the characteristics, quantity, and location of environmental media or materials to be treated or otherwise managed;
  5) A description and conceptual plan of the activities, treatment units, facilities, and processes to be used to implement the selected remedial action alternative including flow diagrams;
  6) Relevant design and operation parameters, including:
     a) Design criteria, assumptions and calculations;
     b) Expected treatment, destruction, immobilization, or containment efficiencies and documentation of how that degree of effectiveness was determined; and
     c) Demonstration that the selected remedial action alternative will achieve the identified remedial goals (may include information from pilot or treatability tests, similar operations, or scientific literature);

7) Design features for control of OHM spills and accidental discharge or system malfunction, including without limitation: containment structures, leak detection devices, run-off controls, pressure valves, bypass systems, or safety cutoffs;

8) A description of the methods for management or disposal of any treatment residual, contaminated soils, and other waste materials containing OHM generated as a result of the selected remedial action alternative;

9) Identification of site-specific characteristics which may affect or be affected by the design, construction, or operation of the selected remedial action alternative, including, but not limited to:

   a) Relationship of the selected remedial action alternative to existing disposal site activities or operations;

   b) Drainage features;

   c) Natural resource areas, local planning and development issues; and

   d) Soil characteristics and groundwater characteristics;

10) A discussion of measures to be incorporated into the design, construction and operation of the remedial action alternative to avoid any deleterious impact on environmental receptors and natural resource areas (including any surface water or wetland), or where it is infeasible to avoid any such impact, a discussion of measures to minimize or mitigate any impact; and

11) A general description of inspections and monitoring which will be performed to ensure adequate construction and performance of the remedial action.

- Construction plans prepared in conformance with appropriate engineering and construction standards and practices, and regulations applicable to construction plans and activities including, as appropriate:

  1) Plans, material specifications, and procedures related to the construction of the selected remedial action alternative; and

  2) A schedule for the design and construction of the remedial action alternative.

- An Operation, Maintenance, and/or Monitoring plan including, as appropriate:

1) Name and telephone number of the person(s) conducting operation, maintenance and/or monitoring activities;

2) General operating procedures, including start-up, testing, maintenance, shutdown, and emergency or contingency procedures; and

3) Specification of the type, frequency and duration of monitoring, and testing or inspections to ensure and confirm that the remedial action is performing as designed. The frequency of monitoring and/or inspections shall be consistent with the Response Action Performance Standard, as described in 310 CMR 40.0191, and in conformance with the terms of applicable permits, approvals or licenses. At a minimum, the results from operation, maintenance and/or monitoring of a remedial action shall be documented and submitted to the DEP every six months in report form as described in 310 CMR 40.0892.

- A health and safety plan to be followed during the construction and implementation of the Comprehensive Response Action;
- A list of any necessary federal, state or local permits, licenses and/or approvals required for the design, construction and/or operation of the selected remedial action alternative and a description of any additional information needed to meet these requirements; and
- A discussion of any property access issues which are relevant to the implementation of the Comprehensive Response Action, and a plan and timetable for resolving property access problems, as appropriate.

As noted above, an As-Built Construction Report, Final Inspection Report and Phase IV Completion Statement will also be submitted as part of Phase IV, but are not included in the RIP.

1.3 REPORT ORGANIZATION

The report is organized to satisfy the requirements of the MCP (310 CMR 40.0874). The report contains the following sections:

Section 2.0 *New Site Information* – includes a summary of new information obtained since submission of the Phase II and Phase III reports, and relevant Site contacts.

Section 3.0 *Design Basis* – includes the identification of target cleanup levels and areas of OHM impacted media (i.e., soil and groundwater) requiring abatement to achieve remedial goals.

Section 4.0 *Conceptual Design – Soil Removal* - includes the: engineering design; construction plans and specifications; operation, maintenance and/or monitoring plans, as appropriate; health and safety plan; list of necessary permits; and, property access issues pertaining to the wetland remediation.

Section 5.0 *Conceptual Design – Groundwater Treatment -* includes the: engineering design; construction plans and specifications; operation, maintenance and/or monitoring plans, as appropriate; health and safety plan; list of necessary permits; and, property access issues pertaining to the groundwater remediation.

Section 6.0 *Implementation Schedule* – includes a proposed schedule to complete implementation of the Comprehensive Response Action.

Section 7.0 *References*

2.0 NEW SITE INFORMATION

2.1 BACKGROUND

Since completion of the Phase II and Phase III reports (ERM, 2005a/b), pre-remedial characterization activities were completed to support remedial design and implementation, and to identify CVOC concentrations in the Source Area saturated soil.

2.2 ADDITIONAL SITE ASSESSMENT ACTIVITIES

2.2.1 Soil

Methods

The purpose of this task was to characterize soil quality to support Phase IV remedial design activities. A total of 22 soil borings were advanced using a Geoprobe to maximum depth of 30 feet bgs in the Source Area in the Northern Area of the Site. Soil boring locations were collocated with previously advanced Membrane Interface Probe (MIP) borings and Waterloo Profiler borings. The soil boring locations are shown on Figure 2. The soil boring logs are included in Appendix B.

Soil samples were collected and screened in the field for total VOCs using a photoionization detector (PID) and the DEP jar headspace method. Twenty soil samples were submitted for analysis of VOCs by EPA Method 8260. Additionally two samples (one grab and one composite) were submitted for analyses of additional analytical parameters, which included:

- Semi-volatile organic compounds (SVOCs) by EPA Method 8270;
- Polychlorinated biphenyls (PCBs) by EPA Method 8082;
- Priority Pollutant 13 Metals (PP13) by EPA Method 6010B/7471; and
- Extractable petroleum hydrocarbons (EPH) by MADEP-EPH-98-1.

One sample was submitted for analysis of waste characterization parameters using the toxicity characteristic leaching procedure (TCLP) and included :

- TCLP Resource Conservation Recovery Act 8 Metals by EPA Method SW 1311/6010/7000;
- TCLP VOCs by EPA Method SW1311/8260;
- TCLP SVOCs by EPA Method SW1311/8270;
- TCLP Pesticides by EPA Method SW1311/8081; and
- TCLP Herbicides by EPA Method SW1311/8150.

Laboratory analytical reports are included in Appendix C.

Results

All 20 of the soil samples submitted for analysis of VOCs contained detectable concentrations of various VOCs. PCE, TCE, and/or cis-1,2-dichloroethene (cDCE) were detected in 15 of these soil samples at concentrations greater than the applicable Method 1: S-2 & GW-1 criteria (Table 1).

No PCBs, SVOCs, or EPHs were detected above analytical laboratory method detection limits for either the grab or composite soil sample (Table 2). Various metals were detected in both the grab and composite sample, none above the applicable RCS-1 criteria (Table 2).

Analysis for TCLP waste characterization parameters detected PCE, TCE, and 2,4,5-trichlorophenol (Table 3). None of these compounds were detected at concentrations above the regulatory criteria presented in 310 CMR 30.125B, Hazardous Waste Regulations.

2.2.2 Groundwater

Methods

The purpose of this task was to continue the evaluation of hydraulic gradients and groundwater quality at the Site. A groundwater sampling round and comprehensive groundwater gauging event for all accessible Site monitoring wells was conducted in April 2006. To date, a total of nine comprehensive gauging and sampling rounds have been conducted at the Site.

On 3 April 2006, depth-to-water measurements were collected from all accessible Site monitoring wells using an electronic water level meter.

From 3 to 7 April 2006, groundwater samples were collected from monitoring wells using low-flow sampling techniques. Physico-chemical parameters (pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential) were monitored during purging until equilibration was achieved, at which time groundwater samples were collected for laboratory analyses. Groundwater samples were analyzed for one of the following parameters, determined by the contaminants of interest for that area of the Site:

- VOCs by EPA Method 8260B; or
- CVOCs by EPA Method 8021B.

Monitoring wells, for which laboratory analytical results for previous sampling events were either below detection limits or below applicable reportable concentrations for all constituents, were excluded from the April groundwater sampling event. A comprehensive groundwater sampling round (i.e., consisting of all Northern Area monitoring wells) was also conducted in July 2006. The results of this sampling event will be provided in the next MCP report.

Results

For the purpose of evaluating groundwater flow directions across the entire Former Raytheon Facility property, ERM routinely prepares two groundwater elevation contour maps for each gauging round, 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 3); and
- Wells with screens set in the deep overburden, (defined as the lower fine sand and silt unit in the Northern Area and the fine to medium sand unit in the Southern Area), (Figure 4). It is important to note that well screens set within this unit vary significantly in depth. However, head data collected from these wells appear to represent a single hydrologic unit and therefore, represent a single piezometric surface. The lower fine sand and silt unit of the Northern Area is particularly significant because it appears to control CVOC migration in this portion of the Site.

Gauging data are presented in Table 4. The upper and lower aquifer potentiometric surface maps for the April 2006 gauging event are shown on Figures 3 and 4, respectively.

In addition to evaluating horizontal groundwater flow, ERM routinely calculates vertical hydraulic gradients for well clusters (i.e., two or more wells installed in close proximity to one another). The vertical gradients are calculated using groundwater elevation data for vertically adjacent monitoring wells. Vertical gradients were also calculated between deep overburden and bedrock wells, where present. The vertical hydraulic gradients calculated using calendar year 2005 potentiometric surface data are presented in Table 5.

Groundwater geochemical parameter data are presented in Table 6. Groundwater analytical results for VOCs are presented in Table 7. Laboratory analytical reports are provided in Appendix C.

2.3 CONCEPTUAL SITE MODEL

Based on data collected to date, ERM has developed the following conceptual site model for the CVOC release in the Northern Area of the Site.

- An apparent historical release of primarily TCE occurred in the vicinity of B-529 (Source Area, Figures 2 and 5). The source signature also includes lower levels of PCE and toluene. Historically, the Northern Area of the Site has been filled and only transient radar 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. The historical release of chlorinated solvents is estimated to be approximately 100 gallons, and to have occurred between 1955 (i.e., when the site was initially developed) and the 1970s (i.e., approximate time of filling in the Northern Area).

- The presence of residual and sorbed VOCs, located in the low hydraulic conductivity fine sand and silt soils, represent the source of dissolved phase impacts to groundwater in the Northern Area. 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 (Figure 6). The predominant groundwater flow direction within the Northern Area is 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 overlain 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. In general, Northern Area vertical hydraulic gradients within the shallow portion of the overburden are downward, while vertical gradients within the deep overburden are upward. These gradients converge toward the fine sand and silt and/or gravel portions of the overburden, which are downward-dipping to the west (Figure 6).

- 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 wells. 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. Analytical data indicates that the plume has reached a steady-state condition (Appendix G of ERM 2005a). The presence of ethene in groundwater indicates that complete intrinsic biodegradation of CVOCs is occurring under natural Site conditions. This degradation of parent constituents is evidence of intrinsic biodegradation within the Northern Area of the Site. CVOCs may be transformed through biological and abiotic reactions. Parent compounds within the Northern Area of the Site (PCE and TCE) make up the majority of contaminant mass near the Source Area, but daughter products (cDCE and VC) are dominant within the downgradient extent of the plume.

2.4 RELEVANT CONTACTS

The following table provides contact information for Site owners and those persons who will operate and/or maintain the selected remedial action alternative(s) during and following construction.

Name	*Role*	*Contact Information*
John C. Drobinski	ERM LSP-of-Record	ERM 399 Boylston St., 6th Fl Boston, MA 02116 (617) 646-7800
Louis J. Burkhardt	Raytheon Company Senior Environmental Engineer Responsible Party	Raytheon Company 880 Technology Park Drive MS 2-2124-01 Billerica, MA 01821 (978) 436-8238
Paula S. Phillips	The Congress Group, Inc. Vice President of Operations Property Owner	The Congress Group, Inc. 33 Arch Street, Suite 2100 Boston, MA 02110
Robert Schelmerdeine	Legal counsel, Wayland Meadows Limited Partnership; c/o Levco Inc. Property Owner	Wayland Meadows Limited Partnership; c/o Levco Inc. 145 Rosemary Street, Needham, MA 02494 (508) 850-5200

3.0 DESIGN BASIS

3.1 IMPACTED AREAS

3.1.1 Soil

Soil is impacted primarily by PCE, TCE, and cDCE, associated with suspected transient release(s) of chlorinated solvents in the Source Area. These CVOCs have been detected in Site soil at levels above reportable concentrations for Category S-1 soil (RCS-1) as defined by the MCP. CVOC concentrations for the soil boring program are shown in plan view (Figure 5).

Although not included in the Risk Characterization, presented in the Phase II, the CVOCs in soil will contribute to a condition of "significant risk" to human health because the Site is located within a DEP-approved Zone II Aquifer Protection Zone. The presence of residual and sorbed VOCs, located in the low hydraulic conductivity fine sand and silt soils, represent the source of dissolved phase impacts to groundwater in the Northern Area. The boundary of the Northern Area CVOC soil residual area was delineated to levels below applicable regulatory standards to the south and west of the Source Area. The northern and eastern boundary of the CVOC soil residual area will be delineated during additional soil sampling conducted during the Source Area soil excavation.

Under current land use conditions, risks to human health by impacted soil are considered negligible since the impacted soil is at depths greater than 5 feet bgs. Additionally, a Deed Restriction was filed on the Former Raytheon Facility property on 21 October 1997. Activities and uses specifically allowed by the Deed Restriction include commercial or industrial uses. Activities and uses specifically prohibited include residential, childcare, daycare, agricultural, groundwater uses (except for remediation purposes) and subsurface activities and/or other activities that could render contaminated media accessible.

3.1.2 Groundwater

Groundwater is impacted primarily by TCE and associated degradation products, likely to be associated with suspected transient release(s) of chlorinated solvents. Five VOCs have been detected in Site groundwater at concentrations above Method 1 GW-1 standards: PCE, TCE, cDCE, VC, and toluene. CVOC concentrations for the most recent monitoring round are shown in cross-section (Figure 6) and plan view (Figure 7).

Toluene was detected for the first time above the RCGW-1 standard within a single sample collected from Waterloo Profiler boring WP-520 during the Source Area characterization activities. Toluene has not been detected above its RCGW-1 standard in groundwater samples collected from monitoring wells located in the Northern Area. The absence of additional groundwater monitoring data to support the detection of toluene above RCGW-1 leads ERM to conclude the detection of toluene above RCGW-1 is not representative of Site conditions.

Chloroform was detected above its RCGW-1 concentration at MW-556S during groundwater sampling events in September and October 2005. Additional groundwater data did not confirm the detection of chloroform in groundwater at this well. Because the detections were not reproducible, a RNF for this condition was not submitted to the DEP.

VOCs in groundwater pose a condition of "significant risk" to human health because the Site is located within a DEP-approved Zone II Aquifer Protection Zone where groundwater quality must meet Massachusetts Maximum Contaminant Levels (MMCLs) for drinking water. Groundwater in the Northern Area flows to the west toward the Sudbury River and associated wetlands, which represent the regional hydrologic discharge boundary. The Northern Area CVOC plume migrates from east to west toward the Sudbury River and associated wetlands. The western boundary of the CVOC plume was delineated to levels below applicable reportable concentrations within the wetlands east of the Sudbury River. The northern boundary of the CVOC plume was delineated to levels below applicable reportable concentrations approximately 0.4 miles south of the Baldwin Pond Wellfield. The plume is currently in steady state. Thus, future potential risk to the Baldwin Pond Wellfield is considered to be minimal.

The condition of significant risk is based on the potential for future exposure by hypothetical receptors (i.e., assumes that drinking water wells are located within the Northern Area, and that groundwater from within the area of impact is withdrawn for consumption). Under current land use conditions (e.g., Deed Restriction), risks to human health are considered negligible since the area of impact is remote from Baldwin Pond Wellfield such that there is currently no complete exposure pathway to impacted groundwater, (i.e., groundwater within the zone of impact is not currently utilized as a source of drinking water).

3.2 REMEDIAL GOALS

3.2.1 Soil

In accordance with 310 CMR 40.0933, Site soil is classified based on land use characteristics and exposure potential. The MCP includes three categories for classification of Site soil (i.e., S-1, S-2, and S-3) based on MCP criteria for accessibility, frequency, and intensity of use. Category S-1 soils are associated with the highest potential for exposure, while Category S-3 soils have the lowest potential for exposure.

Based on current uses, Site soil is classified as Category S-2 because:

- Adults (e.g., office workers) are potentially present at the Site at high frequency, but low intensity;
- Children (e.g., trespassers and visitors) are potentially present at the Site at low frequency and low intensity;
- Some soils are considered to be "accessible" since portions of the Site are unpaved;
- Some soils are considered to be "potentially accessible" since portions of the Site are paved;
- The Deed Restriction filed for the portions of the Site where soil is impacted prohibits activities and use that would result in classification of Site soil as S-1; and
- Based on potential future uses and the limitations of the Deed Restriction, the soil classification is not expected to change and certain areas of the Site should be classified as S-2 under future conditions while others may have the Deed Restriction removed.

Proposed remedial action objectives for Source Area soils are summarized in the following table and represent the arithmetic average concentrations of selected residual OHM following remediation.

Source Area Saturated Soil Target Cleanup Goals

Parameter	*MCP Method 1: S-2 & GW-1 (µg/g or ppm)*
PCE	0.5
TCE	0.4
cDCE	2
VC	0.4

A Source Area saturated soil target cleanup goal is not presented for toluene since previous soil sampling conducted in the Source Area of the Northern Area has not identified toluene at concentrations above RCS-1.

3.2.2 *Groundwater*

Since the Site is located within a current drinking water Source Area (i.e., Zone II aquifer protection zone for the Baldwin Pond Wellfield), abatement measures must reduce the concentrations of VOCs in groundwater to applicable MMCLs in order to achieve a Permanent Solution. A reduction in VOC concentrations to MMCLs would achieve a condition of "no significant" risk to human health under future conditions.

The level and extent of PCE, TCE, cDCE, or VC in groundwater is not anticipated to adversely impact down-gradient surface water quality or potential environmental receptors. A reduction in the concentrations of VOCs to MMCLs would meet Response Action Performance Standards (RAPS, 310 CMR 40.0191) for achievement of a condition of "no significant risk." Therefore, MMCLs are adopted as initial target cleanup goals for VOCs in groundwater and are summarized in the table below.

Groundwater Target Cleanup Goals

Parameter	*MMCLs (µg/L or ppb)*
PCE	5
TCE	5
cDCE	70
VC	2

A groundwater target cleanup goal is not presented for toluene since groundwater monitoring data has not identified toluene in the Northern Area monitoring wells.

To achieve a permanent solution, Response Action Performance Standard (RAPS) also requires consideration of abatement to background levels, if feasible. DEP guidance indicates that "achievement" of background is considered "generically infeasible" for chlorinated hydrocarbons in groundwater, but indicates that a reduction in contaminant concentrations should "approach" background, if feasible (DEP, 2004). Therefore, as a secondary target cleanup goal, abatement of PCE, TCE, cDCE and VC in groundwater will attempt to "approach" background, if feasible. The feasibility of abatement of CVOCs in groundwater to "approach" background will be evaluated based on the success of remedial measures at reducing CVOC concentrations in groundwater to MMCLs.

4.0 CONCEPTUAL DESIGN – SOIL REMOVAL

4.1 OVERVIEW

Remedial activities will require the excavation of an estimated 4,700 cubic yards (yd^3) of soil material from the Source Area in the Northern Area (Figure 8). The excavation will directly disturb approximately 5,000 square feet of surface area and will extend to an average depth of 25 feet bgs.

4.2 DESIGN AND CONSTRUCTION

The Phase III was conducted under the requirements of the MCP and submitted to the DEP in December 2005, (ERM, 2005a). Based on the results of the Phase III comparative analysis, excavation of Source Area saturated soils and bioremediation in groundwater are the preferred remedies for abatement of Site impacts. These remedies were selected based of the criteria specified in the MCP (310 CMR 40.0858): effectiveness, reliability, feasibility to implement, cost-effectiveness, posing minimal risk, and timeliness.

ERM anticipates that the sequence of remedial activities will be as follows:

- Excavation and off site disposal or treatment of saturated Source Area soils;
- Installation of recharge gallery for future carbon substrate amendment;
- Backfilling the excavation with clean fill;
- Monitoring the effects of Source Area abatement on near-source groundwater quality;
- Initiate carbon substrate amendments to abate CVOC impacts to groundwater, as appropriate; and
- Continue monitoring groundwater quality over time.

Raytheon will own the proposed cofferdam structures, dewatering treatment system, and remedial additive injection system while ERM will operate and maintain these structures.

4.2.1 *Pre-Construction Activities*

Pre-construction activities included collection of soil samples to characterize soil quality to support Phase IV remedial design activities. This activity was discussed in Section 2.2.

4.2.2 *Design of Cofferdam*

Hartman Engineering of Clarence, New York has completed design of a cofferdam system to enable the excavation of an approximately 80-foot diameter area, to a depth of approximately 25 feet. Sheet pile will be driven with a 100-ton crane with a 100-foot boom or equivalent to a depth of 55 feet holding the cofferdam in place with a system of concrete walers acting as compression rings, holding open the circular sheet pile configuration (Figure 9). The cofferdam system will eliminate the need for traditional sheet pile and cross bracing, which can restrict accessibility and equipment movement within an excavation.

The depth to water at the site is approximately 10 to 12 feet bgs. The design of the system also takes into account pressure from 20 to 25 feet of water and soils above the bottom of the excavation to minimize upwelling of groundwater from the bottom of the cofferdam to ensure safe work within the cofferdam.

The concrete walers will be spaced 7 to 8 feet apart by design and will be constructed using 4,000 pounds per square inch concrete. Hanger bars will be installed as the concrete dries to hang the walers from the driven pile. Electrical strain gauges will be installed in the concrete walers to provide information on stress to the cofferdam during the excavation due to load changes. Data from strain gauges will be collected to verify that actual loads on the concrete rings do not exceed design loads. Supporting design calculations are included as Appendix D.

There are aboveground and belowground utilities in the vicinity of the excavation, which will be located and confirmed to be deactivated prior to construction.

4.2.3 *Excavation and Staging*

Erosion Control

A small portion of the excavation area will include a Bordering Vegetated Wetland (BVW) and 100-foot Buffer Zone. ERM has filed a Notice of Intent with the Town of Wayland Conservation Commission

(Commission) to conduct the excavation with these protected areas. All field work will be conducted in accordance to the Order of Conditions to be issued by the Commission.

Erosion control practices will be implemented to protect the resource area from sediment entering the BVW adjacent to the area to be excavated. Figure 8 shows the locations where the erosion controls will be installed and maintained until stabilization by vegetation occurs following the excavation. Standard erosion control methods using a staked silt fence and entrenched hay/straw bales will be deployed to protect against runoff into the adjacent BVW (Figure 10).

Dewatering

Groundwater and precipitation entering the excavation will be pumped, collected, treated and discharged. Collected water will be pumpd to a settling tank and/or primary filtration system consisting of bag filters. Water treatment may include OHM removal via activated carbon or other appropriate technologies. A set of secondary bag filters will be used to remove any residual solids from the discharge stream. A flow diagram of the water treatment train is attached as Figure 11. The discharge will be to the site stormwater conveyance system and eventually to the Sudbury River. Sediments and water will be analyzed prior to off site disposal, reuse and/or discharge.

Under the National Pollution Discharge Elimination System (NPDES) regulations, all water discharge associated with a remedial activities require a Remediation General Permit (RGP). Raytheon will apply for a RGP for site activities prior to discharge of treated water to the stormwater system.

At a minimum, influent, intermediate and effluent water from the treatment system will be analyzed for the presence of VOCs, total suspended solids (TSS) and pH. Any other analytical parameters required by the RGP will be added to the analytical schedule. Following initial startup, water will be analyzed on Day 1, 3 and 6 and then weekly thereafter. The Commission will receive copies of all analytical data. Under the Paper Work Reduction Act, the EPA will not receive discharge monitoring reports, but Raytheon will retain these records in accordance with the RGP.

Excavation

The top 5 feet of soil in the targeted remedial area will be removed and screened and staged as "clean soil" for reuse as backfill in later stages of the project. The sheet piling for the cofferdam will be installed at 5 feet bgs to a total depth of 55 feet bgs. The sheets will be installed using traditional pile driving equipment.

Following the installation of the cofferdam sheets, the excavation within the cofferdam will continue in 7- to 8-foot lifts. Soils will be screened and segregated by contaminant levels and staged in appropriate areas. At the end of each lift, a concrete waler will be installed prior to continuing to the next lift. A total of three to four lifts will be excavated to a total depth of approximately 25 feet bgs.

Heavy equipment such as cranes, excavators, front-end loaders and bulldozers will access the remedial area via temporary roadways shown in Figure 8. Based on the delineation of impacts to the Source Area, it is anticipated that approximately 53 feet of the identified BVW will be temporarily impacted by the excavation and by supporting activities. This area will be protected in accordance with the Order of Conditions to be issued by the Commission.

Soil removal is estimated to be approximately 4,700 yd^3 of material from the cofferdam, and up to 4,000 yd^3 of remediation waste may be generated. Dump trucks will be loaded on the temporary roadways to transport impacted material to the staging area. The top 5 feet of soils from each excavation area has been field screened and is considered to be "clean" material. This top 950 yd^3 will be staged in the "Clean Soil Staging Area" next to the excavation areas. The remaining material will be field screened with a PID and segregated in the parking lot staging areas (Figure 8).

Staging

The staging area for management of remedial waste will be located outside the Buffer Zone in the parking area; 300 feet landward of the wetland edge to meet state and local Buffer Zone setbacks (Figure 8). Two remedial waste staging areas, approximately 150 feet by 150 feet in size, will be constructed. A minimum of one water collection trench and/or sump will be excavated in each area, which will collect water runoff from the contaminated soil. Concrete jersey barriers and/or hay bales will be placed around the perimeter of each area and lined with a heavy-duty poly-liner. Stockpiles will be covered in plastic at the end of each work day.

All water will be collected in a sump, and pumped to a settling tank. Water samples will be collected and analyzed for VOCs by EPA Method 8260. Collected (and treated, if necessary) water will be discharged to the stormwater conveyance system under the RGP, if it meets the NPDES discharge criteria. If water treated on site does not meet discharge criteria, it will be contained and shipped off site for disposal. Workers in this area will be required to follow the Site-specific Health and Safety Plan (Appendix E).

Clean fill will be placed at approximate final grade (Figure 9a) as soon as excavation is completed.

Cleaning and Decontamination of Equipment and Sampling Equipment

Any non-dedicated manual sampling equipment used to collect soil samples will be cleaned and decontaminated prior to its initial use, between each sampling location and after the final use. Samples will be collected using a mechanical coring device or a hand shovel. The following general procedures will be followed concerning decontamination efforts:

1) If visual signs (i.e., discoloration) suggest that decontamination was insufficient, the equipment will again be decontaminated. If the situation persists, the equipment will be taken out of service until the situation can be corrected.

2) Verification of the non-dedicated sampling equipment cleaning procedures will be documented by the collection of field blanks (equipment rinsate).

3) All properly decontaminated equipment will be stored in aluminum foil and plastic bags during storage and transport.

The following step-by-step decontamination procedures will be followed for all non-dedicated sampling tools:

i) Non-phosphate detergent wash;

ii) Tap water rinse;

iii) Methanol rinse;

iv) Triple deionized/distilled water rinse; and

v) Air dry.

Heavy equipment will be decontaminated inside the Contamination Reduction Zone and in the parking lot, as necessary. Heavy equipment will be parked on a decontamination pad, which will collect liquids generated during cleaning. Liquids generated during any decontamination process will be collected, contained and appropriately labeled for disposal or treated via the RGP discharge. Waste liquids will be stored on site until potential hazard class identification and final disposition have been determined.

Decontamination protocols will be strictly adhered to in order to minimize the potential for cross-contamination between sampling locations and contamination of off site areas. More specific decontamination procedures are addressed in the Health & Safety Plan (Appendix E).

4.2.4 Management of Remedial Waste

Transportation and Disposal

Stockpiled material will be shipped to the designated disposal facility via truck and/or rail. When segregated material has been released from the stockpile area, it will be loaded into dump trailers or roll-offs utilizing front-end loaders and other earth-moving equipment as needed. Trucks will transport this material to the destination facility or to a rail facility. If the material is transported via rail, the excavated soil will be transferred to rail containers at the rail facility prior to shipment. All necessary transportation permits and approvals will be acquired prior to off site transport.

All hazardous material shipped from the Site will be properly manifested or shipped under a bill of lading if the material is non-hazardous. A log will be maintained to track all shipments that leave the Site. The following information will be tracked:

- Container ID, date, time container left Site;
- Hauler;
- Approximate volume;
- Weight (when measured);
- Waste classification;
- Manifest number; and

- Date of receipt of manifest copy.

All material from the excavation areas will be disposed of at the appropriate regulated disposal facility. Any treated water that does not meet discharge requirements will be containerized and shipped off site for treatment and disposal.

4.2.5 Traffic Plan

Truck traffic in and out the site will be limited to traveling on the westbound side of Route 20 (Boston Post Road). Approximately six to twelve trucks per day will be traveling to and from the site during backfilling and disposal activities. ERM will notify the Town of Wayland of additional traffic during these activities. If necessary a traffic detail will be provided.

4.3 OPERATION PARAMETERS

4.3.1 Sampling

Soil sampling will be conducted for the purposes of establishing residual concentrations of VOCs. Grab samples will be taken from the bottom of the excavation using a crane and clamshell bucket. Perimeter samples will be taken around the circumference of the cofferdam, approximately every 25 feet at three different depths in each location. All soil samples will be analyzed for VOCs by EPA Method 8260.

4.3.2 Structural Monitoring

Electrical strain gauges in the concrete walers provide information for computing levels of stress due to load changes. Data from strain gauges will be collected to verify actual loads in the concrete rings do not exceed design loads.

4.4 IMPLEMENTATION PROGRAM

4.4.1 Spill Prevention Control and Countermeasures

A copy of the Spill Prevention Control and Countermeasures Plan is located in Appendix F.

4.4.2 *Site and Environmental Impacts*

The proposed remedial activities will be conducted in a floodplain wetland, adjacent to the Sudbury River. A Notice of Intent has been submitted to the Commission and the DEP.

The remedial actions proposed are limited to a minor portion of the property in primarily an upland setting adjacent to the parking areas. Wetland jurisdiction within the proposed work zone consists of a narrow swale considered BVW and its associated 100-foot Buffer Zone. The 200-foot Riverfront Area to the Sudbury River does not encompass the proposed work area. The proposed excavation area and supporting layout areas are not located within the 100-year floodplain as shown on Figure 8.

The remedial activities are proposed at the most upgradient portion of this BVW finger where a shallow swale is discernible; however, no signs of flow or surface water are present. This narrow wetland is a linear feature that slopes slightly to the west but no apparent inlets or outlet are in place. The BVW finger lacks a tree canopy in the work area.

To mitigate for the temporary disturbance to the BVW finger and 100-foot Buffer Zone, the approximate pre-existing grades will be reestablished and vegetative cover accelerated by broadcasting seed mixes such as New England Conservation/Wildlife Mix or equivalent.

4.4.3 *Inspections and Monitoring*

Inspection and monitoring of the cofferdam is described in Section 4.3 of this text. Wetland restoration monitoring requirements will be conducted in accordance with the Order of Conditions to be issued by the Town of Wayland.

4.4.4 *Health and Safety Issues*

The Site specific Health and Safety plan was prepared in accordance with 310 CMR 40.0018. A copy of the plan is included in Appendix E.

4.4.5 *Required Permits*

An Notice of Intent (NOI) is required by the Wetlands Protection Act. The completed application was submitted to the Commission on 27 April 2006 for approval of the proposed work. The Commission will issue an Order of Conditions outlining measures to be taken during excavation activities to minimize the impact to the BVW and 100-foot Buffer Zone.

A RGP is required if treated water from the project is to be discharged to the wetland or river. Water from dewatering activities, and/or effluent generated from the treatment of remedial wastewater, will require treatment prior to discharge as described in Section 4.2.3.

4.4.6 Property Access

Raytheon has secured access to the properties listed below to enable implementation of remedial measures.

Property Owner	*Town Parcel #*
Twenty Wayland LLC	23-52C
Levco	23-52D

5.0 CONCEPTUAL DESIGN – GROUNDWATER TREATMENT

5.1 OVERVIEW

Following the completion of the Source Area removal, one year of quarterly monitoring for CVOCs will be conducted to establish new steady-state conditions of the groundwater plume. These new site conditions will be used to develop a detailed implementation plan for bioremediation of the groundwater plume. A general explanation of the technology and site activities are provided in this section.

5.2 BACKGROUND

In situ bioremediation is a remedial technology that, through a series of chemical reactions, transforms CVOCs into neutral by-products, resulting in production of carbon dioxide, water and salt. Site groundwater and monitored natural attenuation (MNA) analytical data provide evidence that intrinsic bioremediation is occurring at the Site. A treatability study was conducted to evaluate the potential for enhancing intrinsic biodegradation of PCE, TCE and cDCE by amending groundwater with an additional carbon source, as well as introducing bacteria known to degrade these compounds completely to ethene (ERM, 2005b). Terra Systems Inc., (Terra Systems) of Wilmington, Delaware performed the treatability study and was present during the collection of the representative groundwater and soil samples for use in the microcosm. The objectives of the treatability study were to:

- Determine if and to what extent the native microbial population can degrade the chlorinated solvents with and without additional substrate; and
- Evaluate potential substrates, such as lactate and soybean oil, to determine which substrate may work best at this Site.

The addition of substrates such as lactic acid and emulsified soybean oil by themselves led to the dechlorination of TCE to cDCE, but did not lead to the complete dechlorination of TCE to ethene.

The treatability study results are not reflective of in situ conditions, based on geochemical data collected in the plume. The heterogeneity of the subsurface is likely the reason for the different assessment outcomes. In situ, the most reducing zones are located in the fine silty sand layers. A physical difference in the redox chemistry was noted during the review of the soil samples during drilling. The increased surface area of the fine particles also creates a more favorable environment for dehalogenating microbes. Intrinsic reductive dechlorination is likely occurring in these zones and discharging this "treated" water to the coarser sand layers below.

These coarser sand layers are where the downgradient groundwater monitoring wells are screened and where samples were taken for the microcosm studies during routine groundwater monitoring activities. The difference in the redox states of the silty sand and the coarser sand units is likely the reason for the difference in microbial activity in situ and therefore the reason the microcosm results were improved by the addition of a dechlorinating enrichment culture.

A complete discussion of the microcosm treatability study was provided in the Phase III (ERM, 2005a).

5.3 DESIGN AND IMPLEMENTATION

5.3.1 Pre-Remedial Design Activities

Implementation of bioremediation requires the installation of application points to apply substrate to the formation. These points are typically located upgradient of the target treatment area to allow advective groundwater flow and diffusion to distribute the substrate and provide a natural conveyance throughout the target treatment area. These points can also provide baseline information to confirm the Site conditions prior to the start of applications.

An infiltration gallery will be installed in the fill area of excavation. This infiltration gallery will be used to passively introduce large quantities of substrate to the subsurface.

ERM installed monitoring wells downgradient of the Source Area to monitor groundwater quality. These monitoring wells (i.e., MW-261S, MW-551, MW-552, and MW-553) will be used to monitor the impact of excavating Source Area residual soils on groundwater. These wells may potentially be used as injection wells during bioremediation.

A baseline round of groundwater sampling will be conducted prior to initiating bioremediation, including both the injection and monitoring points. The following monitoring wells will be designated as monitoring locations for bioremediation remedial activities:

- DEP-19M, MW-261S, MW-262S, MW-264M, MW-265M, MW-266Ma/Mb, MW-267S/M, MW-268M/D, MW-551, MW-552, MW-553.

Each monitoring and injection point will be analyzed for the parameters listed below:

Bioremediation Monitoring Parameters

Analysis	*Method of Analysis*
VOCs	Method 8021B (chlorinated compounds only)
Dissolved gases (methane, ethene, and ethane	EPA Method GC Screen
Chloride	EPA Method 325.2 Ion Chromatography (IC)
Nitrate	EPA Method 300.0 IC
Dissolved Iron	EPA 6010
Dissolved Manganese	EPA 6010
Sulfate	EPA Method 375.4 IC
Alkalinity	EPA Method 2320B
Total Organic Carbon (TOC)	EPA Method 415.1
Phospholipid Fatty Acid (PLFA)	IC
Total Phosphorus	EPA Method 365.2 and SM 4500P-E
Dehalococcoides ethenogenes (DHE)	Gel Electrophoresis
Total Kjeldahl Nitrogen (TKN)	EPA Method 351.3/.1 and SM 4500N-C

Additional monitoring/injection well(s) may be installed to implement and evaluate the bioremediation remedial activity or to replace monitoring wells destroyed during the Source Area soil excavation. The reinstalled wells will meet the same design specifications as the monitoring well it is intended to replace.

5.3.2 *Development of Remedial Design*

Results of the treatability study and the results of groundwater sampling events following the saturated soil excavation will be used to design the type and dosage of substrate for addition in the Northern Area. Injection rates of the remedial additives will be based on the hydraulic characterization data from the injection wells. Currently, the following options are under consideration:

- Passive Injection – The passive approach would involve introducing remedial additives in an infiltration gallery and/or injection wells and monitor at the monitoring well(s). A passive approach would require more extensive monitoring and necessitate a longer monitoring period to allow the natural groundwater gradients to convey nutrients and biomass.
- Semi-Active – The semi-active approach would introduce remedial additives into each injection well as described above. To enhance groundwater flow rates and substrate distribution within the target treatment area, the downgradient monitoring well will be pumped periodically to impart pulsed-pumping on the aquifer. With this approach, groundwater will be extracted from the monitoring well on a monthly or bi-monthly basis to promote downgradient movement of remedial additives. This pulsed method could reduce the evaluation period due to reduced travel times of the remedial additives.

If a semi-active system is used, all extracted groundwater would be collected, mixed with additional substrate and re-injected into the injection wells.

5.3.3 Injection Program

Remedial additives consisting of nutrients and carbon source(s) will be injected into the overburden in the injection wells at the Site to promote reductive dechlorination of PCE, TCE, cDCE, and VC.

Based on results of the treatability study (ERM 2005a), preferred carbon source(s) and quantities of substrate will be identified. Batches of the carbon and nutrients will be added to the injection well approximately weekly. Nutrients will be stored in shipping containers, drums or portable tanks and mixed in batches as needed. The infiltration gallery and/or injection wells will be provided with sealed wellheads and an injection tube within the screened interval of the injection well. If the injection rate is sufficient, gravity additions directly from a mixed tank may be implemented for injection. After approximately one month of operation, the benefits of automating the addition will be evaluated and the system upgraded if deemed appropriate.

5.3.4 *Post-Injection Monitoring*

The designated monitoring locations will be checked periodically during the injection program. The monitoring locations identified (see Section 5.3.1) will provide designated monitoring points for bioremediation remedial action.

Monitoring will consist of the weekly measurement of field parameters (e.g., oxidation-reduction potential, dissolved oxygen, pH, temperature and conductivity), with the monthly analysis of volatiles (PCE, TCE, cDCE, and VC) and the parameters as shown on the above table.

After approximately three months of operation, the monitoring schedule will be reviewed against the impressed impacts on the aquifer and the schedule of future monitoring were adjusted accordingly.

5.4 *IMPLEMENTATION PROGRAM*

5.4.1 *Spill Prevention Control and Countermeasures*

A copy of the Spill Prevention Control and Countermeasures (SPCC) Plan is located in Appendix F.

5.4.2 *Residual Material Management*

Any contaminated groundwater, drilling cuttings or drilling fluids generated as part of the bioremediation treatment will be containerized and disposed of properly.

5.4.3 *Site Impacts*

Implementation of the bioremediation remedial system involves advancement of soil borings and injection of a substrate beneath undeveloped portions of the Site. The substrate will likely migrate to the west along the same flowpath as groundwater.

The bioremediation remedial activities will not affect local drainage features, natural resource areas, or local planning and development issues.

5.4.4 *Environmental Impacts*

The bioremediation remedial activities will be conducted within a mapped Zone II aquifer protection district for the Baldwin Pond Wellfield.

Pursuant to 310 CMR 40.0046(3), since the application of Remedial Additives (i.e., substrate) will not be conducted within 100 feet of any private water supply well or within 800 feet of any public water supply well, well field or tributary thereto, DEP approval is not required to conduct the remedial activities within this resource area. ERM does not anticipate any adverse impacts to the Sudbury River and its associated wetlands or the Baldwin Pond Wellfield from the bioremediation remedial activities as intrinsic bioremediation is currently occurring at the Site.

5.4.5 Health and Safety Issues

The Site-specific Health and Safety plan was prepared in accordance with 310 CMR 40.0018. A copy of the plan is located in Appendix E.

5.4.6 Required Permits

Pursuant to 310 CMR 40.0046, no permits are required from the DEP to complete bioremediation remedial activities within the proposed treatment areas.

5.4.7 Property Access

Raytheon will have to secure access with the current property owner to enable implementation of remedial measures. Property owner and land parcels requiring approval for access are listed in Section 4.4.6.

6.0 *IMPLEMENTATION SCHEDULE*

The anticipated schedule for remedial activities at the Site is presented below.

Implementation Schedule for Phase IV RIP

Date	*Event*
15 September 2006	Prepare Site and Install Cofferdam
1 October 2006	Begin Excavation
30 October 2006	Complete Excavation and Commence Backfill
15 November 2006	Restoration Activities
January 2007	Submit Phase IV Completion Report
May 2007	Initiation of Wetland Restoration Activities
2007	Conduct Quarterly Groundwater Monitoring
2008	Conduct Substrate Injections
2008	Conduct Quarterly Groundwater Monitoring
2008	As-Built Construction Report
2008	Final Inspection Report

7.0 *REFERENCES*

ERM-New England, Inc. (ERM), December 2002, "Release Notification Form, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts," letter report submitted to the DEP.

ERM, December 2003, "Phase I – Initial Site Investigation, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts, RTN 3-22408," report submitted to Raytheon Company.

ERM, December 2005a, "Phase II - Comprehensive Site Assessment, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts, RTN 3-22408," report submitted to Raytheon Company.

ERM, December 2005b, "Phase III – Remedial Action Plan, Former Raytheon Facility, 430 Boston Post Road, Wayland, Massachusetts, RTN 3-22408," report submitted to DEP.

Massachusetts Department of Environmental Protection, "Conducting Feasibility Evaluations Under the MCP". Policy #WSC-04-160, 16 July 2004.

Tables

Table 1
Summary of Soil Analytical Results - VOC
Former Raytheon Facility
Wayland, Massachusetts

Parameter	MCP Criteria Method 1 S-2 & GW-1	Sample I.D. Date Sampled Depth	SB-515 01-Feb-06 15' - 20 '	SB-522 01-Feb-06 10' - 15 '	SB-522A 01-Feb-06 10' - 15 '	SB-525A 14-Apr-06 10 - 15'	SB-525B 14-Apr-06 10 - 15'	SB-529 31-Jan-06 15' - 20 '	SB-529 31-Jan-06 5' - 10 '	SB-530 31-Jan-06 5' - 10 '	SB-530A 01-Feb-06 10' - 15 '	SB-530B 14-Apr-06 10' - 15 '	SB-530C 14-Apr-06 10' - 15 '	SB-531A 31-Jan-06 15' - 20 '	SB-531B 31-Jan-06 10' - 15 '	SB-531C 14-Apr-06 15-20'	SB-531D 14-Apr-06 15-20'	SB-531E 14-Apr-06 15-20'	SB-531F 14-Apr-06 15-20'	SB-534 31-Jan-06 15' - 20 '	SB-534A 31-Jan-06 20' - 25 '	SB-534B 01-Feb-06 15' - 20 '
Volatile Organic Compounds (VOCs) (8260) ug/kg																						
Tetrachloroethene	1,000		490	**1,800**	-	220	44	6.3	**17,000**	**2,900**	160	210	94	63	250	200	160	100	140	230	1.2	-
Trichloroethene	300		**16,000**	**26,000**	1.4	**1,800**	250	30	**57,000**	**3,900**	**520**	**1,700**	**460**	**440**	**1,300**	**1,200**	**1,400**	**780**	**720**	**6,000**	14	3.6
cis-1,2-Dichloroethene	300		240	**1,700**	-	**330**	85	3.5	**2,500**	**2,200**	150	260	86	53	**380**	180	140	-	130	-	1.4	-
Toluene	30,000		-	-	-	-	-	-	5,400	-	-	-	-	-	-	-	-	-	-	-	-	-
p-Isopropyltoluene	NS		-	-	-	-	-	-	-	-	0.91	-	-	-	-	-	-	-	-	-	-	-
N-Butylbenzene	NS		-	-	-	-	-	-	-	-	0.91	-	-	-	-	-	-	-	-	-	-	-
Acetone	3,000		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10

Notes:
Only compounds with detectable results are tabulated
ug/kg = micrograms per kilogram (parts per billion (ppb))
- = Analytical result below the method detection limit.
NS = No Standard
Bold and shaded cells exceed regulatory criteria.

Table 2
Summary of Soil Analytical Results - Additional Parameters
Former Raytheon Facility
Wayland, Massachusetts

Parameter	MCP Criteria RCS-1	Sample I.D. Date Sampled Depth	Composite Soil Boring * 01-Feb-06	SB-522 01-Feb-06 10' - 15 '
Semivolatile Organic Compounds (SVOCs) (8270) ug/kg			-	-
Extractable Petroleum Hydrocarbons (EPH) (EPH-04-1) mg/kg			-	-
Polychlorinated Biphenyls (PCBs) (8082) ug/kg			-	-
Total Metals (6010) & (7471) mg/kg				
Antimony	10		-	-
Arsenic	30		5.6	4.9
Beryllium	0.7		-	-
Cadmium	30		-	-
Chromium	1,000		15	17
Copper	1,000		13	16
Lead	300		5.4	5.5
Mercury	20		-	-
Nickel	300		13	16
Selenium	400		-	-
Silver	100		-	-
Thallium	8		-	-
Zinc	2,500		30	32

Notes:
- = Analytical result below the method detection limit.
NA = Not Analyzed
ug/kg = micrograms per kilogram (parts per billion (ppb))
mg/kg = milligrams per kilogram (parts per million (ppm))
NS = No Standard
* = SB-515, SB-522, SB-522A, SB-528, SB-530A, SB-534B

Table 3
Summary of Soil Analytical Results - Waste Characterization
Former Raytheon Facility
Wayland, Massachusetts

Parameter	Regulatory Level ug/L	Sample I.D. Date Sampled	SB-529 31-Jan-06
TCLP Volatile Organic Compounds (VOCs) (8260) ug/l			
Tetrachloroethene	700		82
Trichloroethene	500		260
TCLP Semivolatile Organic Compounds (SVOCs) (8270) ug/l			
2,4,5-Trichlorophenol	400,000		28
TCLP Pesticides and Herbicides			-
TCLP Metals (6010)			-

Notes:
- = Analytical result below the method detection limit.
NA = Not Analyzed
ug/l = micrograms per liter (parts per billion (ppb))
Regulatory Level = Maximum Concentration for Toxicity Characteristic (310 CMR 30.125B)

Table 4
Summary of Groundwater Gauging Data
Former Raytheon Facility
Wayland, Massachusetts

Well I.D.	Measuring Point Elevation (ft. ASL)	3-Apr-06	
		Depth to Water (ft. below measuring point)	Potentiometric Surface Elevation (ft. above sea level)
DEP-19S	120.79	2.93	117.86
DEP-19M	120.62	0.40	120.22
DEP-19D	120.78	0.78	120.00
DEP-20	119.98	0.35	119.63
DEP-21	119.18	**	**
HA-101	127.27	6.90	120.37
HA-102	128.14	13.41	114.73
HA-103	131.54	13.67	117.87
HA-104	132.39	16.90	115.49
IP-16S	134.77	16.18	118.59
IP-16D	134.74	16.49	118.25
IP-17S	134.80	17.80	117.00
IP-17D	134.83	17.40	117.43
MW-1S	133.79	9.54	124.25
MW-1M	133.78	12.84	120.94
MW-1D	133.74	14.14	119.60
MW-10	130.86	7.88	122.98
MW-32	124.41	3.62	120.79
MW-33S	133.58	17.75	115.83
MW-33M	133.77	17.62	116.15
MW-33D	133.57	17.68	115.89
MW-33B	133.67	16.48	117.19
MW-34	136.67	10.49	126.18
MW-37	134.43	15.21	119.22
MW-37M	134.40	17.02	117.38
MW-38	134.42	14.67	119.75
MW-40	134.84	14.25	120.59
MW-40S	134.82	14.24	120.58
MW-41	127.46	13.51	113.95
MW-42S	134.44	13.84	120.60
MW-43S	133.82	14.30	119.52
MW-43D	134.31	48.30	86.01
MW-44S	134.73	14.85	119.88
MW-44M	134.57	15.12	119.45
MW-44D	134.66	15.30	119.36
MW-45S	132.07	17.14	114.93
MW-45M	132.28	17.33	114.95
MW-45D	131.88	15.41	116.47
MW-45B	131.59	16.43	115.16
MW-46S	131.44	13.56	117.88
MW-46M	131.52	-	-
MW-47S	132.30	16.64	115.66
MW-47M	131.99	15.96	116.03
MW-47D	132.29	16.25	116.04
MW-101	134.60	18.22	116.38
MW-102	134.50	17.89	116.61
MW-103	134.50	15.85	118.65
MW-104	134.22	14.49	119.73
MW-105	134.58	14.63	119.95
MW-105M	134.22	19.94	114.28
MW-106	134.63	15.44	119.19
MW-106M	134.63	16.20	118.43
MW-107	134.65	17.42	117.23
MW-108	134.69	17.36	117.33
MW-109	134.12	25.50	108.62
MW-110	134.04	16.21	117.83
MW-111	133.88	24.09	109.79
MW-112	133.68	16.24	117.44

Table 4
Summary of Groundwater Gauging Data
Former Raytheon Facility
Wayland, Massachusetts

Well I.D.	Measuring Point Elevation (ft. ASL)	3-Apr-06	
		Depth to Water (ft. below measuring point)	Potentiometric Surface Elevation (ft. above sea level)
MW-113	133.60	24.65	108.95
MW-114	133.48	16.39	117.09
MW-115	133.56	-	-
MW-116	133.72	16.50	117.22
MW-117	134.84	16.79	118.05
MW-118	134.88	16.61	118.27
MW-201S	132.38	16.59	115.79
MW-201M	132.19	16.25	115.94
MW-201D	132.10	16.00	116.10
MW-202S	132.74	16.48	116.26
MW-202M	132.98	16.80	116.18
MW-202D	132.72	16.74	115.98
MW-203S	132.50	17.41	115.09
MW-203M	132.39	17.20	115.19
MW-203D	132.14	16.24	115.90
MW-204S	132.98	17.69	115.29
MW-204M	132.02	16.69	115.33
MW-204D	132.30	16.55	115.75
MW-205S	131.98	16.61	115.37
MW-205M	132.12	16.79	115.33
MW-205D	131.98	14.50	117.48
MW-206S	130.82	16.04	114.78
MW-206M	130.75	16.19	114.56
MW-206D	130.66	15.61	115.05
MW-207S	129.16	14.49	114.67
MW-207M	129.29	14.74	114.55
MW-207D	129.10	13.70	115.40
MW-208S	132.14	16.39	115.75
MW-208M	132.38	16.73	115.65
MW-208D	132.38	16.42	115.96
MW-209	134.56	****	****
MW-210	134.48	19.92	114.56
MW-211	135.26	14.80	120.46
MW-212	134.39	14.72	119.67
MW-212M	133.84	19.48	114.36
MW-213	134.84	17.81	117.03
MW-214	134.60	18.29	116.31
MW-215S	133.42	13.45	119.97
MW-215M	133.48	13.54	119.94
MW-215D	133.44	14.11	119.33
MW-216S	134.54	14.06	120.48
MW-216M	134.59	14.12	120.47
MW-216D	134.59	15.19	119.40
MW-217S	130.06	13.21	116.85
MW-217M	130.44	13.99	116.45
MW-217D	130.20	13.70	116.50
MW-218S	130.24	14.16	116.08
MW-218M	130.16	14.41	115.75
MW-218D	130.02	13.76	116.26
MW-219S	118.12	3.75	114.37
MW-219M	118.09	3.23	114.86
MW-219D	117.95	2.99	114.96
MW-220S	117.09	3.64	113.45
MW-220M	117.29	3.15	114.14
MW-220D	116.99	2.00	114.99

Table 4
Summary of Groundwater Gauging Data
Former Raytheon Facility
Wayland, Massachusetts

Well I.D.	Measuring Point Elevation (ft. ASL)	3-Apr-06	
		Depth to Water (ft. below measuring point)	Potentiometric Surface Elevation (ft. above sea level)
MW-221M	120.07	2.90	117.17
MW-221D	120.22	3.60	116.62
MW-261S	131.28	10.80	120.48
MW-262S	129.60	8.85	120.75
MW-262M	130.52	13.26	117.26
MW-262D	129.73	11.26	118.47
MW-263S	127.96	7.60	120.36
MW-263M	127.77	8.30	119.47
MW-264S	126.32	6.30	120.02
MW-264M	126.28	6.75	119.53
MW-264D	126.63	9.28	117.35
MW-265S	130.06	9.54	120.52
MW-265M	129.89	10.43	119.46
MW-265D	130.07	12.54	117.53
MW-266S	126.79	8.33	118.46
MW-266Ma	127.72	8.22	119.50
MW-266Mb	126.88	10.39	116.49
MW-266D	127.70	10.24	117.46
MW-266B	128.14	8.42	119.72
MW-267S	125.30	8.06	117.24
MW-267M	125.40	8.39	117.01
MW-267D	125.88	8.82	117.06
MW-267B	124.02	7.19	116.83
MW-268S	123.66	6.89	116.77
MW-268M	122.34	6.00	116.34
MW-268D	123.41	7.00	116.41
MW-268B	124.86	8.53	116.33
MW-269S	125.54	8.29	117.25
MW-269Ma	124.96	9.02	115.94
MW-269Mb	125.42	9.76	115.66
MW-269D	125.34	10.74	114.60
MW-307	124.86	10.50	114.36
MW-313S	114.61	1.90	112.71
MW-313D	114.37	3.10	111.27
MW-314S	114.10	3.75	110.35
MW-314D	114.09	3.50	110.59
MW-315S	114.07	3.10	110.97
MW-315D	113.79	-	-
MW-403	134.39	18.21	116.18
MW-404	134.94	17.89	117.05
MW-405S	134.90	17.01	117.89
MW-551	129.30	8.68	120.62
MW-552	130.09	9.61	120.48
MW-553	130.33	9.65	120.68
MW-554S	120.93	7.80	113.13
MW-554Ma	120.82	5.20	115.62
MW-554Mb	120.96	4.90	116.06
MW-554D	120.96	5.55	115.41
MW-555S	121.10	8.23	112.87
MW-555Ma	121.25	5.70	115.55
MW-555Mb	121.26	6.12	115.14
MW-555D	121.19	5.93	115.26
MW-556S	120.93	8.90	112.03
MW-556M	121.00	5.36	115.64
MW-556D	120.92	5.44	115.48
MW-TP-3	131.08	9.70	121.38

Notes:
- = not measured / not accessible
** = potentiometric surface was at or above the top of casing
**** = dry well

Table 5
Summary of Vertical Hydraulic Gradient Data
Former Raytheon Facility
Wayland, Massachusetts

	3-Apr-06							
Well Designation	**Reference Elevation (ft ASL)**	**Depth to Water (ft)**	**Saturation Elevation (ft ASL)**	**Head Elevation (ft)**	**Head Change (ft)**	**Length Change (ft)**	**Hydraulic Gradient (ft/ft)**	**Up/Down**
DEP-19S	120.79	2.93	108.10	117.86	-2.36	25.00	-0.09440	Up
DEP-19M	120.62	0.40	83.10	120.22				
DEP-19M	120.62	0.40	83.10	120.22	0.22	10.00	0.02200	Down
DEP-19D	120.78	0.78	73.10	120.00				
MW-1S	133.79	9.54	121.10	124.25	3.31	27.50	0.1204	Down
MW-1M	133.78	12.84	93.60	120.94				
MW-1M	133.78	12.84	93.60	120.94	1.34	15.00	0.0893	Down
MW-1D	133.74	14.14	78.60	119.60				
MW-262S	129.60	8.85	104.86	120.75	3.49	26.04	0.1340	Down
MW-262M	130.52	13.26	78.82	117.26				
MW-262M	130.52	13.26	78.82	117.26	-1.21	24.86	-0.0487	Up
MW-262D	129.73	11.26	53.96	118.47				
MW-263S	127.96	7.60	105.28	120.36	0.89	27.40	0.03248	Down
MW-263M	127.77	8.30	77.88	119.47				
MW-264S	126.32	6.30	108.60	120.02	0.49	24.50	0.02000	Down
MW-264M	126.28	6.75	84.10	119.53				
MW-264M	126.28	6.75	84.10	119.53	2.18	34.88	0.06250	Down
MW-264D	126.63	9.28	49.22	117.35				
MW-265S	130.06	9.54	114.50	120.52	1.06	29.52	0.03591	Down
MW-265M	129.89	10.43	84.98	119.46				
MW-265M	129.89	10.43	84.98	119.46	1.93	44.00	0.04386	Down
MW-265D	130.07	12.54	40.98	117.53				
MW-266S	126.79	8.33	113.04	118.46	-1.04	37.29	-0.02789	Up
MW-266Ma	127.72	8.22	75.75	119.50				
MW-266Ma	127.72	8.22	75.75	119.50	3.01	13.33	0.22581	Down
MW-266Mb	126.88	10.39	62.42	116.49				
MW-266Mb	126.88	10.39	62.42	116.49	-0.97	39.60	-0.02449	Up
MW-266D	127.70	10.24	22.82	117.46				
MW-266D	127.70	10.24	22.82	117.46	-2.26	33.21	-0.06805	Up
MW-266B	128.14	8.42	-10.39	119.72				
MW-267S	125.30	8.06	48.72	117.24	0.23	15.46	0.01488	Down
MW-267M	125.40	8.39	33.26	117.01				
MW-267M	125.40	8.39	33.26	117.01	-0.05	28.70	-0.00174	Up
MW-267D	125.88	8.82	4.56	117.06				
MW-267D	125.88	8.82	4.56	117.06	0.23	32.18	0.00715	Down
MW-267B	124.02	7.19	-27.62	116.83				
MW-268S	123.66	6.89	49.86	116.77	-0.64	17.38	-0.03682	Up
MW-268M	123.41	6.00	32.48	117.41				
MW-268M	123.41	6.00	32.48	117.41	-0.45	35.42	-0.01270	Up
MW-268D	124.86	7.00	-2.94	117.86				
MW-268D	124.86	7.00	-2.94	117.86	4.05	26.10	0.15517	Down
MW-268B	122.34	8.53	-29.04	113.81				
MW-269S	125.54	8.29	107.41	117.25	1.31	14.55	0.0900	Down
MW-269Ma	124.96	9.02	92.86	115.94				
MW-269Ma	124.96	9.02	92.86	115.94	0.28	49.69	0.00563	Down
MW-269Mb	125.42	9.76	43.17	115.66				
MW-269Mb	125.42	9.76	43.17	115.66	1.06	62.53	0.01695	Down
MW-269D	125.34	10.74	-19.36	114.60				
MW-313S	114.61	1.90	105.60	112.71	1.44	22.00	0.06545	Down
MW-313D	114.37	3.10	83.60	111.27				
MW-314S	114.10	3.75	105.30	110.35	-0.24	22.00	-0.01091	Up
MW-314D	114.09	3.50	83.30	110.59				
MW-315S	114.07	3.10	105.20	110.97	NM	22.00	NM	NM
MW-315D	113.79	NM	83.20	NM				
MW-554S	120.93	7.80	78.50	113.13	-2.49	67.50	-0.03689	Up
MW-554Ma	120.82	5.20	11.00	115.62				
MW-554Ma	120.82	5.20	11.00	115.62	-0.44	30.00	-0.01467	Up
MW-554Mb	120.96	4.90	-19.00	116.06				
MW-554Mb	120.96	4.90	-19.00	116.06	0.65	61.00	0.01066	Down
MW-554D	120.96	5.55	-80.00	115.41				
MW-555S	121.10	8.23	78.30	112.87	-2.68	47.50	-0.05642	Up
MW-555Ma	121.25	5.70	30.80	115.55				
MW-555Ma	121.25	5.70	30.80	115.55	0.41	48.00	0.00854	Down
MW-555Mb	121.26	6.12	-17.20	115.14				
MW-555Mb	121.26	6.12	-17.20	115.14	-0.12	62.00	-0.00194	Up
MW-555D	121.19	5.93	-79.20	115.26				
MW-556S	120.93	8.90	78.80	112.03	-3.61	101.50	-0.03557	Up
MW-556M	121.00	5.36	-22.70	115.64				
MW-556M	121.00	5.36	-22.70	115.64	0.16	21.00	0.00762	Down
MW-556D	120.92	5.44	-43.70	115.48				

Notes:
(-) vertical gradient represents upward groundwater flow
(+) vertical gradient represents downward groundwater flow
NM = Not measured (Not accessible)

Table 6
Summary of Groundwater Geochemical Parameters
Former Raytheon Facility
Wayland, Massachusetts

Well ID	April 06					
	Temperature (deg C)	pH (std units)	Oxidation-Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Conductivity (µS/cm)
DEP-19M	NMD	NMD	NMD	NMD	NMD	NMD
MW-261S	9.41	6.66	31.6	1.74	173	122
MW-262S	7.69	6.67	-42.7	0.3	200	134
MW-264M	7.21	6.33	-15.4	0.37	274	181
MW-265M	5.52	6.31	108	0.67	276	173
MW-266Ma	6.86	6.18	20.5	0.76	420	272
MW-266Mb	6.14	6.59	-68.8	0.7	243	155
MW-267M	8.7	6.88	-49.4	0.92	314	216
MW-267S	9.8	6.83	-75.1	0.21	404	287
MW-268D	9.3	8.19	-155.9	0.37	305	213
MW-268M	9.34	6.72	-90.3	0.28	381	267
MW-551	9.62	6.98	-69.9	0.18	159	112
MW-552	9.71	7.22	21.9	0.44	258	183
MW-553	8.86	11.08	-72.1	0.19	269	185
MW-554D	10.44	8.36	-309.2	1.01	216	156
MW-554Ma	9.9	8.27	-288.2	0.6	170	121
MW-554Mb	10.74	8.28	-165.4	0.63	189	138
MW-554S	10.36	8.83	-173.5	0.29	250	180
MW-555D	10.68	8.19	-230.2	1.1	408	296
MW-555Ma	11.12	7.49	-123.6	0.51	219	161
MW-555Mb	10.83	8.12	-155.3	0.6	174	127
MW-555S	12.08	8.89	-158.3	0.31	261	196
MW-556D	10.4	8.45	-256.4	0.64	197	142
MW-556M	10.31	8.14	-160.8	0.51	230	166
MW-556S	10.39	7.85	-174.8	0.27	268	193

Notes:
C = degrees Celsius
µS/cm = microSiemens per centimeter
mg/L = milligrams per liter
pH units = standard units
mV = millivolts
NTU = Nephelometric Turbidity Units
NMD = Not Measured due to a Dry well

Table 7
Summary of Groundwater VOC Analytical Results
Former Raytheon Facility
Wayland, Massachusetts

Parameter	MCP Method 1: GW1	Sample I.D. Date Sampled Comments	DEP-19M 06-Apr-06	DEP-19M 06-Apr-06 DUP	MW-261S 03-Apr-06	MW-262S 05-Apr-06	MW-264M 05-Apr-06	MW-265M 05-Apr-06	MW-266Ma 05-Apr-06	MW-266Mb 05-Apr-06	MW-267S 04-Apr-06	MW-267M 04-Apr-06	MW-268M 03-Apr-06	MW-268M 03-Apr-06 DUP	MW-268D 03-Apr-06	MW-551 04-Apr-06
Volatile Organics (VOCs) (ug/L)																
Tetrachloroethene	5		0.61	0.61	**56**	**11**	**7.6**	**54**	-	**53**	**6.1**	**24**	**51**	-	-	0.7
Trichloroethene	5		4	4.2	**3,600**	**100**	**59**	**1,100**	**9.7**	**290**	**400**	**510**	**2,200**	**2,100**	**21**	**40**
cis-1,2-Dichloroethene	70		24	24	**80**	-	**200**	**2,300**	1.8	**310**	67	**260**	**5,100**	**5,100**	22	0.58
Vinyl Chloride	2		-	-	-	-	**26**	**310**	-	**22**	-	-	**230**	**230**	-	-
1,1-Dichloroethane	70		-	-	-	-	-	-	-	-	-	-	-	-	-	-
trans-1,2-Dichloroethene	100		-	-	-	-	-	-	-	1.2	-	-	-	-	-	-
Chlorofrom	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-

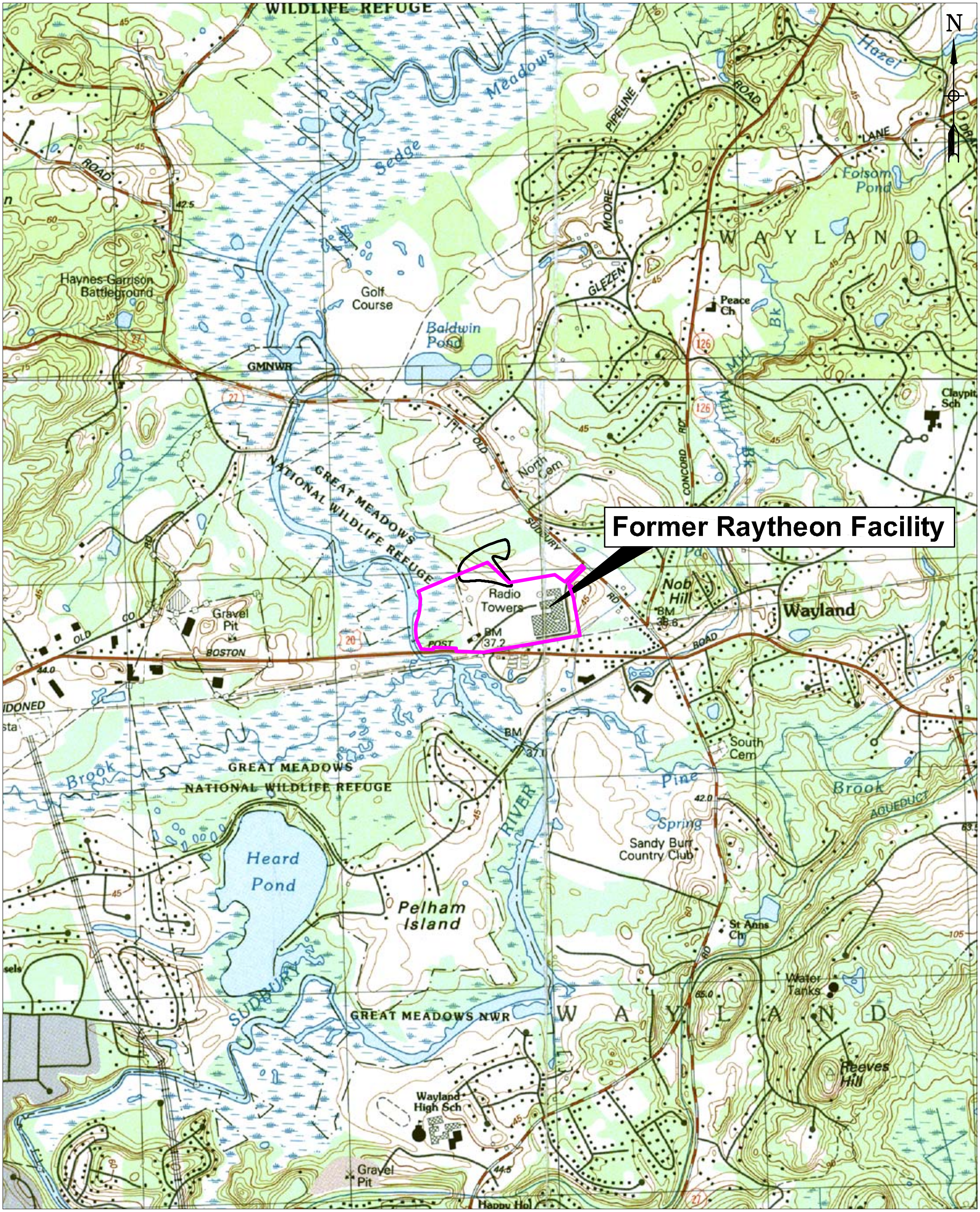
Notes:
- = Analytical result below the method detection limit. (ND)
Empty Cells = Not Analyzed
Bold and Shaded cells indicate exceedance of MCP Standard
DUP = Field Duplicate
ug/L = micrograms per liter (parts per billion (ppb))

Table 7
Summary of Groundwater VOC Analytical Results
Former Raytheon Facility
Wayland, Massachusetts

Parameter	MCP Method 1: GW1	Sample I.D. Date Sampled Comments	MW-552 04-Apr-06	MW-552 01-Aug-06	MW-553 04-Apr-06	MW-554S 06-Apr-06	MW-554Ma 06-Apr-06	MW-554Mb 06-Apr-06	MW-554D 06-Apr-06	MW-555S 06-Apr-06	MW-555Ma 06-Apr-06	MW-555Mb 06-Apr-06	MW-555D 06-Apr-06	MW-555D 06-Apr-06 DUP	MW-556S 13-Jan-06	MW-556S 06-Apr-06	MW-556M 06-Apr-06	MW-556D 06-Apr-06
Volatile Organics (VOCs) (ug/L)																		
Tetrachloroethene	5		**230**	**240**	**24**	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	5		**6,200**	**4,300**	**400**	-	-	-	-	-	-	-	-	-	-	-	-	-
cis-1,2-Dichloroethene	70		**310**	**270**	68	-	-	-	-	-	-	-	2.4	2.7	-	-	-	-
Vinyl Chloride	2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	70		-	-	-	-	-	-	-	-	-	-	0.79	0.86	-	-	-	-
trans-1,2-Dichloroethene	100		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorofrom	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
- = Analytical result below the method detection limit. (ND)
Empty Cells = Not Analyzed
Bold and Shaded cells indicate exceedance of MCP Standard
DUP = Field Duplicate
ug/L = micrograms per liter (parts per billion (ppb))

Figures



Scale 1:25,000

0.5 km 0 500 m

0.5 mi 0 1,000 ft

Legend

Subject Property Line

Disposal Site Boundary

Figure 1 - Site Locus Map

Former Raytheon Facility - Wayland, MA

ERM

R:\Raytheon\Wayland - 1922\Report - Phase 4 April 2006\LOCUS.dwg (05/03/2006 - 2:41pm Boston)

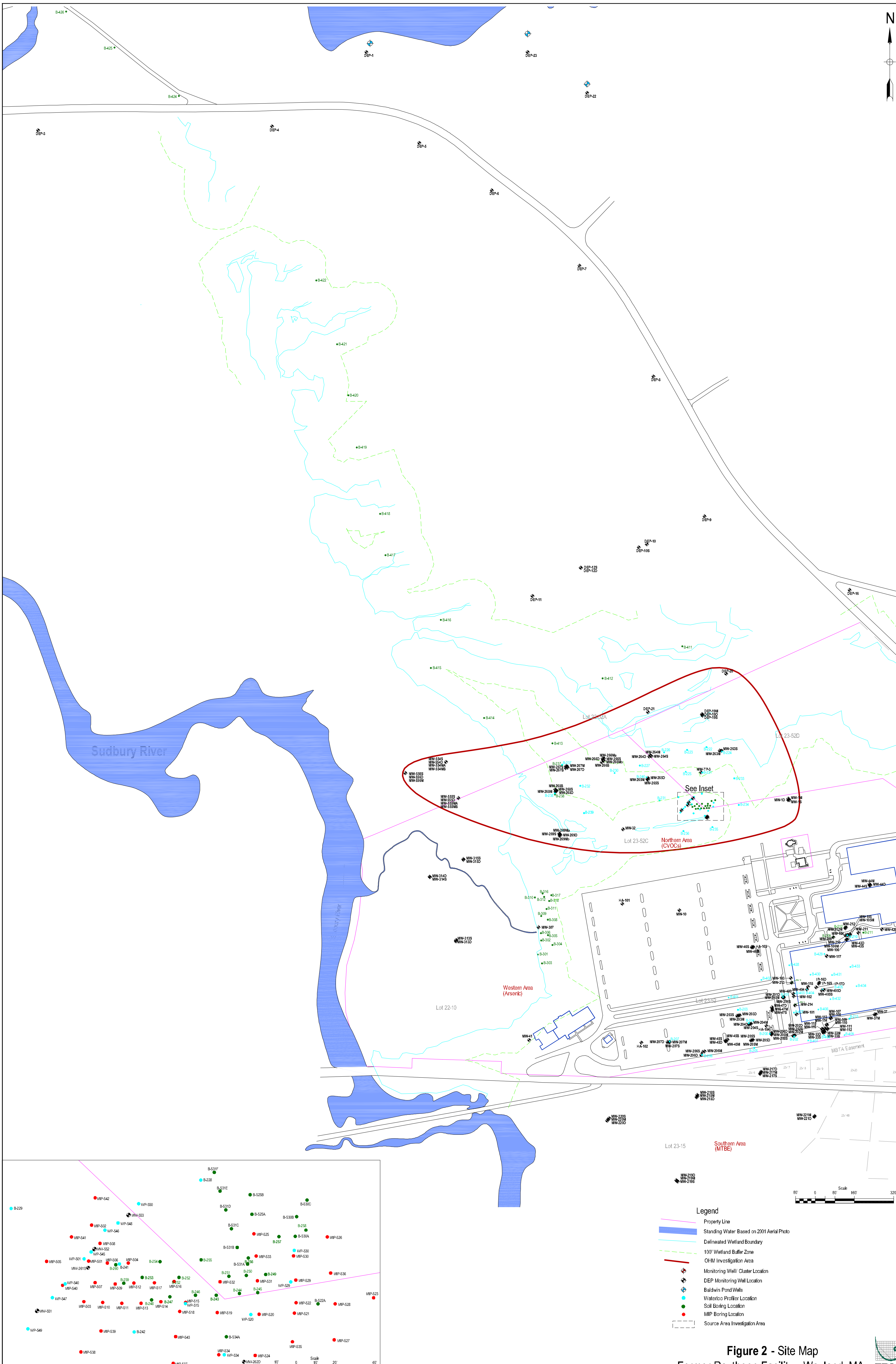
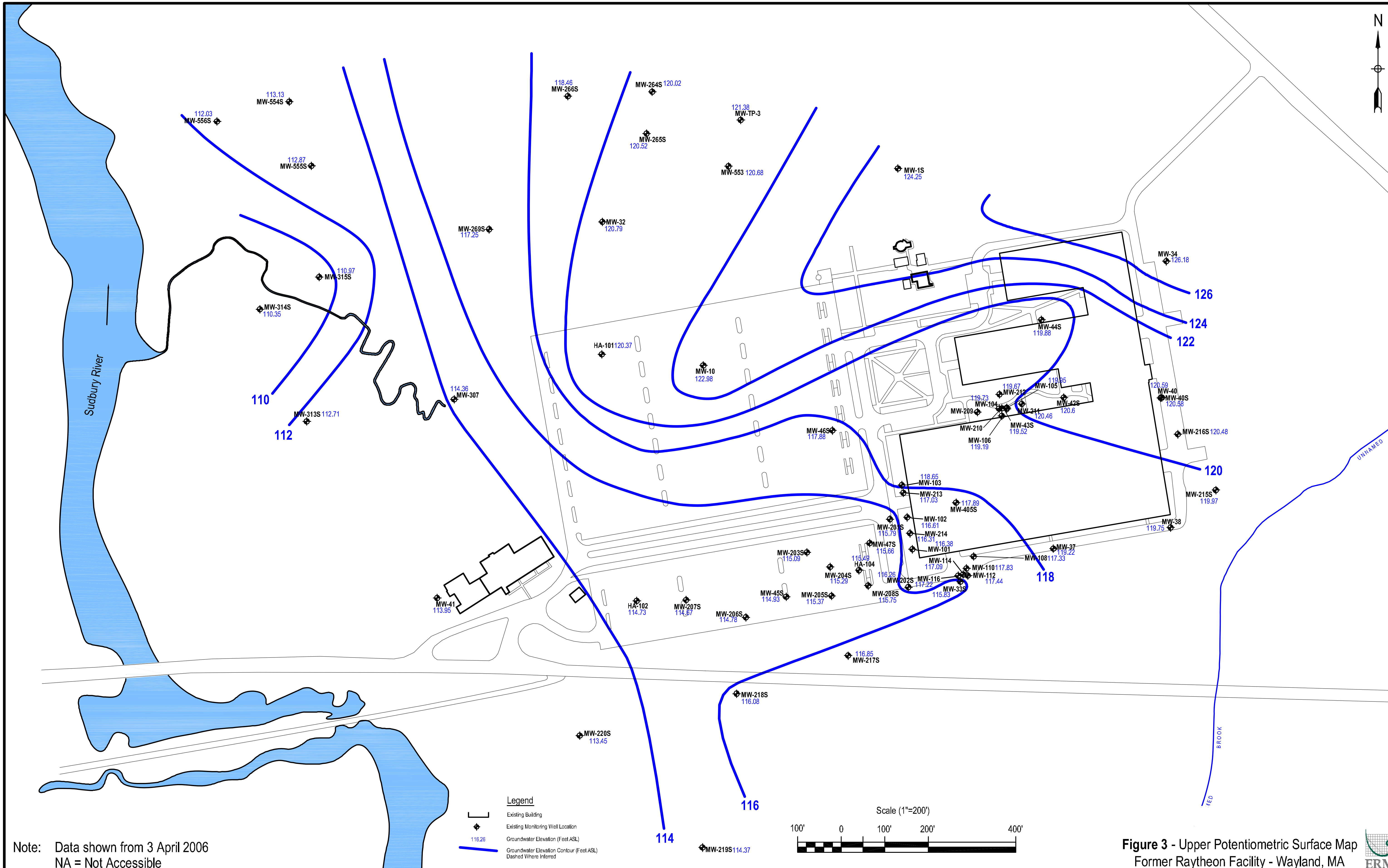


Figure 2 - Site Map

Former Raytheon Facility - Wayland, MA



Note: Data shown from 3 April 2006
NA = Not Accessible

Figure 3 - Upper Potentiometric Surface Map
Former Raytheon Facility - Wayland, MA

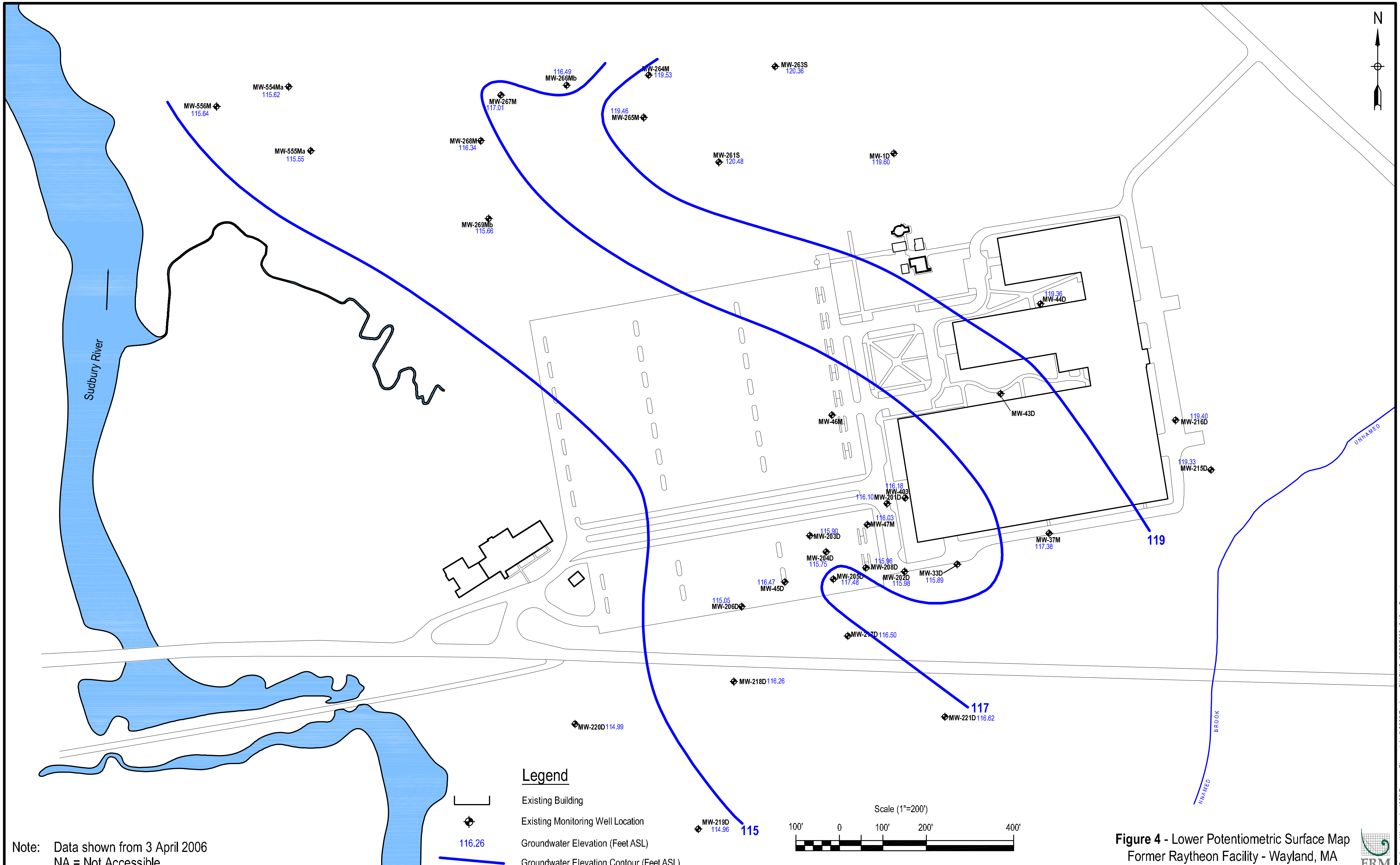


Figure 4 - Lower Potentiometric Surface Map
Former Raytheon Facility - Wayland, MA

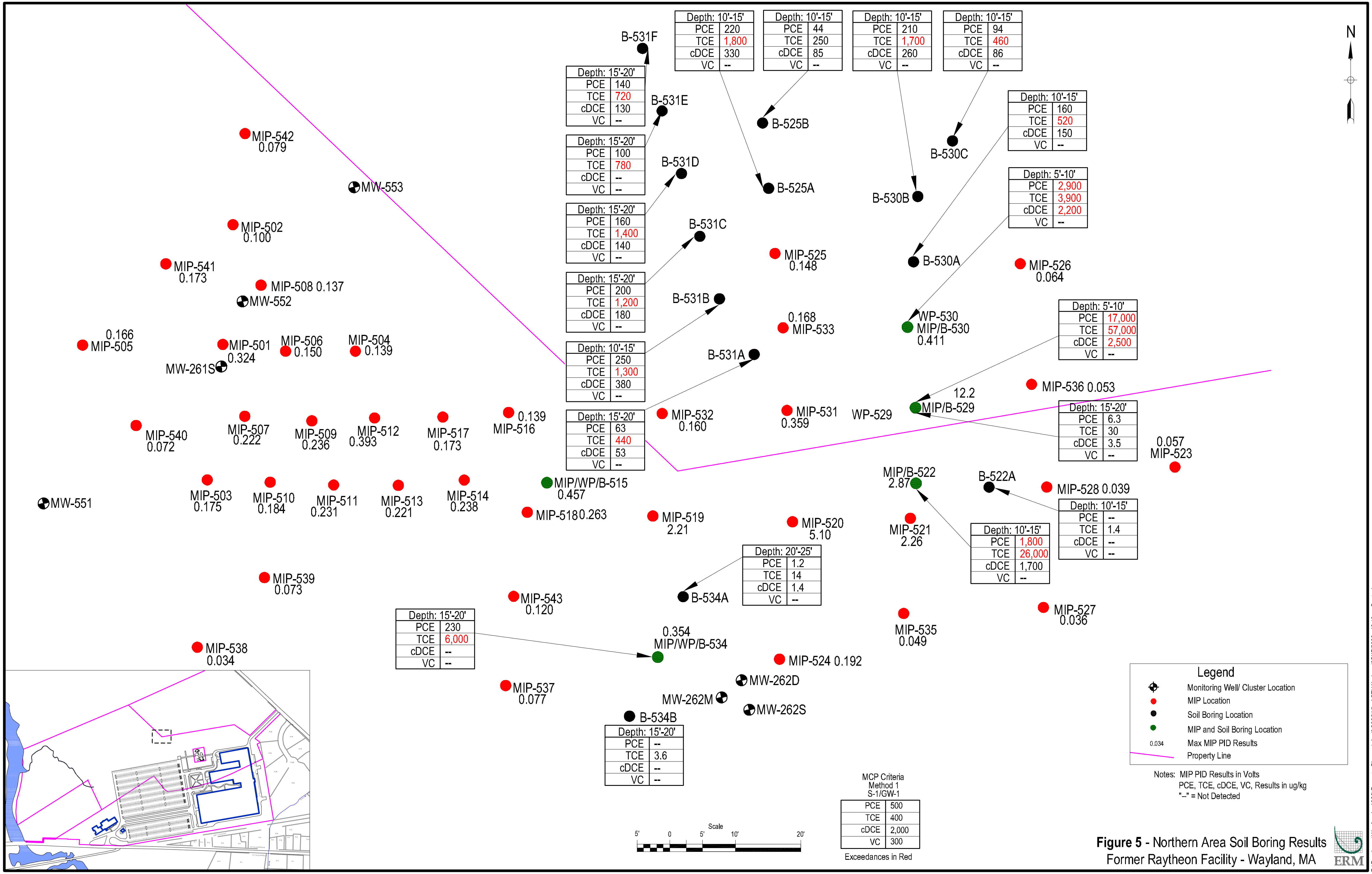
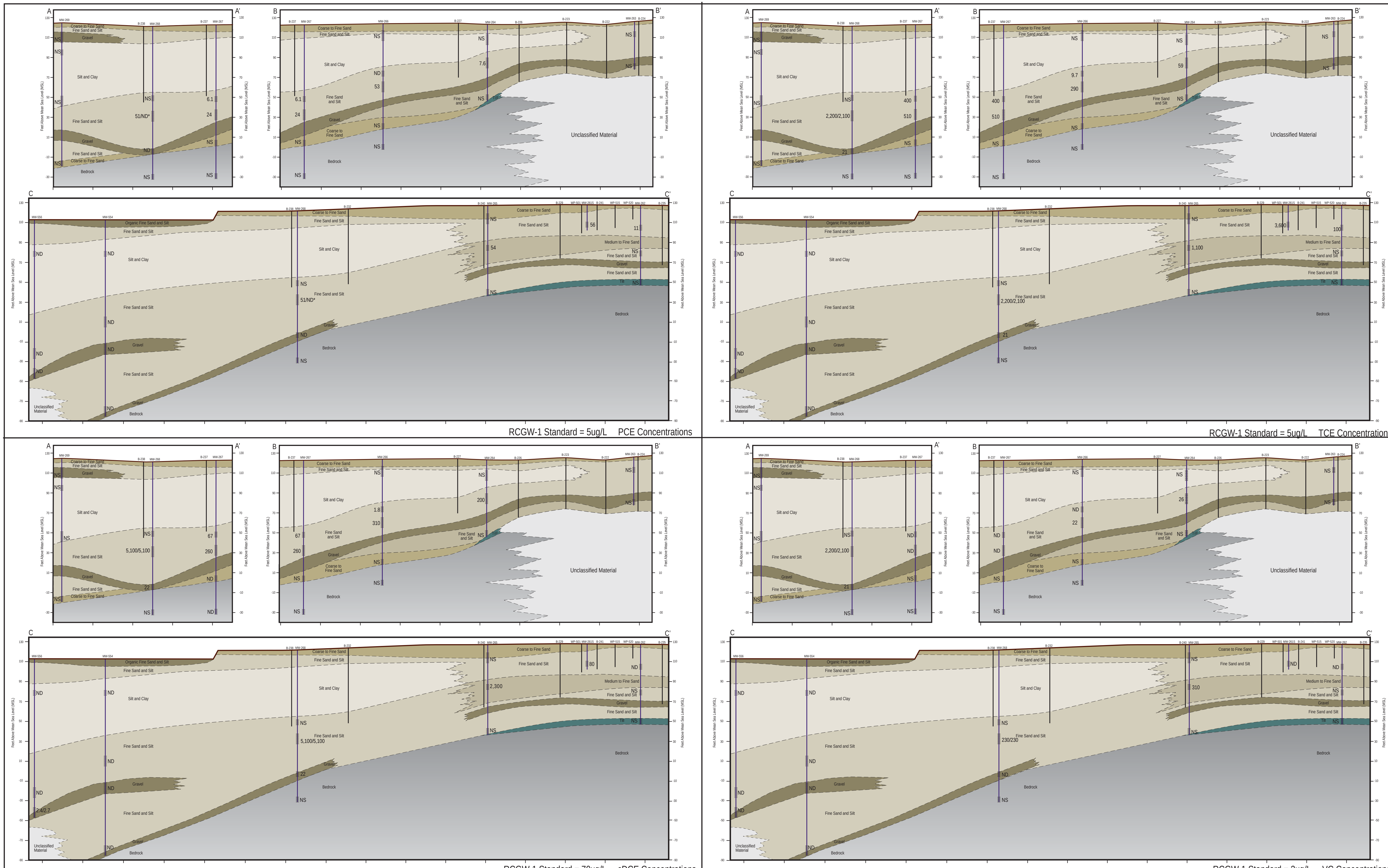
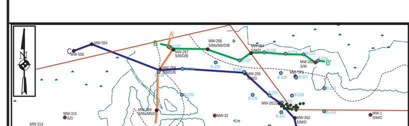


Figure 5 - Northern Area Soil Boring Results
Former Raytheon Facility - Wayland, MA





Legend

Monitoring Well
Well ID
Compound Concentration/Duplicate (ug/L)
Screened Interval/ Sample Point

Soil Boring
Boring ID

10 Foot Well Screen

5 Foot Well Screen

Scale:
Horizontal Scale 1" =80'
Verticle Scale 1"=40'

Note: Concentration Values from April 2006 Sample Analyses
2,200/2,100 = Duplicate Sample
* = Detection Limit was 50 ug/L for Sample
ND = Not Detected
NS = Not Sampled; Previous sampling results were below method detection limits or below reportable concentrations for all constituents.

Figure 6 - Cross Sections of Northern Area Groundwater CVOC Concentrations
Former Raytheon Facility - Wayland, MA

ERM

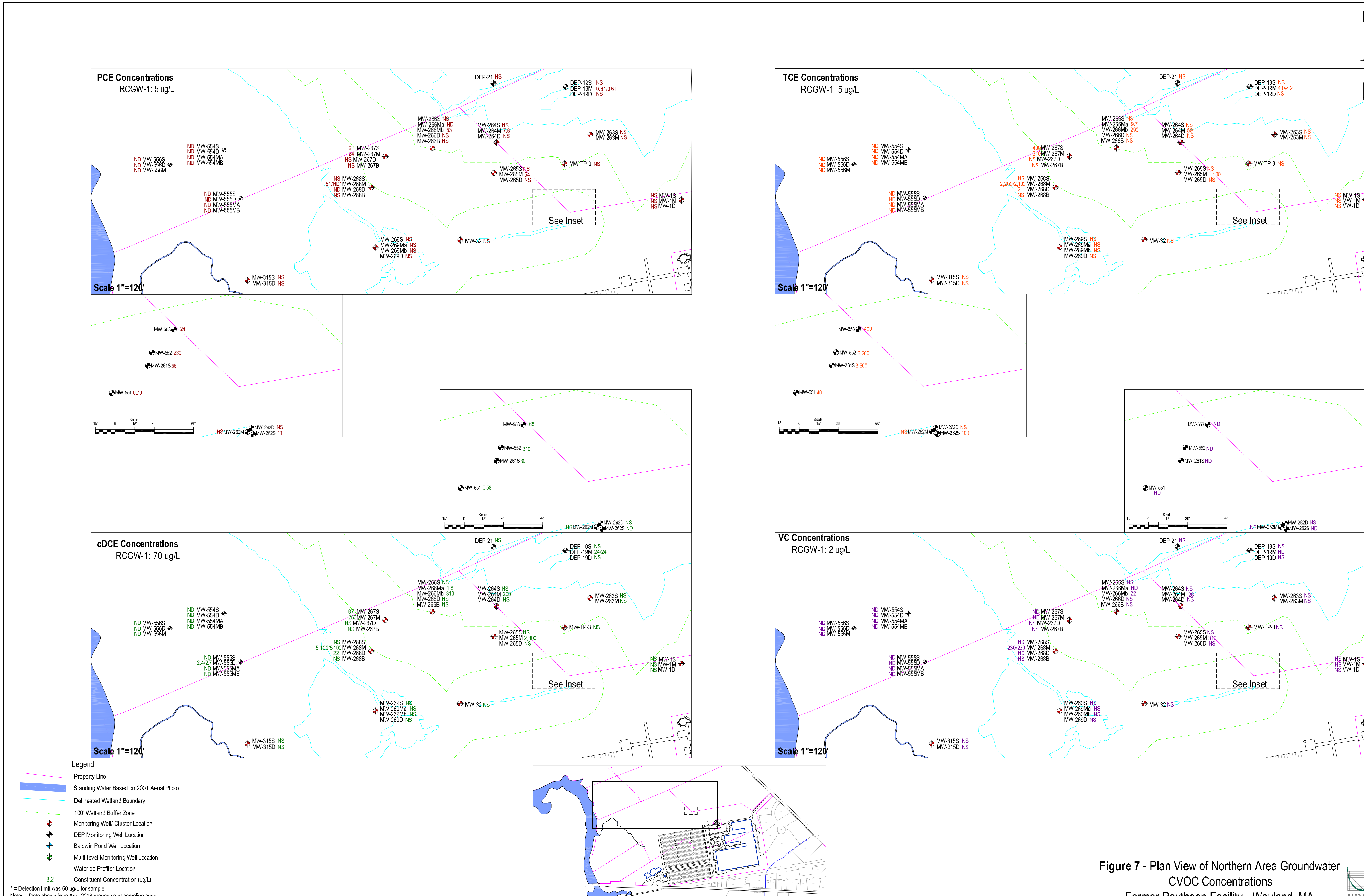


Figure 7 - Plan View of Northern Area Groundwater CVOC Concentrations
Former Raytheon Facility - Wayland, MA

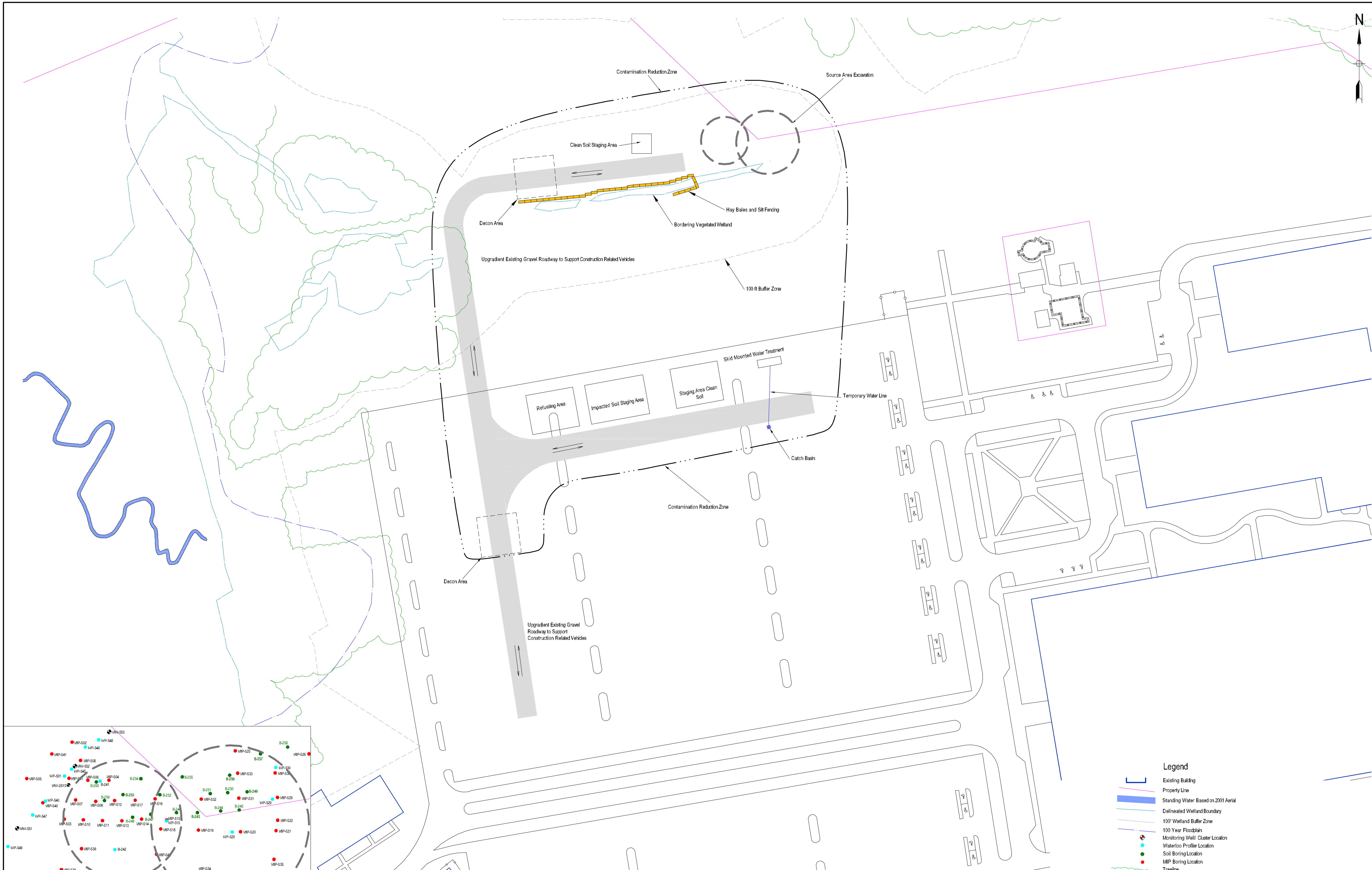
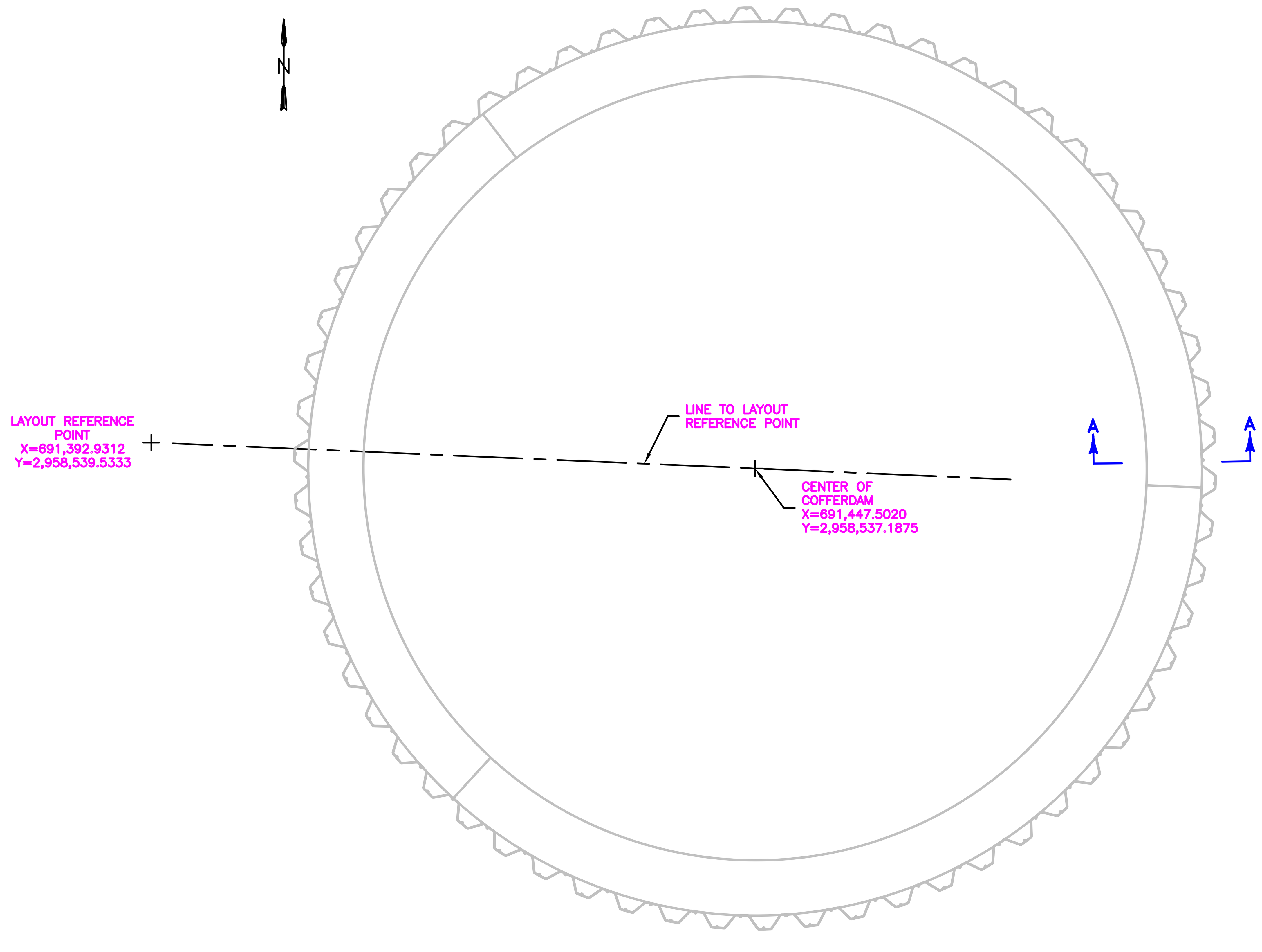
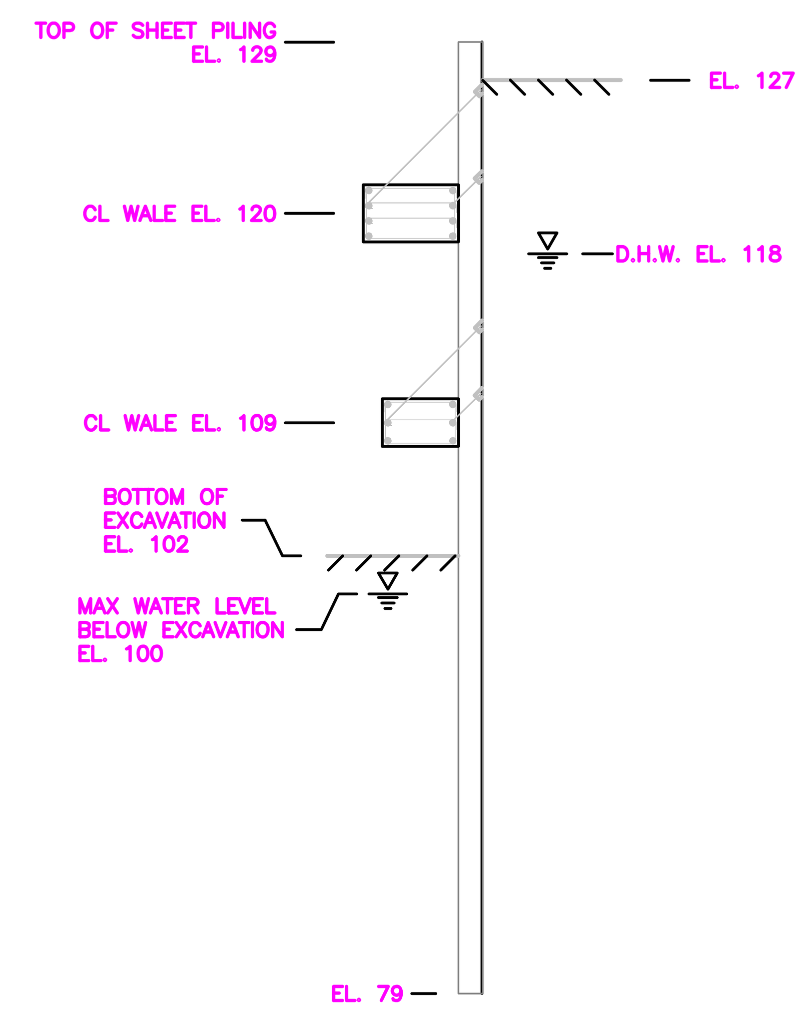


Figure 8 - Site Features and Proposed Work Areas
Former Raytheon Facility - Wayland, MA



COFFERDAM PLAN



SECTION A–A

GENERAL NOTES

1) The cofferdam portion of the project involves the construction of a cofferdam to allow excavation and removal of contaminated soil. The cofferdam consists of a steel sheet piling wall and circular reinforced concrete wales. It is anticipated that the sheet piling will be extracted after the cofferdam is backfilled. It is anticipated that the reinforced concrete wales will be left in place and covered with backfill.

2) Available geotechnical information indicates strata of granular soil with varying amounts of silt and minor amounts of clay. In general terms, the anticipated soil conditions are approximately 9 feet of medium dense sand and silt, underlain b approximately 37 feet of loose sand and silt, then underlain by various strata o more dense granular soil with silt. Groundwater is anticipated approximately 9 feet below existing ground level.

   In the event that the soil actually encountered differs significantly from the descriptions above, or if unanticipated obstructions are encountered, Hartman Engineering will be notified immediately and construction operations in the vicinit of the differing soil or obstruction will cease until the situation is evaluated.

3) Groundwater will enter the cofferdam through interlock seepage and through the soil at the bottom of the excavation. It is anticipated that pumps located inside the cofferdam will maintain the water at an acceptable level.

   Special attention must be directed toward examining the excavation bottom fo indications of piping (rapid upward water flow at a specific location) or heave (swelling or uplift of a portion of the excavation bottom). Either of these conditions is an indication of an unanticipated subsurface condition which may cause damage to the cofferdam. If piping or heave is detected or suspected, Hartman Engineering will be notified immediately and dewatering operations will be suspended until the condition is evaluated.

4) The Contractor will measure and record the length of each sheet pile prior to driving and will keep a record of all trimming, cutting, etc., such that the bottom elevation of individual sheet piles can be determined at any time. Refer to Monitoring Procedure Item 1A.

5) If, at any time, the bracing or monitoring system is damaged by construction operations, Hartman Engineering will be notified immediately. Until the severity o the damage can be evaluated, construction operations will cease and construction personnel will be evacuated from the excavation.

6) In the event that the cofferdam cannot be constructed as designed and detailed, the Contractor will not proceed with the construction of the cofferdam until the data for this determination has been reviewed and incorporated into the design b Hartman Engineering.

7) Standard construction site safety measures (construction of stairways, provision o barricades to stop rolling objects, provision of ladders, fences, etc,) are the responsibility of the Contractor and are not shown on these drawings.

8) The concrete wales are not to be used for storage of materials.

9) ll work will be performed in a manner consistent with industry standards established by AISC (American Institute of Steel Construction), ACI (American Concrete Institute), and AWS (American Welding Society).

10) Test cylinders will be used to evaluate concrete wale strength. It is recommended that sufficient cylinders be made so that strength can be evaluated 2 days, 3 days, 4 days, 7 days, and 28 days after installation of the concrete.

11) It is intended that a representative of Hartman Engineering will be present at the obsite at the time the strain gauge instrumentation is installed in the concrete wales in order to instruct and assist the Engineer's field personnel in the installation and use of the strain gauge monitoring system. The schedule of the visit will be coordinated by the Engineer's personnel and Hartman Engineering.

12) For additional information related to the cofferdam, see Drawings No. 06-602-LS-1, and 06-602-DE-1.

MATERIAL SPECIFICATIONS

1) Sheet Piling: Chaparral Steel Co. PZC18 Section, ASTM A572 Grade 50 Steel or approved equal. All sheet piling will be new at the start of the project.

2) Concrete: Use concrete meeting Project Specifications for Structural Concrete; additionally, concrete must develop 4000 psi ultimate strength after 7 days.

3) Concrete Reinforcement: Steel reinforcing bars for concrete will be ASTM A615 Grade 60 bars detailed in accordance with current ACI Specifications. Splices in the longitudinal reinforcement must be capable of developing the full tensile capacity of the reinforcement. Splices in adjacent bars will be separated 2'-6" minimum. The contractor shall submit shop drawings of the reinforcement to Hartman Engineering for approval.

4) Structural Steel:

   (A) Plate and Miscellaneous Steel: ASTM Grade A36 or stronger steel.

   (B) Welding Electrodes: E70XX

   (C) Welder Qualifications: Each Welder, Welding Operator or Tacker who performs work on the cofferdam must be qualified for each process and position used for the construction. Qualification standards required are those stipulated in the Project Documents.

Figure 9A

8/8/06	⚠1	REVISED PROJECT TO ONE COFFERDAM

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HARTMAN ENGINEERING
4910 RANSOM ROAD CLARENCE, NEW YORK 14031

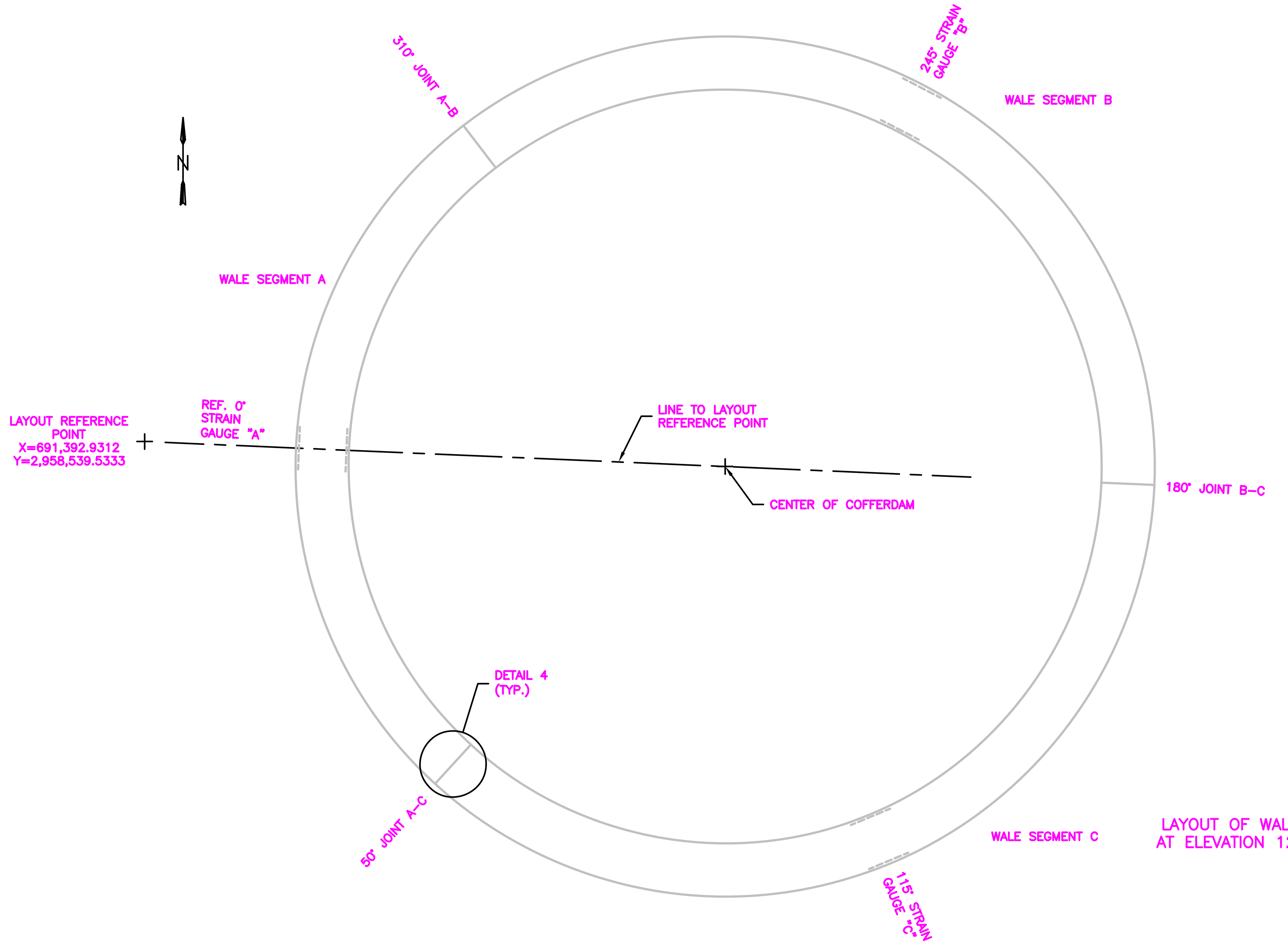
DATE: MAY 25, 2006 | DRAWN BY: DAM | CHECKED BY RJH

COFFERDAM FOR REMEDIATION OF
FORMER RAYTHEON FACILITY SITE
IN WAYLAND, MA

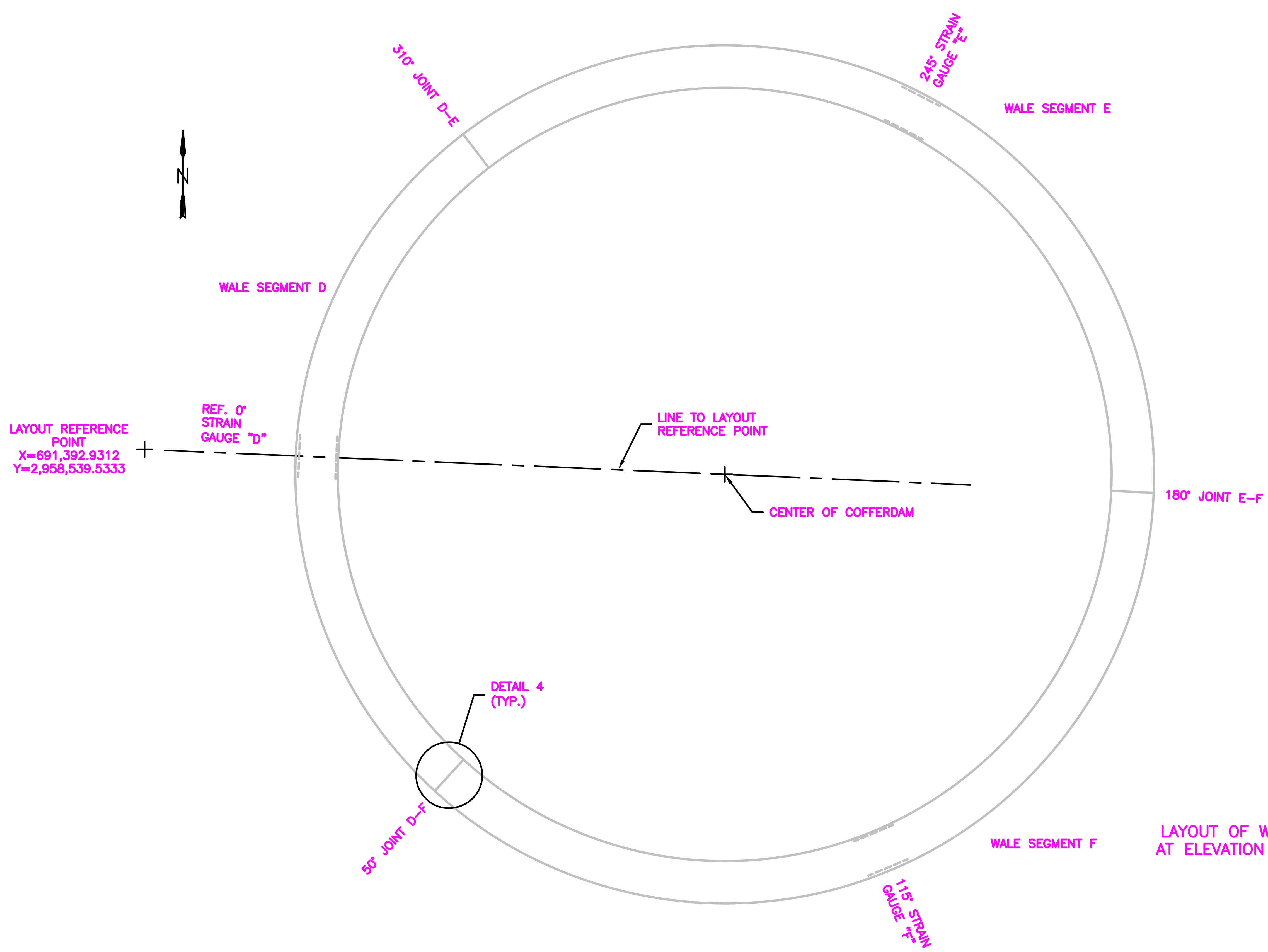
GENERAL PLAN, SECTION A–A,
GENERAL NOTES, AND MATERIAL SPECIFICATIONS

SCALE: 1/8"=1'-0" | DRAWING NUMBER 06–602–GP–1 | SHEET 1 OF 3

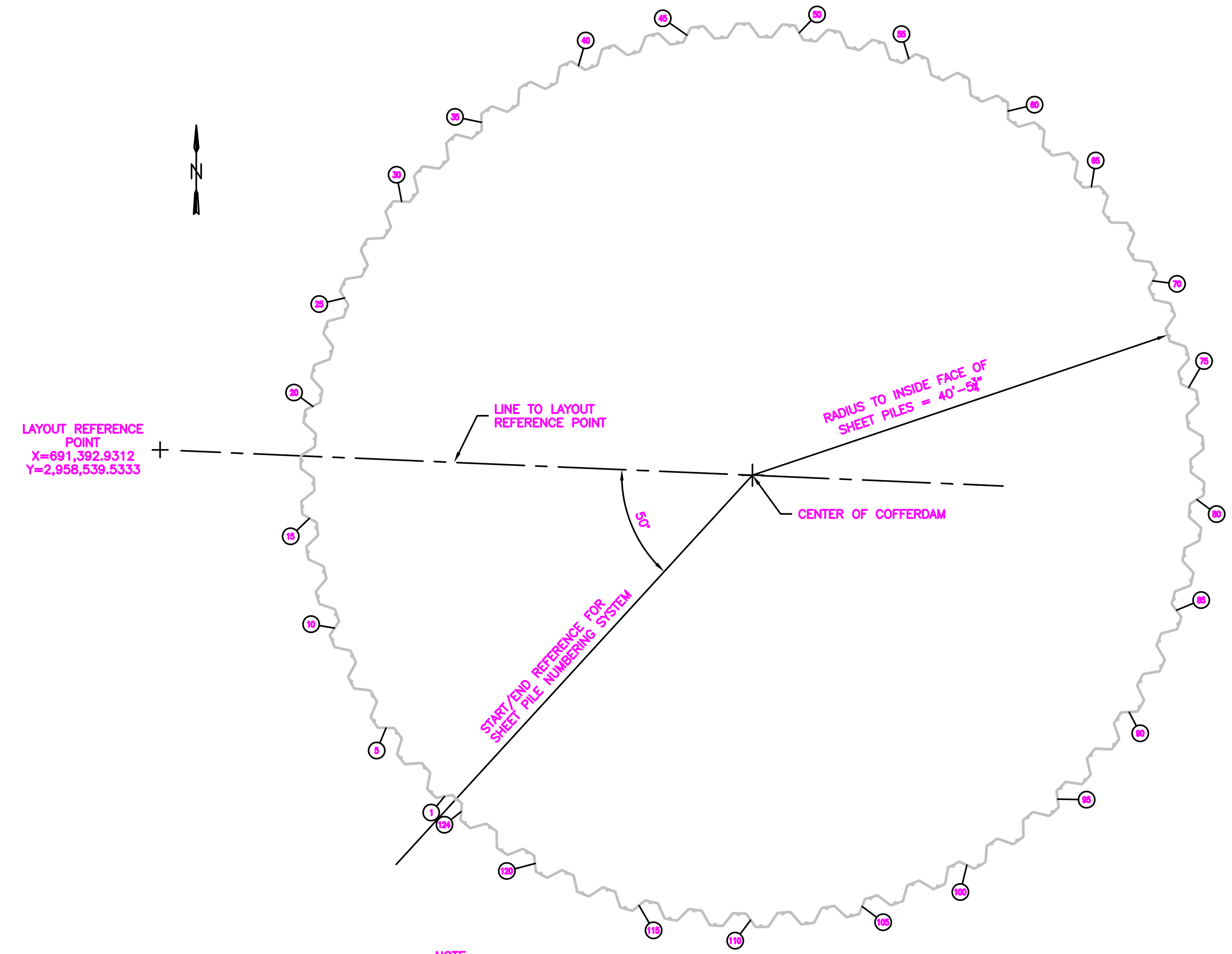
FILENAME: 06–602–GP–1.dwg; MAY 25 , 2006



LAYOUT OF WALE AT ELEVATION 120



LAYOUT OF WALE AT ELEVATION 109



NOTE:

(#) INDICATES SHEET PILE NUMBER DESIGNATION

SHEET PILE LAYOUT
124 PCS PZC18

Figure 9B

Date	Rev.	Description
8/8/06	⚠	REVISED PROJECT TO ONE COFFERDAM

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HARTMAN ENGINEERING
4910 RANSOM ROAD CLARENCE, NEW YORK 14031

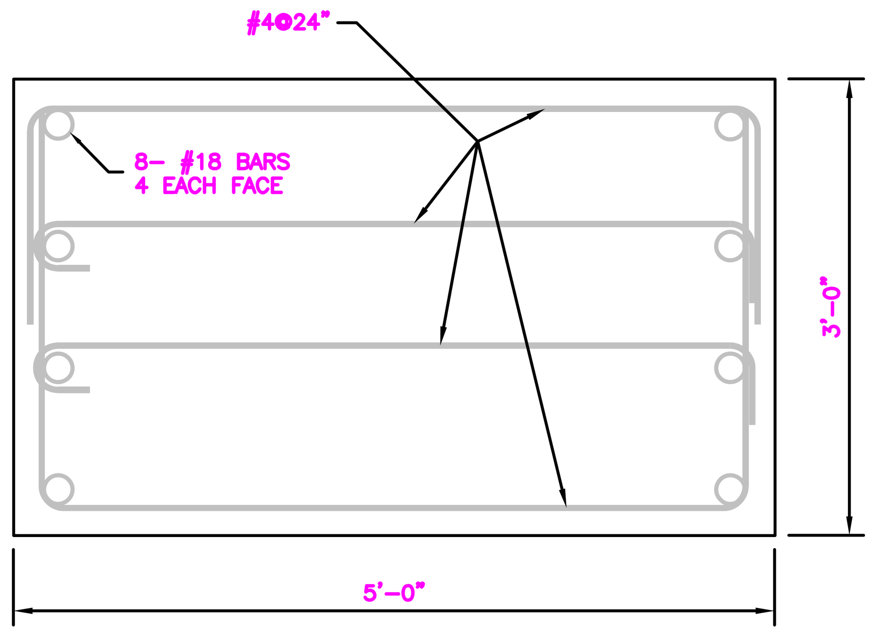
DATE: MAY 25, 2006 | DRAWN BY: DAM | CHECKED BY RJH

COFFERDAM FOR REMEDIATION OF FORMER RAYTHEON FACILITY SITE IN WAYLAND, MA

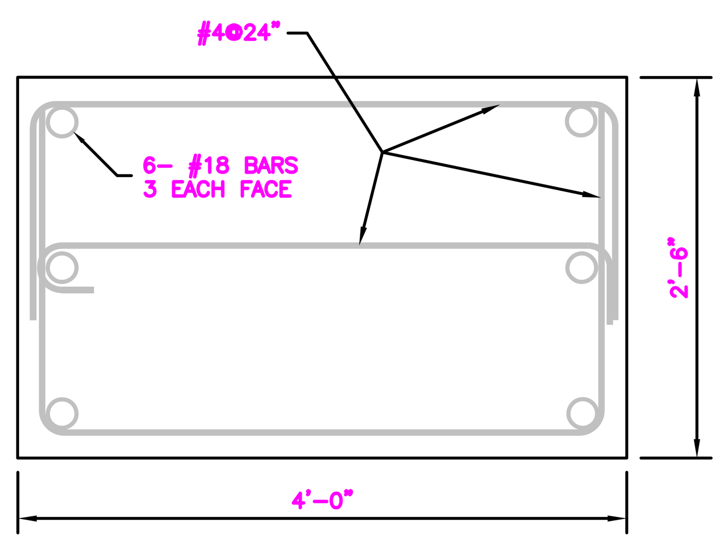
SHEET PILE LAYOUT AND WALE LAYOUTS

SCALE: $\frac{1}{8}$"=1'-0" | DRAWING NUMBER 06-602-LS-1 | SHEET 2 OF 3

FILENAME: 06-602-GP-1_R1.dwg;DATE: AUGUST 8, 2006



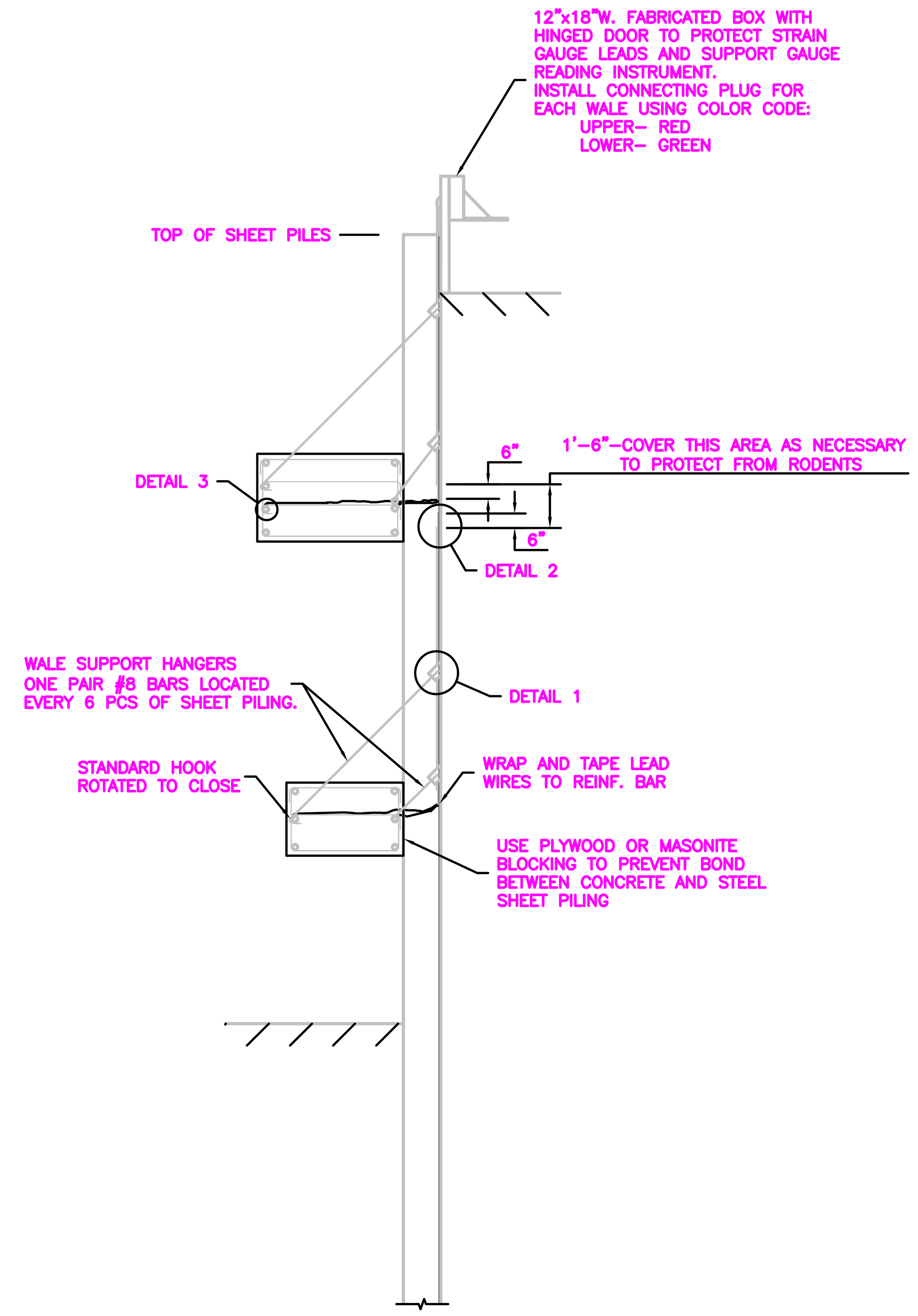
WALE AT ELEVATION 120



WALE AT ELEVATION 109

WALE SECTIONS

SCALE: 1"=1'-0"



TYPICAL SECTION SHOWING STRAIN GAUGE MONITORING INSTRUMENTATION

SCALE: 1/4"=1'-0"

MONITORING PROCEDURE

1) General Monitoring Procedure During Construction of the Circular Cofferdam

(A) Prior to driving the sheet piling, check the length of the sheet piling to verify all sheets are the anticipated length. If under-length sheets are detected, the shall not be used without approval of Hartman Engineering. If over-length sheets are detected, they may be used provided:
(1) They are permanently identified,
(2) A permanent record of the length and exact location is established.

(B) Immediately after the sheet piling is driven, the location of the sheet pile line will be verified by survey and the results of the survey will be immediatel forwarded to Hartman Engineering. In the event that sheet piles are located either:
(1) More than 3 inches off location toward the inside of the cofferdam, or
(2) More than 6 inches off location toward the outside of the cofferdam,
Hartman Engineering will be contacted immediately.

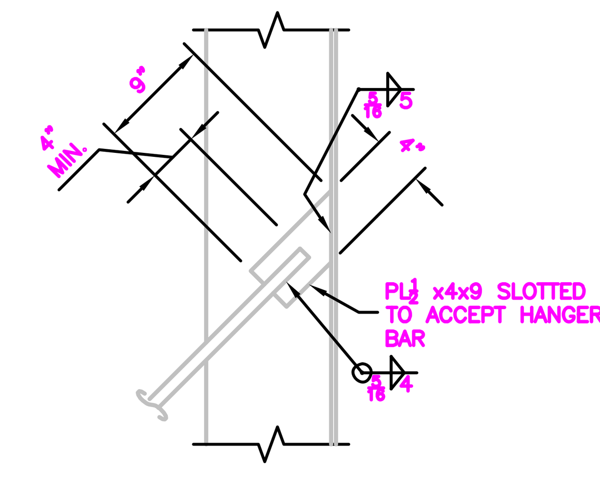
(C) As construction of the cofferdam progresses, the location of the sheet pile will be determined by survey at the elevation of each wale and the results of the survey will be immediately forwarded to Hartman Engineering. If the deviation of any sheet piles from the intended location exceeds the limits in part (B) above, Hartman Engineering will be contacted immediately.

2. Strain Gauge Monitoring Procedure

(A) Electrical resistance type strain gauges will be incorporated into the concrete wales as shown on Drawing No. 06-602-LS-1. See General Note Number 11.

(B) The gauges will be read by the Contractor in accordance with the following schedule:
(1) fter the strain gauge rods are in place and before the concrete wale is poured,
(2) One day after the concrete is poured,
(3) Every working day from the start of construction of the cofferdam until the excavation is complete, then
(4) Twice weekly until the backfill operation is complete.

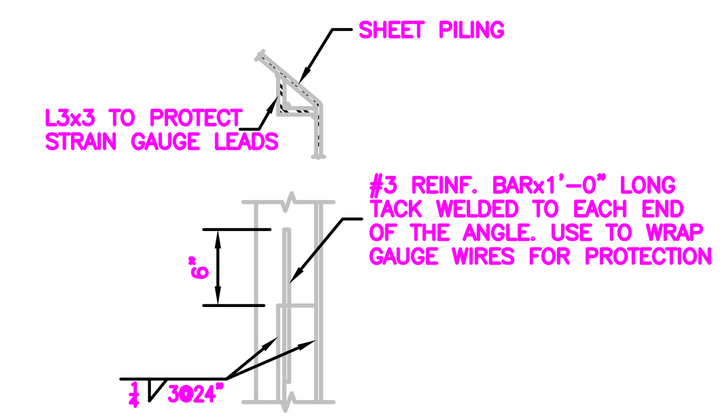
(C) If any strain gauge readings exceed the ranges of strain reading specified on the data recording sheet, the contractor will immediately contact Hartman Engineering. Otherwise, the data will be transmitted weekly by telephone facsimile to Hartman Engineering at 716-759-2668.



DETAIL 1

WALE HANGER ATTACHMENT

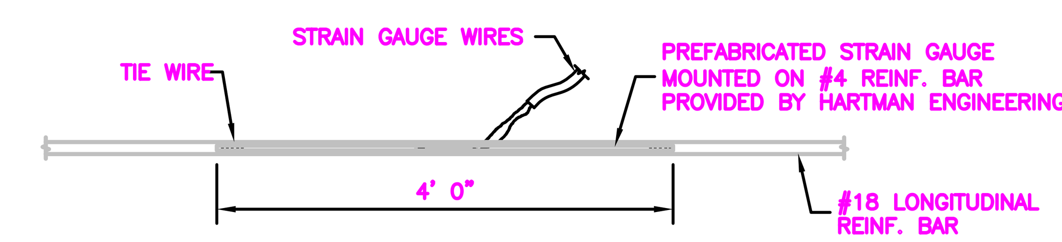
SCALE: 1"=1'-0"



DETAIL 2

GAUGE WIRE PROTECTION

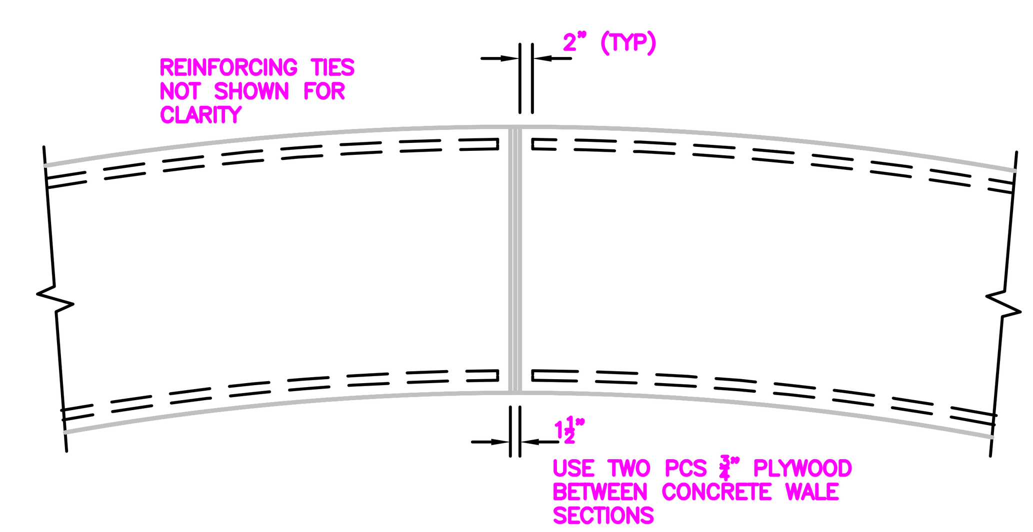
SCALE: 1"=1'-0"



DETAIL 3

INSTALLATION OF STRAIN GAUGE INSTRUMENTATION

SCALE: 1"=1'-0"



DETAIL 4

JOINT AT ENDS OF WALE SEGMENTS

SCALE: 1/4"=1'-0"

Figure 9C

8/8/06	⚠	REVISED PROJECT TO ONE COFFERDAM

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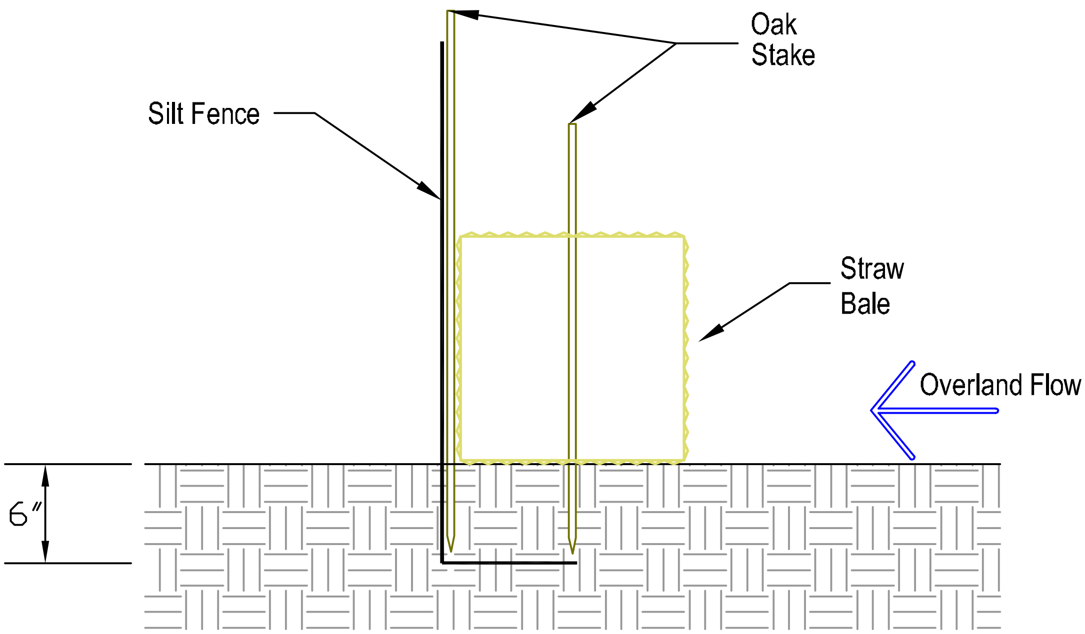
DATE: MAY 25, 2006 | DRAWN BY: JRC | CHECKED BY: RJH

COFFERDAM FOR REMEDIATION OF FORMER RAYTHEON FACILITY SITE IN WAYLAND, MA

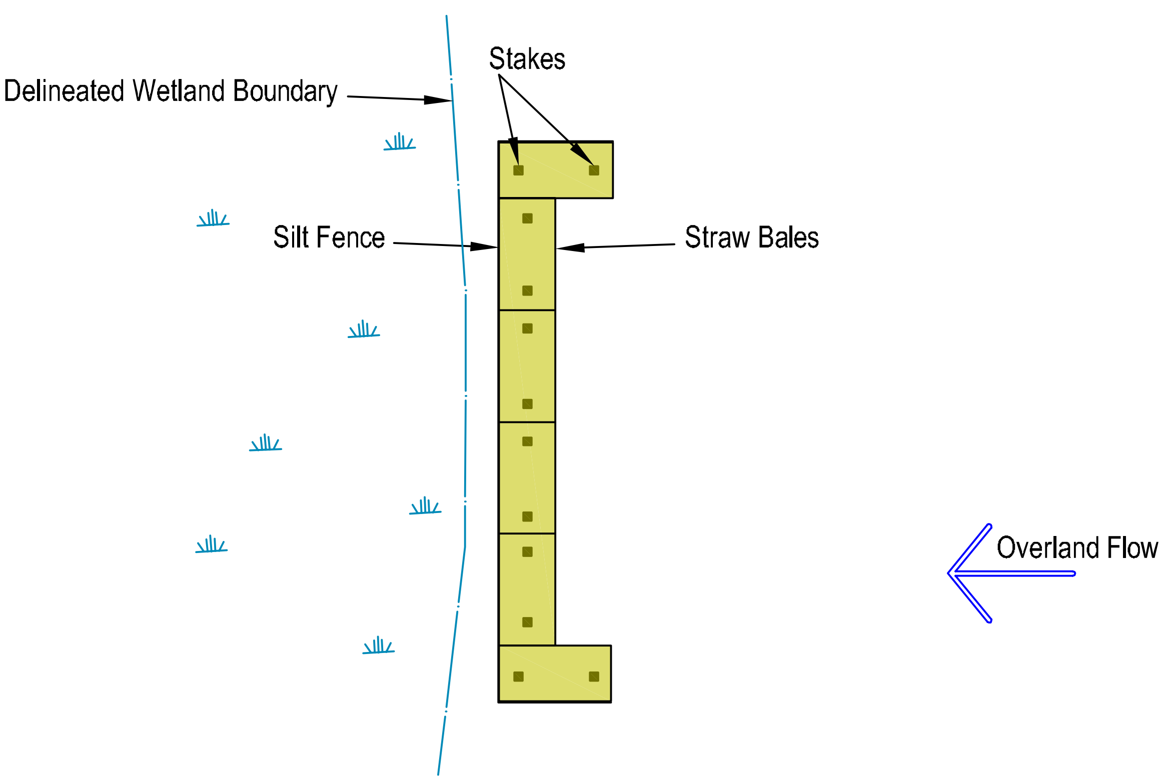
WALE REINFORCEMENT, TYPICAL SECTION SHOWING STRAIN GAUGE MONITORING INSTRUMENTATION, MONITORING PROCEDURE AND DETAILS 1 THROUGH 4

SCALE: AS NOTED | DRAWING NUMBER: 06-602-DE-1 | SHEET 3 OF 3

FILENAME: 06-602-DE-1_R1.dwg DATE: AUGUST 8, 2006



TYP. BARRIER DETAIL



TYP. SILT FENCE AND STRAW BALE ARRANGEMENT

NOTE:
1) Erosion check to be bales of hay secured to the ground with two (2) 4'-long stakes for each bale.
2) Stakes to be imbedded to a depth of 1', spaced no more than 1.5' apart.
3) All silt fences to be landward of Wetland.

Scale = Not To Scale

Figure 10 - Straw Bale and Silt Fence Detail
Former Raytheon Facility - Wayland, MA

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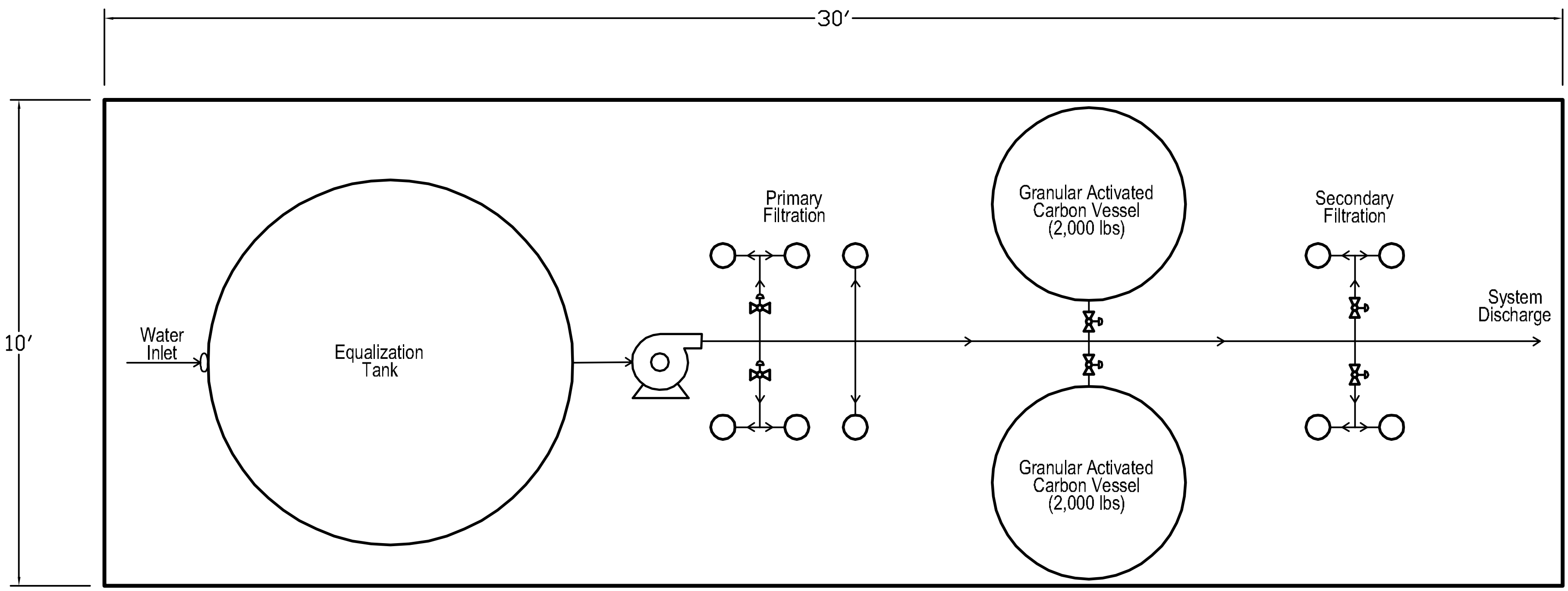

Not to Scale

Figure 11 - Typical Skid-Mounted Water Treatment Unit
Former Raytheon Facility - Wayland, MA

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