FINAL
REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

VOLUME III-A

PROJECT OPERATIONS PLAN

FIELD SAMPLING PLAN

OLIN CHEMICAL SUPERFUND SITE
51 EAMES STREET
WILMINGTON, MASSACHUSETTS

Submitted to:

United States Environmental Protection Agency
Region I – New England
One Congress Street
Boston, Massachusetts 02114

Submitted by:
Olin Corporation
3855 North Ocoee Street
Suite 200
Cleveland, Tennessee 37312

Prepared by:

MACTEC

MACTEC Engineering and Consulting, Inc.
107 Audubon Road
Wakefield, Massachusetts 01880

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Project No. 6107-09-0016.01

August 14, 2009

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	Microgram per Liter
µmhos/cm	Micromhos per Centimeter
APHA	American Public Health Association
ARAR	Applicable or Relevant and Appropriate Requirements
AS/SVE	Air Sparge/Soil Vapor Extraction System
ASTM	American Society for Testing and Materials
ATV	Acoustic Televiewer
BEHP	Bis(2-ethylhexyl)phthalate
BGS	Below Ground Surface
BIPS	Borehole Image Processing System
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	Chain of Custody
C-RAM	Construction-Related Release Abatement Measure
CRSP	Community Relations Support Plan
CSL	Calcium Sulfate Landfill
CSM	Conceptual Site Model
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,2-DCE	1,2-dichloroethene
DAPL	Dense Aqueous Phase Liquid
DMF	Dimethylformamide
DO	Dissolved Oxygen
EBK	Equipment Rinsate Blank
EPH	Extractable Petroleum Hydrocarbon
FBK	Field Blanks
FDR	Field Data Record
FLOC	Flocculant
FOL	Field Operations Leader
FRI	Focused Remedial Investigation
FSP	Field Sampling Plan
GPM	Gallons per Minute
GPS	Global Positioning System
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HI	Hazard Index
HPFM	Heat Pulse Flow Meter
HQ	Hazard Quotient
HR/MS	High Resolution/Mass Spectrometry

ID	Identification
IDW	Investigation Derived Waste
IRA	Immediate Response Action
IRSWP	Interim Response Steps Work Plan
LCS	Laboratory Control Sample
LEL	Lower Explosive Level
LNAPL	Light Non-Aqueous Phase Liquid
MACTEC	MACTEC Engineering and Consulting, Inc.
MassDEP	Massachusetts Department of Environmental Protection
MBTA	Massachusetts Bay Transportation Authority
MCP	Massachusetts Contingency Plan
mg/L	Milligram per Liter
ml/min	Milliliter per Minute
MLP	Multi-level Piezometers
MMB	Maple Meadow Brook
MMBA	Maple Meadow Brook Aquifer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl-tert-butyl ether
mV	Millivolt
MWRA	Massachusetts Water Resources Authority
MWSW	Municipal Water Supply Wells
NAVD	North American Vertical Datum
NDMA	N-nitrosodimethylamine
NDPA	N-nitrosodiphenylamine
ng/L	Nanograms per Liter
No.	Number
NPL	National Priorities List
NTU	Nephelometric Turbidity Unit
OD	Outside Diameter
off-PWD	off-Property West Ditch
Olin	Olin Corporation
on-PWD	on-Property West Ditch
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PCMP	Post-Construction Monitoring Program
PID	Photoionization Detector
PPE	Personal Protective Equipment
PPM	Parts per Million
Property	51 Eames Street Property
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride

QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAM	Release Abatement Measure
RGP	Remediation General Permit
RI/FS	Remedial Investigation and Feasibility Study
RPM	Rate per Minute
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Groups
Site	Olin Chemical Superfund Site
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semi-volatile Organic Compound
1,1,1-TCA	1,1,1-trichloroethane
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TIC	Tentatively Identified Compounds
TMP	Trimethylpentene
TPK	Trip Blanks
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VC	Vinyl Chloride
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbon

1.0 INTRODUCTION

This Field Sampling Plan (FSP) has been prepared for the Olin Chemical Superfund Site (Site) in Wilmington, Massachusetts, on behalf of Olin Corporation (Olin) by MACTEC Engineering and Consulting, Inc. (MACTEC). The Sampling and Analysis Plan (SAP) is comprised of the FSP and the Quality Assurance Project Plan (QAPP). The FSP has been prepared as Volume III-A of the Remedial Investigation and Feasibility Study (RI/FS) Work Plan and is consistent with the work plan structure described in Section II.F.2B of the Statement of Work (SOW), Remedial Investigation and Feasibility Study, Olin Chemical Superfund Site, prepared by the United States Environmental Protection Agency (USEPA) Region I – New England and dated June 2007. Volume III-B of the RI/FS Work Plan, the QAPP, is bound separately. Both are part of the SAP and the Site RI/FS Work Plan, the organization of which is described below for reference.

This FSP is organized according to the Operable Units (OU) defined in the SOW:

- Operable Unit 1: OU1 is defined as the approximately 50-acre Olin 51 Eames Street Property (Property) including the former facility area, the established conservation area, the on-Property ditch system, the Calcium Sulfate Landfill (CSL), and the Slurry Wall/Cap Containment Area. The OU1 RI/FS will evaluate soil, sediment, surface water (including the on-Property Ditch System), and potential vapor issues (if applicable).
- Operable Unit 2: OU2 is defined as off-Property surface water and sediment areas, including at a minimum, the off-Property East Ditch, and West Ditch. This OU will also include surface water and sediment in portions of Maple Meadow Brook (MMB) and Sawmill Brook. The OU2 RI/FS will evaluate surface water and sediment issues.
- Operable Unit 3: OU3 is defined as all on- and off-Property groundwater areas including the Maple Meadow Brook Aquifer (MMBA), groundwater beneath the Olin Property, and groundwater located south and east of the Olin Property. The OU3 RI/FS will evaluate groundwater and potential vapor issues (if applicable).

The RI/FS Work Plan is comprised of several interrelated plans that will guide the completion of this RI/FS. They are detailed in the four volumes:

- Volume I – Project Overview
- Volume II – Site Management Plan and Community Relations Support Plan are combined in a single document.
  - o Site Management Plan (SMP) provides a written understanding and commitment of how various project aspects such as access, security, contingency procedures,

management responsibilities, investigation-derived waste disposal and data handling will be managed; and

  - Community Relations Support Plan (CRSP) provides a written understanding and commitment of how Olin will support the USEPA's Community Relations Program at the Site.

- Volume III – SAP includes two separate documents as separate volumes.
  - Volume III-A – FSP provides a summary of the sampling objectives and describes the sampling program for each area of investigation at the Site;
  - Volume III-B – QAPP documents in writing the Site-specific objectives, policies, organizations, functional activities, sampling and analysis activities and specific quality assurance/quality control (QA/QC) activities designed to achieve the data quality objectives of the RI/FS. The QAPP provides sampling, analytical and validation procedures, as well as quality assurance and quality control requirements prepared in accordance with the format required by USEPA Region I; and

- Volume IV – Health and Safety Plan (HASP) establishes the procedures, personnel responsibilities and training necessary to protect the health and safety of all on-Site personnel during the RI/FS. The HASP provides for routine but hazardous field activities and for unexpected Site emergencies and provides requirements and procedures for biological, physical and chemical hazards to RI/FS Site workers.

The Site is comprised of the Olin Property, an approximately 50-acre parcel, in Wilmington, Massachusetts, and adjoining off-Property areas impacted by manufacturing and waste disposal activities at the Property (Figure 1.0-1). The northern portion of the Property was formerly the site of a chemical manufacturing facility. The southern portion of the Property is forested, except in the southwestern corner where the closed CSL is located. The forested area and the formerly developed area are separated by the South Ditch and bordering wetland areas of the Ephemeral Drainage. Approximately 20 acres within this forested area is subject to the terms of an Environmental and Open Space Restriction that restricts future commercial development activities on the portion of the Property. Site features are shown on Figure 1.0-2, including off-Property areas.

2.0 SITE BACKGROUND

2.1 SITE HISTORY

The Site includes the approximate 50-acre Olin Property and adjacent off-Property areas that have been impacted by manufacturing and waste disposal activities at the Property. The Property is located in a heavily industrialized area within the southern portion of the Town of Wilmington and is the location of a former manufacturing facility that produced specialty chemicals for the rubber and plastics industry from 1953 to 1986. From 1953 to 1980, the facility was owned by several companies whose operations resulted in environmental contamination to on-Property soil, groundwater, sediment and surface water. Appendix A contains supplemental information requested by USEPA with respect to the manufacturing operations of the facility. That appendix summarizes manufacturing operations, including raw materials, waste materials, products, facility buildings, storage tanks, septic tanks, leach fields, and major waste disposal features. Several historical aerial photographs taken between 1938 and 1995 have previously been submitted to the USEPA (on April 25, 2008). Figure 2.1-1 shows historical features of the Property such as building locations, waste disposal features, and tank farms.

Olin purchased the Property in 1980 and ceased operations in 1986. After Olin initiated closure of the Site in 1986, the chemical manufacturing buildings were demolished and removed along with the closure of the lined lagoons. Since 1987, Olin has conducted numerous environmental investigations, risk assessments and remedial actions to develop an understanding of the nature of environmental impacts and to protect human health and the environment. These investigations and cleanups were carried out by Olin and supervised by Massachusetts Department of Environmental Protection (MassDEP) under Chapter 21E of the General Laws of Massachusetts and the Massachusetts Contingency Plan (MCP). The investigations and assessments were based on data collected and analyzed in accordance with work plans approved by the MassDEP. Data generated are of known data quality and usability determined by data validation procedures that met the MCP requirements.

These investigations and subsequent remedial actions have resulted in the excavation and off-site disposal of soil from the former Lake Poly, two Drum Disposal Areas, a Buried Debris Area and sediment from the on-Property West Ditch (on-PWD), the on-PWD Wetland, the South Ditch, and the Central Pond. All removal actions were conducted in accordance with work plans approved by the MassDEP and soils and sediments were manifested, transported and disposed of at facilities licensed and approved for such materials. An area of trimethylpentenes (TMPs) in soil and shallow groundwater known as the EPH/VPH area (referring to Extractable Petroleum Hydrocarbons and Volatile Petroleum Hydrocarbon analyses) and located near Plant B was identified and successfully remediated using an air sparge/soil vapor extraction system (AS/SVE). This AS/SVE system was closed and removed subsequent to approval by the MassDEP.

Since 1997, Olin has operated the Plant B groundwater recovery/treatment system as an Immediate Response Action (IRA) under the MCP. The system was installed in response to the seepage of a light non-aqueous phase liquid (LNAPL) into the East Ditch that is located at the eastern perimeter of the Property. The LNAPL is a process oil that also contains bis(2-ethylhexyl)phthalate (BEHP), N-nitrosodiphenylamine (NDPA), and TMPs. The system was designed to create a groundwater cone of depression to prevent migration of the LNAPL and to allow for mechanical removal of the material. Groundwater extracted during operation of the system is treated to remove iron and ammonia as well as dissolved organic compounds. The treated groundwater is discharged to surface water on the Property in compliance with a Remediation General Permit (RGP).

In September 1992, the report titled "Interim Action Plan, West Ditch Precipitate, Olin Corporation, Wilmington Facility" (CRA, 1992) was prepared and submitted to MADEP. The plan included the construction of a weir in the upstream portion of the South Ditch that would raise the surface water level in the off-Property West Ditch (off-PWD) and the upper portion of the South Ditch. This ponding of water in the off-PWD and upper portion of the South Ditch would suppress groundwater discharge to the off-PWD and reduce the formation of flocculant (floc). On June 21, 1994, Olin notified MassDEP that the installation of the weir in the South Ditch had been completed.

In 2000/2001, Olin constructed a Slurry Wall/Cap (sometimes referred to as the Containment Area) around the on-Property portion of the Upper Dense Aqueous Phase Liquid (DAPL) Pool as a Release Abatement Measure (RAM) consistent with the MCP. The intent of this source control action was to eliminate, to the extent feasible, the on-Property DAPL source material as a source of dissolved constituents to groundwater. The containment area is comprised of a perimeter slurry wall keyed into bedrock and a temporary cap to minimize infiltration of precipitation into the Slurry Wall/Cap. Construction of the slurry wall was preceded by a pre-design boring program to determine the depth to bedrock, and completion of chemical compatibility testing of the DAPL and the design slurry mixture. The slurry wall working with the geometry of the bedrock depression contains the on-Property DAPL and overlying impacted groundwater within the Slurry Wall/Cap. The compatibility testing indicated that the hydraulic conductivity of the design slurry mix decreased over a six month period in contact with DAPL material. These results suggest that hydraulic performance of the design slurry mixture improves when in contact with DAPL material.

As part of the RAM related to the construction of the Slurry Wall/Cap, the 1994 weir was replaced by a new weir consisting of precast concrete box structures at the confluence of the on-PWD, off-PWD, and South Ditch, upstream of the old weir. The old weir was removed during the sediment remediation of the South Ditch.

Additionally, the on-PWD was remediated as part of the 2000 RAM and was replaced by a culvert which runs between the western fence-line of the property and the Slurry Wall. The on-PWD culvert is currently used to channel storm water runoff from Eames Street and treated discharge from Plant B to the South Ditch.

Currently, the Property is not in active use and contains a vacant office and laboratory building, a general purpose building with pilot lab, two warehouses, a building which houses a groundwater recovery and treatment facility (Plant B) and a closed landfill (CSL). In 2006, Olin installed a 40-foot office trailer near Plant B for use by the Olin employees who operate Plant B and maintain the Property. Property access is controlled along the entire Property perimeter by an eight foot high fence and all access gates are locked when Olin employees are not on the Property.

The Olin Property is situated over glacial outwash deposits that overlie glacial till and igneous and metamorphic bedrock. The saturated thickness of these glacial deposits increases within a buried bedrock valley to the northwest of the Property forming an aquifer underlying MMB and Saw Mill Brook known as the MMBA. The Town of Wilmington operated a municipal water supply well field located over one-half mile northwest of the Property within the MMBA. During 2002, the Town wells were in use intermittently, with certain wells being taken off-line by the Town during different time periods in response to concerns of potentially exceeding nitrite standards in the distribution system. In October 2002, the Town ceased use of all the wells in the MMBA except the Town Park Well. In April 2003, the use of this well field was suspended by the Town of Wilmington Water Department due to the detection of N-nitrosodimethylamine (NDMA) in four of the five MMBA municipal water supply wells (MWSWs). NDMA was not detected in the Town Park Well, and NDMA was not detected within the water supply distribution system. Olin worked with the Town of Wilmington to develop a supplemental water source through a water purchase agreement from adjacent communities after the Town suspended use of the MWSWs. This supplemental water source remains in service. In order to provide a permanent supply, the town has constructed a new connection to the Massachusetts Water Resources Authority (MWRA) system that is funded by Olin and the other respondents.

In September 2005, USEPA identified the Site as a Proposed Site for the National Priorities List (NPL). The primary hazardous substance used by USEPA to score the Site was NDMA (USEPA, 2005). The primary exposure pathway evaluated by USEPA was groundwater. Other principal contaminants noted in the NPL listing included chloride, sodium, sulfate and ammonia.

2.2 CONCEPTUAL SITE MODEL

The components of the Conceptual Site Model (CSM), (contaminant sources, migration pathways, receptors, contaminant fate and transport) were discussed extensively in the Draft Focused Remedial Investigation Report (FRI) (MACTEC, 2007). The major components of the CSM are summarized below to provide context for the discussion of OU sampling objectives. The physical CSM is presented graphically in Figure 2.2-1.

Contaminant Sources

Sources and potential sources of contamination at the Facility are related to former manufacturing operations and waste disposal practices. These include specific areas of waste disposal and infrastructure at the facility. The majority of the contaminant sources have been investigated and addressed through remedial actions under the MCP. These sources and other potential sources of contamination are identified below.

Primary sources include:

- Surface features that received liquid wastes included the Former Lake Poly, East and West Pits and the three Acid Pits. Each of these unlined pits received liquid wastes during facility operations, between 1953 and approximately 1970. The liquid wastes contained sulfuric acid, sodium chloride, sodium sulfate, ammonium chloride, ammonium sulfate, chromium sulfate, and other constituents. Sodium dichromate was used in the Kempore® (azodicarbonamide) process and acidic wastes containing chromium were discharged until 1967. Two lined lagoons were later constructed which received calcium sulfate containing wastes.

- Facilities where surface spills or releases may have occurred include former manufacturing facilities including the laboratory, Plants A, Plant B (TMPs released), Plant C-1, C-2, C-3, and Plant D and the wastewater treatment plant which was installed in the early 1970s; former transformer locations; and former chemical storage tanks and tank farms (particularly processing oil release (LNAPL) from Plant B Tank Farm).
- Former debris disposal area.
- Former drum disposal area.
- Plant B Tank Farm – processing oil spills.

Additional potential sources include:

- Former fuel oil underground storage tank (UST) locations;
- Urea silo;
- Non-contact cooling water outfall;
- Former or existing sumps and floor drains; and
- Subsurface utilities and septic systems.

As discussed in the Draft FRI, soil and waste removal actions were previously conducted at the Former Lake Poly, the former drum disposal areas, former debris area. Therefore, these primary sources are considered historical source areas. The lined lagoons that received calcium sulfate containing liquid waste were dismantled and closed, and were situated within the current Containment Area.

The proposed RI investigation program includes specific soil and groundwater sampling and analysis for investigation of releases potentially associated with the primary sources and potential sources.

The secondary sources are associated with the primary source areas that received liquid processing wastes. Those secondary sources include the two DAPL pools located within bedrock depressions on-Property and off-Property (Upper DAPL Pool, the Main Street DAPL Pool and the small area around MW-83D). These secondary sources were created as the result of the historical discharge of liquid waste materials into the Former Lake Poly, the East and West Pits, and the three acid pits. The liquid wastes discharged to the unlined pits had high concentrations of dissolved inorganic constituents with fluid densities greater than water allowing these dense liquids to penetrate the underlying overburden water table and migrate vertically downward to and along the sloping bedrock surface, to the current locations where a DAPL pooled in bedrock depressions.

The DAPL is characterized as a dense, low pH liquid with high concentrations of total dissolved solids. The principal constituents of DAPL include sodium, calcium, chloride, iron, manganese, sulfate, ammonia or ammonium ion, aluminum, and chromium. The characteristics of DAPL have been defined based on statistical analysis of chemical and physical measurements and include a specific gravity greater than or equal to 1.025 and specific conductance greater than 20,600 micromhos per centimeter (µmhos/cm). Additional discussion of DAPL physical data is presented in Section 2.1.2.2.1 of the Draft FRI (MACTEC, 2007). The physical and chemical processes controlling fate and transport of the DAPL constituents is described in Section 5.1.2 of the Draft FRI (MACTEC, 2007) and Section 5 of the Phase II Supplemental Investigation Report (Smith, 1997).

The DAPL and groundwater that immediately overlies DAPL also contain low level concentrations of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The most commonly detected VOCs include: acetone, bromoform, 2-butanone, 2-hexanone, toluene, and TMPs. The most commonly detected SVOCs include: benzoic acid, BEHP, phenols, naphthalene, NDPA and NDMA. The diffuse groundwater does not have a unique specific gravity and its working definition is groundwater with specific conductance between 3,000 and 20,600 µmhos/cm. There is a wide range of constituent concentrations in diffuse groundwater.

Historical Migration Pathways and Mechanisms

Previous reports have indicated that during the operation of the facility, the DAPL material, which moved primarily in response to gravity, migrated to the west and northwest within a sloping bedrock valley (the Western Bedrock Valley) in the area of the MMB wetland. The conceptual model suggests that when the discharge of the wastes to the unlined surface features ceased, the gravity-driven migration of DAPL to the west also gradually ceased. Currently, the DAPL material remains in isolated bedrock depressions (the Upper DAPL pool, the Main Street pool, and the area of around GW-83D) and is no longer migrating laterally along the bedrock surface by that gravity-driven mechanism. The down slope migration of DAPL was arrested by the presence of bedrock ridges or saddles positioned perpendicular to the direction of the bedrock valley. The elevation of the top of DAPL in these pools has been measured by inductance logging since 1992 and has remained stable, within measurement sensitivity, and is coincidental with the low point of bedrock saddles containing the Upper DAPL Pool and the Main Street DAPL Pool.

The historical migration of this dense fluid was accompanied by convective mixing with groundwater resulting in an area of dissolved DAPL constituents in the deeper portions of the overburden aquifer in both on-Property and off-Property areas. As advective flow of DAPL ceased, the primary mechanism for release of dissolved constituents from the DAPL to overlying groundwater became chemical diffusion, which is a slow and inefficient mass transfer process. The diffusion of dissolved constituents into the groundwater above resulted in the diffuse groundwater. Simply stated, diffuse groundwater is groundwater that has been impacted by the diffusion of constituents from DAPL. The term diffuse groundwater describes the geochemical continuum between DAPL and overlying groundwater (Geomega, 1998, 2003). Several of the DAPL constituents, and in particular chromium, are rapidly attenuated by geochemical reactions (such as precipitation) which take place as solutes move over a distance of several feet from the low pH environment of the DAPL to the buffered pH conditions of the diffuse groundwater above it.

Groundwater in the MMBA (Ipswich River Watershed) flows in a westerly and then northerly direction following the Western Bedrock Valley in the vicinity of the Wilmington MWSW. Based on the topography of surrounding land, and the underlying bedrock, and groundwater level measurements in both overburden and bedrock, bedrock groundwater movement mimics the general direction of groundwater flow in the overburden aquifer. Surface water flows in MMB wetland result from upstream surface water inflows, run-off and groundwater discharge.

Dissolved constituents in diffuse and overlying groundwater at the former facility property and in the area to the west of the property boundary but within the Aberjona Watershed would have migrated downgradient from the former Facility portion of the Site and areas underlying the South Ditch and Ephemeral Drainage area. Some overburden groundwater on the western side of the property flows southwesterly before turning south toward the off-PWD and upper East Ditch. Groundwater in the central portions of the former facility flows south easterly and progressively easterly as it approaches the East Ditch. Again the movement of bedrock groundwater is expected to mimic that of the overlying overburden groundwater system. Surface water flows in the East Ditch, Ephemeral Drainage, and East Ditch result from precipitation and overland run-off as well as discharge from shallow groundwater. Portions of the South Ditch vary from gaining to losing conditions seasonally, depending on the elevation of underlying groundwater. Discharge of shallow impacted groundwater to South Ditch surface water results in precipitation and subsequent deposition of Al-Cr-Fe floc within ditch sediments. Dissolved phase constituents in surface water and floc-impacted sediment in the South Ditch and East Ditch migrate to down stream areas.

Historical disposal practices resulted in impacts to the West Ditch Wetland area and the on-PWD. Materials that might have entered the on-PWD via surface flow or Former Lake Poly would have flowed, with surface water, south into the South Ditch, and subsequently, in an easterly direction in the South Ditch, to the East Ditch and downstream to the New Boston Street Drainway. Historical analytical data indicate that some of the constituents (oil, chromium, phthalates, and NDPA, in particular) were deposited or sorbed to the sediments of the ditch system. Other more soluble constituents of that waste material (such as ammonia, calcium, sulfate, sodium, and chloride) migrated with surface water through the ditch system, but also had some impact on sediments.

Processing oil was released to the subsurface in the area of the Plant B Tank Farm. An LNAPL is present in the subsurface in that area, and this material was reported as a seep in the adjacent bank of the East Ditch. A groundwater containment system was installed and been operated to create a cone of depression and has effectively eliminated migration of LNAPL to the East Ditch.

<u>Current Migration Pathways and Mechanisms</u>

Current migration pathways are less numerous than historical ones given there are no longer liquid waste disposal to the land surface and the Plant B Treatment System continues to operate. Migration pathways in groundwater will consider the location of groundwater divides, vertical and horizontal gradients, and how those divides and gradients affect solute migration throughout the Site. The migration pathways that will be further assessed or monitored by RI activities include:

- Diffusion of dissolved constituents from the two DAPL pools and the GW-83D area to diffuse groundwater;

- The migration of on-Property diffuse and impacted overlying groundwater to the South Ditch and to a lesser extent to the East Ditch, with subsequent floc formation, and subsequent migration of dissolved phase constituents and floc to the East Ditch and downstream areas;
- Migration of impacted groundwater along the axis of the Western Bedrock Valley west of the groundwater divide located near Jewel Drive;
- Potential migration of impacted groundwater within the MMBA upward toward surface water of the MMB wetland;
- The migration of shallow groundwater east of the groundwater divide near Jewel Drive in downgradient directions (primarily in the direction of the South Ditch and East ditch;
- The nature and extent, and migration of constituents in bedrock groundwater in on-Property and off-Property locations;
- Existing or former utilities and drain lines from process areas located within the former Facility;
- The vapor intrusion pathway will be investigated in the RI to determine if it is a complete pathway;
- Migration of dissolved constituents from the CSL in groundwater to the northeast and southwest from the groundwater divide that bisects the CSL;
- Migration of impacted groundwater to active area supply wells; and
- Potential migration of impacted groundwater and discharge to Landfill Brook and the surrounding wetland area in the headwater area of Landfill Brook.

Receptors

Based on existing environmental data the following receptor pathways are complete:

- Human (industrial/commercial) and ecological exposure to on-Property soils.
- Human (industrial/commercial) and ecological (semi-aquatic) exposure to surface water and sediment in the South Ditch.
- Ecological exposure (semi-aquatic) to surface water and sediment in the East Ditch, even considering limited value of ecological habitat in the Massachusetts Bay Transportation Authority (MBTA) East Ditch. Realistically, human exposure to the East Ditch is prevented along most of its length by MBTA access restrictions.
- Human exposure to groundwater used as drinking water (residential wells). USEPA has indicated the on-going monitoring of these wells is the appropriate action for this pathway at this time.

The Wilmington MWSWs in the MMBA are not in use. Air migration pathways have been evaluated previously, and it was concluded that migration of contaminants from groundwater through the vadose zone into occupied buildings is not a complete pathway. In addition, contaminants at the Site are largely non-volatile (inorganics, metals, and SVOCs). The potential for vapor migration pathways from groundwater and soil will however be re-assessed using new chemical data for VOCs and SVOCs data to be collected for OU1 and OU3.

3.0 SAMPLING OBJECTIVES

This section discusses the sampling objectives for each OU and associated media. This discussion is preceded by a summary of the proposed analyte list for the RI.

3.1 IDENTIFICATION OF PROPOSED REMEDIAL INVESTIGATION ANALYTE LIST

Based on a review of the manufacturing operations at the facility and the results of the previous investigation activities, a RI Analyte List has been developed and approved by USEPA. Table 3.1-1 identifies the RI Analyte List. The RI Analyte List is comprised of two components: the standard comprehensive analyte list that includes Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) metals, inorganics, CERCLA SVOCs (including NDMA), and CERCLA VOCs (including TMPs); and the "additional Site-specific analytes" that have been included to address manufacturing operations at the facility and/or specific requests by USEPA.[1]

Several inorganic and organic parameters, including ammonia, chloride, nitrite/nitrate, sulfate, TMPs, and NDMA (Method 8270), are included in the standard comprehensive analyte list, consistent with previous investigations. At the request of USEPA, benzoic acid, benzyl alcohol, and diphenyl oxide (diphenyl ether) have been added to the standard comprehensive analyte list as SVOCs by USEPA Method 8270. It should be noted that although NDMA can be reported in the standard Method 8270 analysis, NDMA will also be analyzed using a modified Method 8270 procedure to accomplish reporting limits that are as low as possible (low level analysis) to meet project action levels to the extent possible. In this context, NDMA low level analysis is called out as a separate analysis (separate from SVOCs by Method 8270) in the tables that summarize the analytical programs for the environmental media.

The "additional Site-specific analytes" include polychlorinated biphenyls (PCBs) (for samples in the area of electrical transformers), Massachusetts EPH and VPH, and several compounds associated with historical operations or requested by USEPA including dimethylformamide (also known as N,N-dimethylformamide or DMF), phthalic anhydride, hydrazine, acetaldehyde, formaldehyde, nonylphenol, perchlorate, diphenylamine, tin, and the products Opex® and

[1] The CERCLA target analyte lists for Methods 8270 and 8260 have been augmented by additional analytes that are contained on the target analyte lists for those methods as published in the Compendium of Analytical Methods that is associated with the Massachusetts Contingency Plan.

Kempore®. Specific nuances pertaining to analysis of some of these compounds are explained below.

The products Opex® and Kempore® have low solubility in both water and organic solvents and therefore are not readily extractable from environmental media for chemical analysis. An analytical method is not available for Opex® and Kempore® in soil and sediment matrices. An analytical method is available for water matrices. In addition, an analytical method for nonylphenol does not currently exist for soil and sediment, matrices, although a method does exist for water matrices. Nonylphenol has numerous possible isomers and the method for its analysis is based on a technical mixture of the most common isomers. Investigations of soil and sediment will not include Opex® and Kempore® or nonylphenol analysis. Investigations of groundwater and surface water will include Opex® and Kempore® and nonylphenol analysis.

PCBs or EPH/VPH will be analyzed in soil and groundwater respectively at specific locations where transformers or fuel storage tanks formerly existed. Tin will be included in the standard analyte list for metals. Diphenylamine, if present, is reported with NDPA in the SVOC analysis. Samples where NDPA is detected in soil will be reprocessed with a special sample cleanup procedure and re-run to determine if the NDPA detection is NDPA, diphenylamine, or a combination of both compounds. (Note this same procedure will be used for other OU1, OU2, and OU3 media.) The remaining compounds, DMF, phthalic anhydride, hydrazine, acetaldehyde/formaldehyde, perchlorate, will be analyzed for in soil, sediment, surface water and groundwater. In addition, N-nitrosodipropylamine will be reported with NDMA under the low level NDMA analysis. The low level NDMA analysis will not be used for groundwater analysis at locations where historical data indicate NDMA is present at concentrations greater than 1 µg/L (microgram per liter). NDMA is a standard analyte in the USEPA Method 8270 SVOC analysis, and NDMA at concentrations of 1 µg/L or greater will be reported with the SVOCs under Method 8270. In addition, USEPA has specifically requested that soil and sediment also be tested for hexavalent chromium (Cr +6 or Cr VI) and a method has been included in the QAPP for this analysis.

Although several of the "additional Site-specific analytes" fall under the classification of semi-volatile compounds, when the analytical group SVOCs is identified in text or in tables, it is explicitly intended to mean the analytes reported under the USEPA Method 8270 as identified in the QAPP (including parameters included on the MCP target analyte list [TAL] for that method).

The same is also true for VOCs. When the analyte group VOCs is identified in text or tables, it explicitly means the analytes reported under USEPA Method 8260b as identified in the QAPP (including parameters included on the MCP TAL for that method). The Method 8260 list in the QAPP contains additional compounds required under the MCP as well as the two TMP compounds. Several compounds are reported under both the VOC (8260) and SVOC (8270) methods (chlorinated benzene isomers, and naphthalene), and the higher of the values reported will be used in quantitative risk assessment calculations, if required.

3.2 OU1 SAMPLING OBJECTIVES

OU1 includes on-Property soils, surface water, sediment, and the vapor intrusion pathway (air). Proposed sampling in OU1 includes collection of surface and subsurface soil samples below buildings and foundations on the Property, around these buildings and foundations, near historical Property features (including USTs, transformers and leach fields), in the South Ditch floodplain and other representative locations, and collection of surface water and sediment samples (0-6 inches) from the South Ditch. Sediment will also be collected from the Lower South Ditch and a reference location for toxicity testing. These data, in conjunction with previously collected data, will be used to support evaluations in the RI, human health and ecological risk assessments, and development and evaluation of remedial alternatives in the FS. In addition to the general and OU- specific objectives for the RI/FS stated in Volume I and the SOW, the primary sampling objectives for collection of samples in OU1 are:

- Refinement of previous investigation findings.
- Assessment of nature and extent of Site-related contaminants in OU1 media (including the area south of the South Ditch).
- Investigation of manufacturing process areas.
- Data collection for risk assessment purposes, (including results of sediment toxicity testing).

In consideration of potential future development, characterization of surface and subsurface soils outside of and below the foundations of buildings used in former manufacturing processes will be conducted to assess the presence or absence of Site-related contaminants. These data will support risk characterization for commercial and industrial exposure scenarios consistent with the industrial setting and potential future use of this Site as well as risk characterization for ecological resources in undeveloped portions of OU1. For risk assessment purposes, surface soil will be considered the 0-1 foot interval from ground surface, including the first foot of soil immediately underlying foundations (assuming potential future removal of the foundations). Soil from 1-10 feet will be considered as subsurface soil for risk assessment purposes, (i.e., to characterize soils for a future construction worker exposure scenario). Soil sample data collected at depths greater than 10 feet will be used in conjunction with other soil data for assessment of nature and extent of Site-related contaminants.

Post-remedial subsurface soil confirmatory sampling and analysis in the EPH/VPH area west of Plant B shall be conducted to document post-remediation (AS/SVE for TMP removal) conditions in that remediated area.

The floodplain area of the Lower South Ditch begins on-Property and extends off-Property to the East Ditch. The Lower South Ditch floodplain soils (on-Property and off-Property) shall be investigated as part of OU1 to characterize the nature of contamination in surface and subsurface soils in that area. Historically, data collected from floodplain soils have included detections of chromium and SVOCs, including BEHP.

Surface and subsurface soils in the floodplain area of the Lower South Ditch, including the area between the eastern Property boundary and the East Ditch as discussed below, have been well characterized for chromium. Additional sampling shall be conducted in the Lower South Ditch to complete the characterization of the nature of and distribution of SVOC contamination in surface soil in that area. Based on an assessment of sediment hazard indices (HI), a location will be identified for sediment for a longer term toxicity test.

The RI will characterize background conditions by re-sampling all historical background locations including soil, surface water, and sediment locations as discussed below. Much of the background conditions information has been previously presented in the 1997 Supplemental Phase II Report (Smith, 1997). Attachment 3 of Appendix S of that report is the Characterization of Background Conditions. The following text identifies the background locations where samples will be collected and submitted for laboratory analysis for the standard comprehensive analyte list.

Soil background samples (0-1 ft below ground surface (bgs)) will be collected at previous background locations as follows:

- Soil sample locations SS015XXBKX through SS019XXBKX), and
- Soil sample location BS021REF.

Surface water and sediment background samples will be collected and submitted for laboratory analysis for the standard comprehensive analyte list at the following locations:

- Sample locations SW001XXBKX through SW004XXBKX and SW014XXBKX for surface water, and
- Sample locations SD001XXBKX through SD004XXBKX, SD014XXBKX, and BS012REF for sediment.

The proposed soil, surface water, and sediment background locations are presented in Figures 3.2-1, 3.2-2, and 3.2-3, respectively. The analytical parameters for the soil background samples are summarized in Table 3.2-1 and the parameters for surface water and sediment background samples are summarized in Table 3.2-2. The proposed soil, surface water, and sediment investigation program to address these OU1 objectives are described in Section 4.

3.3 OU2 SAMPLING OBJECTIVES

OU2 includes off-Property surface water and sediment. The primary sampling objective for collection of samples in OU2 is assessing current concentrations of Site-related contaminants. This sampling is proposed for surface water and sediment in the MMB Wetland area, in the East Ditch and the New Boston Street Drainway, and in the off-PWD. The analytical data will be used to support evaluations in the RI, human health and ecological risk assessments, and development and evaluation of remedial alternatives in the FS. As described in Volume I of the RI/FS Work Plan, new data that are collected will be statistically evaluated and compared to historical data to determine if the both data sets represent the same sample population and if the new and historical data can be combined (pooled) for quantitative analysis.

Surface water and sediment in the MMB Wetland area, the East Ditch, and the off-PWD have been sampled under the MCP. Those prior investigations, as discussed in the Section 2.1.4 of the Draft FRI, delineated the nature and extent of impacts to surface water and sediment within the off-PWD, the East Ditch, and downstream water courses including the New Boston Street Drainway. Surface water and sediment data collected within MMB and Sawmill Brook within the MMB Wetland supported conclusions that groundwater discharge in those areas had not impacted either surface water or sediment. These data also included several analytical results for

NDMA in surface water that were qualified NJ and have been interpreted as potential, false positive results. Additional sampling of surface water and sediment locations is also proposed for those media and areas to confirm prior data and resolve any uncertainties related to previously qualified data. In addition, additional stream gauging will be completed to provide a better estimate of groundwater and surface water mass balances in the MMB Wetland complex.

In addition to the general and specific RI/FS objectives stated in the Volume I of the RI/FS Work Plan the primary sampling objectives for collection of samples in OU2 are:

- Assessment and confirmation of previous investigation findings;
- Assessment and confirmation of nature and extent of Site related contaminants;
- Collection of surface water flow data within the MMB Wetland complex; and
- Collection of data for risk assessment purposes.

The proposed surface water and sediment investigation program to address these objectives is described in Section 5. Data collection for background conditions characterization for surface water and sediment is proposed in this program.

3.4 OU3 SAMPLING OBJECTIVES

As discussed in the Draft FRI, the overburden groundwater system flows within two regional watersheds defined as the Aberjona and Ipswich watersheds. Groundwater within the MMBA is within the Ipswich watershed. Groundwater underlying the Olin Property and to the southeast is within the Aberjona watershed. The groundwater divide between these two watersheds is approximately coincidental with designated MassDEP Zone II and non-Zone II groundwater classifications (i.e., areas outside the Zone II classification). The horizontal and vertical extent of groundwater impacts from Site-related contaminants within the overburden groundwater system has been well characterized in both the Ipswich and Aberjona watersheds; however, additional characterization activities will be completed to further define the downgradient extent of potential groundwater impacts in both areas. The objectives for groundwater characterization are not based on groundwater classification, but rather establishing nature and extent of groundwater impacts. Therefore the sampling objectives that follow can be applied equally to Zone II and non-Zone II groundwater within both the Aberjona and Ipswich watersheds. In addition to the general and specific RI/FS objectives stated in the Volume I of the RI/FS work plan the primary sampling objectives for collection of groundwater samples include:

- Assessment of current concentrations of Site-related contaminants in groundwater to confirm or refine previous investigation findings concerning the nature and distribution of Site related impacts to overburden and bedrock groundwater including downgradient extent.
- Continuation of monitoring of DAPL Pool elevations.
- Determination of current groundwater flow directions and horizontal and vertical gradients, both within overburden groundwater, and between overburden and bedrock groundwater.
- Assessment of surface water and groundwater interaction in Sawmill Brook and MMB by measuring the gradient between shallow groundwater and surface water at specific locations.
- Assessment of groundwater quality in bedrock between the Upper and Main Street DAPL pools and the area on the ridge to the southwest of the Site, and on the opposite side of the DAPL pools side nearer Eames Street and Jewel Drive.
- Collection of data for risk assessment purposes, including assessment of the potential for vapor intrusion.
- Assessment of groundwater quality in active residential and commercial supply wells in areas potentially located within the downgradient portions of the Site.
- Assessment of surface water and groundwater interaction in Landfill Brook by measuring the gradient between groundwater and surface water at specific locations.

The proposed groundwater investigation program to address these objectives is described in Section 6. Evaluation of OU3 data in the RI/FS, will consider groundwater use and State groundwater classifications or other appropriate Applicable or Relevant and Appropriate Requirements (ARAR).

The geologic, geochemical, and hydrogeologic conditions at the Site have been well characterized and do not require additional specific characterization in the RI to meet objectives stated in the SOW. Additionally, the evaluation of the rate of diffusion and other transport mechanisms controlling the migration of contaminants between DAPL, diffuse, and overlying groundwater were discussed in the Phase II Supplemental Investigation Report (Smith, 1997).

The Olin Site is bisected by a groundwater divide and impacted groundwater flows in opposite directions toward different watersheds. Therefore an area of groundwater that could be considered to be upgradient of the Site, and unaffected by former facility does not exist. Therefore, background groundwater quality data from the adjoining Industri-plex Superfund Site was utilized in the Draft FRI to place groundwater quality at the Site in context. Overburden and bedrock groundwater monitoring wells, including residential wells, exist that are outside the region of groundwater impacted by releases from the Olin facility. At the conclusion of the RI sampling activities, if it is determined to be necessary, the Industri-plex Superfund Site background data may be revisited, and data from non-impacted wells may be assessed and evaluated to determine whether such data is appropriate for use as reference locations for evaluating ambient or background water quality.

4.0 OU1 INVESTIGATION

This section presents the proposed sampling and analytical program for OU1. Section 4 is organized as follows:

Section 4.1 – surface soil
Section 4.2 – subsurface soil
Section 4.3 – surface water
Section 4.4 – sediment
Section 4.5 – air

In each of these subsections, there is a brief discussion of historical sampling, identification of proposed sample locations and associated analytical parameters, and the rationale for the proposed sampling and analytical program. Information concerning the manufacturing history and physical layout of the facility also supports the proposed sampling and analytical program for OU1. The OU1 sampling and analytical program will consist of one sampling event to collect surface soil, subsurface soil, and sediment samples. Surface water sampling will consist of two rounds of sampling to account for seasonal variations. One sampling event will be a low flow event (Fall), and the other high flow event (Spring). The sampling locations and analyses are discussed in the following sections.

4.1 SURFACE SOILS SAMPLING AND ANALYTICAL PROGRAM

The following section describes the location of proposed surface soil sampling, the rationale for selection of sample locations, and the analytical program proposed for surface soils collected within OU1. Surface soils are defined as the interval from ground surface (0) to one (1) foot bgs. This definition will be used for sample locations both outside of and under former or existing building slabs. For building foundations, the interval will start at the contact between the concrete slab and underlying soil.

4.1.1 Historical Surface Soil Sampling and Analysis

Several soil investigations including specific source-area investigations have been conducted at the Site since the 1991. The historical investigations have been discussed in detail in Section 2 of the Draft FRI, submitted to the USEPA in October 2007 (MACTEC, 2007). Tables 2.1-2 and 2.1-3 of the Draft FRI identify all historical soil samples collected by "area" and by "date", respectively. Those tables identify sample dates, sample depths, and analytical parameters for each of the samples previously collected.

Numerous removal actions and remedial actions have been conducted at the facility, resulting in reductions in soil concentrations (TMPs in the former Plant B processing area), the removal of surface and subsurface soils (as well as sediments) from OU1, and the containment of soils within a slurry wall/cap (primary purpose of the slurry wall/cap is containment of groundwater). Soil removal activities have been conducted consistent with work plans approved by MassDEP in the areas identified below. Final reports documenting all soil removal activities were submitted to the MassDEP.

- Former Lake Poly area
- Drum Area A and Drum Area B
- Buried Debris Area (including SWMU-27)
- Petroleum-impacted soils east of the large water tank
- Banks of Central Pond and the Central Pond Drainage Area
- Banks of the South Ditch
- Targeted soil hot spot removals (Confirmatory samples collected from four sides and bottom of each excavation (GEI, 2001a, 2001b))
    - RSO-6 (cadmium)
    - A8-CW1 (polycyclic aromatic hydrocarbons [PAHs] and dibenzofuran)

4.1.2 Sample Locations

The proposed surface soil sampling and analysis program has been developed consistent with the objectives identified in Section 3.2 and are the result of discussions and meetings between Olin and USEPA. These discussions resulted in establishing preliminary exposure areas within OU1 to guide sample collection activities. These sampling objectives include assessment and refinement of previous investigation findings, assessment of nature and extent of Site-related contaminants (including Lower South Ditch floodplain soils), investigation of manufacturing-related areas and locations, and collection of data to support risk assessment activities.

OU1 has been divided into four general exposure areas and include Exposure Areas A, B, C, and D which will constitute areas for investigation. Area A includes the former manufacturing area and is subdivided into eight preliminary subareas (A1 to A8) that isolate particular buildings or production areas. Area B includes the South Ditch and forested and wetland areas between the former manufacturing facility and South Ditch. Area C is the areas south of South Ditch includes the identified Conservation Area. Area D is the Containment Area. Table 4.1-1 identifies the proposed sampling and analysis program according to these areas. Table 4.1-1 is organized by investigation areas (A1 to A8, B, C, and D) in order to indicate more clearly the rationale for sample locations and analytical parameters. Table 4.1-1 includes a surface soil sample location identification (ID) which corresponds to sample location IDs shown on Figure 4.1-1.

As shown on Figure 4.1-1, investigation areas (A1 to A8, B, C, and D) are identified on the Property to establish a visual aid for review of the spatial coverage of samples and to aid the reader in locating the proposed samples identified in Table 4.1-1. These areas were established to provide a frame of reference to visualize existing and proposed soil sample coverage and density.

The proposed surface soil sample locations are identified and shown in Figure 4.1-1. A total of 134 surface soil samples are proposed. These locations were established by agreement between USEPA and Olin. Most of the historical surface soil samples collected at the Site were collected from a depth of 0 – 3 feet bgs, consistent with the MCP definition of surface soil. These samples did not meet the USEPA CERCLA program definition of surface soil (0 - 1 foot bgs) and therefore, will be considered subsurface soil samples for purposes of the RI/FS. Please note that figures showing the Building or Plant designations are included in Appendix A. It should be noted that several of the sub-slab sample locations were identified to address two concerns: nature and extent beneath the slab and the potential releases from storage tanks identified in or adjacent to the buildings as identified in Appendix A. The 134 surface soil samples include, but are not limited to the following:

- Twenty-eight surface soil samples will be collected from beneath the slabs or foundations of buildings on the Property as identified in Table 4.1-1 and shown in Figure 4.1-1.
- One surface soil sample adjacent to each of the three former USTs.
- One surface soil sample is proposed for collection between Plant D and the Plant D tank farm near the area of the hydrazine tank that historically was located there.
- Two surface soil samples are proposed for collection at each of the five historical transformers that were located on the Property.
- One surface soil samples will be collected from the tile field behind the historical Plant B building, and one surface soil samples will be collected from the leach field west of the General Purpose Building and Pilot Lab.
- Two surface soil samples will be collected behind the Plant B Treatment Building.

- Two soil samples will be collected in the historical water drainage feature (as shown in the aerial photograph from 1967) behind the water tank.
- Twelve surface soil samples will be collected around the perimeter of the Site.
- Ten surface soil samples will be collected from the open areas to the south of the South Ditch.
- Eleven surface soil samples will be collected from the Lower South Ditch floodplain.
- Four surface soil samples will be collected from the CSL drainage area.
- Four surface soil samples will be collected from the access road to the CSL.
- Ten surface soil samples will be collected in the temporary cap area.
- Two surface soil samples will be collected in the on-PWD Wetland. Depending on the media encountered at the location, the samples will be collected as either sediment or surface soil.
- One surface soil sample will be collected in the area of Lake Poly.

Additionally, background soil samples will be recollected from the historical background soil sample locations listed in Section 3.2 and shown in Figure 3.2-1. The analytical suite for those samples is summarized in Table 3.2-1.

Figure 4.1-1 shows the spatial coverage of the proposed surface soil samples and the proposed analytical program.

4.1.3 Analytes and Frequency of Analysis

All surface soil samples will be analyzed for the standard comprehensive analyte list and a representative subset of surface soil samples will be analyzed for one or more “additional Site-specific analytes” as outlined in Table 4.1-1. The “additional Site-specific analytes” in soil include: NDMA (low level analysis), EPH/VPH, DMF, phthalic anhydride, acetaldehyde/ formaldehyde, hydrazine, diphenylamine, and hexavalent chromium. The analytical program presented in Table 4.1-1 has been agreed upon with USEPA. Please note that the column heading “NDMA” in this table refers to low-level analysis. The soil samples collected near the historical transformers will be analyzed for PCBs. The soil samples collected near the former USTs will be analyzed for EPH/VPH.

4.2 SUBSURFACE SOILS SAMPLING AND ANALYTICAL PROGRAM

The following section describes the location of proposed subsurface soil sampling, the rationale for selection of sample locations, and the analytical program proposed for surface soils collected within OU1. Consistent with discussions with USEPA, Olin proposes collecting 74 on-Property subsurface soil samples. Subsurface soil samples will be collected at similar locations as discussed for surface soil in Section 4.1 because the objectives for surface soil and subsurface soil are quite similar. Subsurface soil samples are proposed at each of the 28 surface soil sampling locations specifically focused on investigation beneath slabs. Subsurface soil samples are not proposed at locations that are being investigated for potential surficial releases (such as at transformer locations and the floodplain soils).

4.2.1 Historical Sampling and Analysis, Nature and Extent

Subsurface soil investigations are described in detail in Section 2 of the Draft FRI (MACTEC, 2007). Tables 2.1-2 and 2.1-3 of the Draft FRI identify all historical soil samples collected by "area" and by "date" respectively. Those tables identify sample dates, sample depths, and analytical parameters for each of the samples previously collected. Figure 2.1-2 of the Draft FRI (MACTEC, 2007) identifies the locations of the previously collected subsurface soil samples at the Property (including sample locations where excavation subsequently occurred). Subsurface soil sampling has been conducted in the former manufacturing area of the Site (including, but not limited to, the former and current Plant B area, the East and West Warehouses, the former Plant D tank farm, and the area east of the former Plant D tank farm), the former Lake Poly area, the containment area (collected prior to construction of the slurry wall and as part of confirmation sampling related to the on-PWD), the South Ditch, Central Pond and other removal actions. Subsurface soil samples have also been collected off-Property in the off-PWD and the North Pond area.

4.2.2 Sample Locations

The proposed subsurface soil sampling and analysis program has been developed consistent with the objectives identified in Section 3.2 and by agreement between USEPA and Olin. These objectives include assessment and refinement of previous investigation findings, assessment of the nature and extent of Site-related contaminants, investigation of former manufacturing-related areas and locations, and collection of data to support risk assessment activities. The proposed subsurface soil samples are identified in Table 4.2-1 and their locations and analytical program are shown in Figure 4.2-1. At each of the identified subsurface soil sample locations, a sample will be collected from the 1 – 10 foot interval and a sample will also be collected from the interval deeper than 10 feet bgs. Table 4.2-1 identifies sample locations using the investigation areas that were discussed previously for surface soil samples in Section 4.1.3. The proposed subsurface soil sample locations and the associated analytical program are described in Table 4.2-1, and include, but are not limited to the following:

- Twenty-eight subsurface soil samples will be collected from beneath the slabs or foundations of buildings on the Property (co-located with the surface soil samples discussed previously) as identified in Table 4.1-2 and shown in Figure 4.1-2.
- Two samples are proposed for collection behind the Plant B Treatment Building.
- One sample is proposed for collection between Plant D and Plant D tank farm, near the area of the historical hydrazine tank.
- One sample will be collected from the tile field behind the historical Plant B building, and one sample will be collected from the leach field west of the General purpose Building and pilot lab.
- Three samples are proposed for the three former fuel oil USTs area behind the former Boiler House.
- Two samples are proposed for the former surface water feature between Plant B Tank Farm and the Plant D Tank Farm.
- Two samples will be collected in the West Ditch Wetland.
- One sample will be collected in the area of Lake Poly.

Figure 4.2-1 shows the spatial coverage of the proposed subsurface soil samples and the associated analytical program.

4.2.3 Analytes and Frequency of Analysis

All subsurface soil samples will be analyzed for the standard comprehensive analyte list and a representative subset of subsurface soil samples will be analyzed for one or more “additional Site-specific analytes” as identified in Table 4.2-1. The analytical program presented in Table 4.2-1 has been agreed upon with USEPA. Please note that the column heading “NDMA” in this table refers to low-level analysis.

To the extent possible, the decision to conduct laboratory analysis of the soil samples collected from greater than 10 feet bgs will depend on the laboratory results for the soil samples collected from the 1 – 10 foot interval. The analytical results for a soil sample collected from 1 – 10 feet bgs will be compared to the USEPA “Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites” for industrial land use and the Groundwater Protection Soil Screening Levels (risk-based) published in the USEPA RSL Table (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm).

For any analyte group (such as SVOCs), if all detected chemicals in that analyte group have associated RSLs and SSLs and all reported concentrations are below the corresponding RSLs and SSLs, then the sample collected from greater than 10 feet at that location will not be analyzed for that analyte group. If one or more chemicals in an analyte group has a reported concentration that is above either or both the RSL and SSL (or does not have RSLs), then the sample collected from greater than 10 feet at that location will be analyzed for that analyte group. A minimum of six soil samples collected from depths greater than 10 feet bgs in the areas of the former unlined impoundments in the former production area will be analyzed for the standard comprehensive analyte list plus the "additional Site-specific analyte list". Those samples will be collected and analyzed to assess the potential presence of DAPL material.

4.3 SURFACE WATER SAMPLING AND ANALYTICAL PROGRAM

The following section describes the location of proposed surface water sampling, the rationale for selection of sample locations, and the analytical program proposed for surface water samples collected within OU1. On-Property surface water samples will be collected at historical sample locations and one new location along the length of the South Ditch as part of the RI. The South Ditch, between the western Property boundary and the East Ditch, is included in this sampling and analysis program. A small portion of the ditch is located off-Property (between the eastern Property boundary and the East Ditch).

4.3.1 Historical Sampling and Analysis, Nature and Extent

The historical OU1 surface water sampling is discussed in detail in Section 2 of the Draft FRI (MACTEC, 2007). OU1 surface water includes samples collected in the South Ditch, the on-PWD, and the Central Pond. Surface water investigations were initiated in the South Ditch in 1977 and 1978. Currently, surface water sampling is conducted in the South Ditch as part of the Interim Response Steps Work Plan (IRSWP). Sampling in the on-PWD was conducted from 1977 until 2000, when the remediation of sediment was conducted and the ditch was replaced with a culvert. Surface water in Central Pond was sampled in 1992, 2000, and 2001. The summary of the historical surface water analytical data collected over the past ten years is presented in Table 4.3-1. Among metals and inorganics, the most frequently detected parameters include aluminum, chloride, chromium, iron (unfiltered) sodium, potassium, calcium, sulfate, and ammonia. BEHP and NDMA were also detected in OU1 surface water. Figure 4.3-1 identifies the historical surface water sampling locations. Figures 4.3-2 and 4.3-3 show the surface water concentration distributions of ammonia and NDMA, respectively. These figures show sample results beginning in the upstream portion of the South Ditch with concentrations generally decreasing in the downstream direction and throughout the East Ditch.

4.3.2 Sample Locations

The proposed surface water sampling and analysis program has been developed consistent with the objectives identified in Section 3.2 and through discussion and agreement between USEPA and Olin. These objectives include assessment and refinement of previous investigation findings, assessment and confirmation of nature and extent of Site-related contaminants, and collection of data to support risk assessment activities. Five surface water sample locations are proposed as part of the OU1 RI: ISCO-1, SD-17, SDSW-E, SW-Prop-1, and ISCO-2. As shown in Figure 4.3-4, the proposed sampling locations are strategically located at the upstream end of the South Ditch (above the weir), at three mid-point areas, and at the downstream end of the ditch, just before the confluence with the East Ditch to determine and confirm the extent to which impacted groundwater that discharges to the ditch is affecting surface water quality and to collect information for use in the human health and ecological risk assessments. Additionally, background surface water samples will be recollected from the historical background surface water sample locations listed in Section 3.2 and shown in Figure 3.2-2. The analytical suite for those samples is summarized in Table 3.2-2.

4.3.3 Analytes and Frequency of Analysis

Surface water samples in the South Ditch will be collected on two separate occasions corresponding to low flow surface water conditions (Fall) and high flow surface water conditions (Spring), respectively. This sampling frequency is adequate to assess current conditions and seasonal variation. All OU1 surface water samples will be analyzed for the standard comprehensive analyte list and for low-level NDMA and for the "additional Site-specific analytes" as identified in Table 4.3-2. The "additional Site-specific analytes" in surface water include: NDMA (low level analysis), Opex®, Kempore®, EPH/VPH, nonyl phenol, DMF, phthalic anhydride, acetaldehyde/ formaldehyde, hydrazine, diphenylamine, and hexavalent chromium.

4.4 SEDIMENT SAMPLING AND ANALYTICAL PROGRAM

The following section describes the location of proposed sediment sampling, the rationale for selection of sample locations, and the analytical program proposed for sediment samples collected within OU1. On-Property sediment samples will be collected at four historical sample locations and one new location along the length of the South Ditch as part of the RI. It should be noted that the sediments of the South Ditch between the western Property boundary and the "Delta" were excavated in 2000 and disposed off-Site.

4.4.1 Historical Sampling and Analysis, Nature and Extent

On-Property sediment sampling in the South Ditch and on-PWD was initiated in the 1990's. The on-PWD Wetland, South Ditch, and Central Pond were characterized in 2000 for the excavation activities that were conducted as a Construction-Related Release Abatement Measure (C-RAM) that was started in 2000. After excavation activities were completed, confirmation samples were collected from the underlying soils except in the on-PWD Wetland area where sediment remained in the broader bottom and sidewalls of the excavation, which is now contained within the containment area.

The historical OU1 sediment sampling is discussed in more detail in Section 2 of the Draft FRI (MACTEC, 2007). The locations of historical OU1 sediment samples (including now excavated sample locations and post-excavation confirmatory samples) were identified in Tables 2.1-4 (by area) and 2.1-5 (by date) and shown in Figure 2.1-8 of the Draft FRI (MACTEC, 2007). The locations of historical sediment samples are shown in Figure 4.4-1 of this FSP.

The on-PWD was completely excavated in September and October 2000, and the entire organic sediment layer was removed. The ditch was backfilled and replaced with a culvert (further to the west than the original on-PWD) that connects the on-PWD Wetland and the South Ditch. The actual extent of sediment removal is shown in Figure G-2 of the 2001 C-RAM Status Report (GEI, 2001a). The location of the excavated on-PWD is within the footprint of the Slurry Wall/Cap. All confirmation sampling for the on-PWD sediment excavation involved soils adjacent to and beneath the excavated sediment (GEI, 2001a, 2001b). No sediment remains in the former on-PWD.

The sediment in the South Ditch was also excavated to depth up to 3 feet bgs in September 2000 from the weir to the delta area, and confirmatory soil sampling was conducted beneath and adjacent to the excavated sediment. The bottom of the excavation uniformly extended into the underlying sand layer. In May 2001, additional sediment excavation was conducted in the South Ditch (greater horizontal extent) with subsequent confirmatory soil sampling. No organic sediments remained in the excavation area. The South Ditch sediment was replaced with imported organic soil, erosion control netting was installed, and the ditch was restored in May and June 2001 (GEI, 2001a, 2001b). The area of sediment removal extended from just east of the weir to the area referred to as the Delta. The actual extent of sediment removal is shown in Figures G-3a and G-3b of the 2001 C-RAM Status Report (GEI, 2001a). The portion of the South Ditch where excavation of sediment was conducted is referred to hereafter in this document as the Upper South Ditch, and the portion downstream of the excavated sediment is hereafter referred to as the Lower South Ditch (the unremediated portion of the South Ditch). Note: the 2001 GEI report referred to two portions of the remediated area as the Upper South Ditch and Lower South Ditch.

Sediment sampling has been conducted annually along the remediated portion of the South Ditch as part of the Post-Construction Monitoring Program (PCMP) to assess potential recontamination. Currently, sediment sampling in the South Ditch is conducted annually as part of the IRSWP. The samples are analyzed to monitor constituents present in chromium-bearing floc that is generated by groundwater discharge and mixing with surface water in the ditch.

Organic sediments from the Central Pond were excavated in September/October 2000, and confirmatory soil samples were collected at the bottom and sidewalls of the excavation. The bottom of the excavation uniformly extended into the underlying sand layer. Additional sediment excavation was conducted in November/December 2000 and in May 2001 (GEI, 2001a, 2001b). Figure G-4 of the 2001 C-RAM Status Report identifies the boundaries of the Central Pond sediment excavations as well as the excavated soils in the Central Drainage Area. Excavated sediments were disposed off-site in accordance with applicable regulations. Restoration of the wetland areas was conducted in May/June 2001.

Organic sediments from the on-PWD Wetland were excavated to depths up to three feet in September 2000 and in May 2001. Sediments and soil were also excavated from the Buried Debris Area in September/October 2000 and May 2001. Confirmatory samples were collected with each excavation. Figure G-1 of the 2001 C-RAM Status Report identifies the boundaries of the sediment and soil excavation in the on-PWD Wetland and the Buried Debris Area. The West Ditch Wetland and the Buried Debris Area were restored in May/June 2001 (GEI, 2001a, 2001b). Excavated sediment and soil from both areas were disposed off-site in accordance with applicable regulations.

Table 4.4-1 presents a summary of analytical data for OU1 sediments under current conditions. This summary does not include any sediment data for locations that have been excavated, unless samples were collected subsequent to the excavation. Sample locations included in the data summary include the entire South Ditch (both on-Property and off-Property), Central Pond, and the on-PWD Wetland. Most frequently detected parameters include BEHP (59 percent detection frequency), 2,4,4-trimethyl-1-pentene (19 percent detection frequency), 2,4,4-trimethyl-2-pentene (13 percent detection frequency), the three EPH fractions (100 percent detection frequency), and several metals (particularly aluminum, chromium, and iron which have been associated with floc in the ditch system). Figures 4.4-2 and 4.4-3 show the distributions of sediment concentrations of chromium and BEHP respectively, for current conditions at OU1 (and OU2). These distributions reflect the previous facility discharges and the on-Property sediment removal actions that have been completed. Additionally, one location from the Lower South Ditch area will be selected for 42-day chronic exposure *Hyalella azteca* whole sediment toxicity testing for survival, growth, and reproduction. Sediment will be collected from the location with the highest HI based on existing data after the collection of the samples currently proposed for the South Ditch.

HIs will be calculated by summing hazard quotients (HQs) calculated for each analyte. Maximum detected concentrations of each analyte will be compared to screening benchmarks in order to calculate an HQ.

$$HQ = \frac{\text{Maximum Concentration}}{\text{Benchmark}}$$

And

$$HI = \Sigma(HQs)$$

Toxicity tests will be completed according to the following guidance:

- EPA/600/R-99/064: Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, Second Edition (USEPA, 2000).

4.4.2 Sample Locations

The proposed sediment sampling and analysis program for OU1 has been developed consistent with the objectives identified in Section 3.2. These objectives include assessment of and confirmation and refinement of previous investigation findings, assessment of and confirmation of nature and extent of Site-related contaminants, and collection of data to support risk assessment activities. Five sediment sample locations are proposed as part of the RI: SD-SD-2, SD-SD-3, SDSW-E, SD-Prop1, and ISCO-2, as shown in Figure 4.4-4. Additionally, background sediment samples will be recollected from the historical background sediment sample locations listed in Section 3.2 and shown in Figure 3.2-3. The analytical suite for those samples is summarized in Table 3.2-2.

4.4.3 Analytes and Frequency of Analysis

All OU1 sediment samples will be analyzed for the standard comprehensive analyte list and for the "additional Site-related analytes" that have analytical methods for sediment as identified in Table 4.3-2. The "additional Site-specific analytes" in sediment include: NDMA (low level analysis), EPH/VPH, DMF, phthalic anhydride, acetaldehyde/formaldehyde, hydrazine, diphenylamine, and hexavalent chromium.

4.5 AIR

The following section describes previous air sampling and analysis conducted at the Site, the planned health and safety air monitoring during RI activities at the Site. Air monitoring will be conducted for health and safety purposes during soil sampling activities. Also discussed in this section is the approach that will be used to evaluate the potential for vapor intrusion.

4.5.1 Previous Air Sampling and Analysis

Air monitoring has been conducted at the Site during various removal actions. In 2000, air quality monitoring was performed during the drum removal actions on the property. Air monitoring was conducted for both the Work Zone area (within the active excavation and/or along the excavation limits) and Perimeter locations (250 feet from the excavation limit). The Work Zone air monitoring was conducted for "carbon monoxide, VOCs, hydrogen sulfide and lower explosion limit using a multi-gas meter with photoionization detector (PID), and for airborne dust using a Sibata real-time dust monitor." (GEI Consultants, 2001c). Real-time air monitoring was conducted, and time-weighted average air monitoring was done for dust and VOCs for two days.

The real-time data for total and chromium dust monitoring indicated that the dust levels in the Work Zone were very low. No detected concentrations of chromium dust exceeded the NIOSH REL TWA, the OSHA PEL TWA or the Massachusetts Threshold Effects Exposure Limit. Dust monitoring was not conducted at Perimeter locations because other activities not associated with the Drum Removal were being conducted that could have impacted results. Dust suppression measures were used if visible evidence of dust was observed.

The detected VOC concentrations from Work Zone TWA air monitoring were below NIOSH RELs and OSHA PELs. The "VOC concentrations for identified compounds in all Perimeter samples were more than an order of magnitude less than the REL or PEL for compounds detected in the Work Zone." (GEI Consultants, 2001c).

Envirogen also conducted air monitoring sampling during a test pit excavation of the Former Plant B building slab. Perimeter air samples were collected for ammonia during the test pit excavation and on the following day. "Ammonia was not present in the vicinity of the test pit excavation at levels significantly above the laboratory reporting limit." (Envirogen, 2000).

The Drum Removal activities and the test pit excavation activities conducted in 2000 are considered a worst case scenario for proposed activities in the RI. Additionally, there are no on-going air emissions affecting off-Property locations.

The revised FSP will contain a technical presentation that identifies and discusses previous air sampling and analysis at the Site and will discuss why the previous air sampling activities, combined with the information concerning historical activities, indicate that an air quality assessment involving air sampling and analysis is not warranted at this time.

4.5.2 Health and Safety Monitoring

Air monitoring of the work environment will be undertaken during intrusive activities (soil borings, well installation, and sampling activities) to ensure that the personal protective equipment (PPE) and engineering controls utilized at the Site are sufficient to ensure worker safety. At a minimum, this monitoring will include evaluations for hazardous concentrations of airborne VOCs. When drilling indoors, the level of carbon monoxide and oxygen and potential for explosive atmospheric environments will be monitored continuously with an O_2/LEL (lower explosive level) meter.

Although the tasks and methods used in soil sampling are not expected to create an airborne dust issue, MACTEC anticipates using water spray methods during intrusive activities to reduce the potential for airborne dust, if needed. However, whenever the Subcontractor is drilling into and through concrete, wet methods of drilling must be implemented to prevent airborne dust. In the event that soil conditions and intrusive activities are causing an airborne dust problem that cannot be controlled by water spray methods, said activity would be halted temporarily, until the activity can be monitored with a respirable dust meter. The Site Health and Safety officer or Field Operations Leader (FOL) will notify the MACTEC PM and Project ES&H officer and determine if it is necessary to implement additional engineering controls or perimeter monitoring. If additional monitoring is required, a JHA will be prepared for that activity.

4.5.3 Vapor Intrusion Evaluation

The vapor intrusion pathway is being evaluated because the CSM for the Site (Figure 2.2-1 and Section 2.2) suggests that there may be some potential for a complete vapor intrusion pathway associated with volatile compounds in the subsurface under current and potential future land uses at the former Facility and the surrounding areas. It is ultimately necessary, if there is a complete exposure pathway, to determine if the vapor intrusion pathway risks might be significant. The following technical approach will be implemented to investigate the potential vapor intrusion pathway for the Site (both on-Property and off-Property) and to generate the analytical data and other information necessary to include the vapor intrusion pathway into the BHHRA, if the pathway is determined to be potentially significant during the investigation. The vapor intrusion evaluation approach is discussed in the OU1 portion of the FSP consistent with the SOW that requires assessment of this potential pathway for both OU1 and OU3 as necessary. Subsurface soils and shallow groundwater are both potential sources of volatile compounds that might contribute to the vapor intrusion pathway at OU1. Shallow groundwater (not subsurface soil) would represent a potential source of volatiles for the vapor intrusion pathway at off-Property locations (OU3). Therefore, the vapor intrusion evaluation approach described here applies to both OU1 and OU3. The approach described below and outlined in Figure 4.5-1 is a step-wise approach that may include one or more of the following tiers of investigation/evaluation.

- Tier 1 – Primary Screening – *determine if the pathway needs to proceed to Tier 2 (sufficiently volatile and toxic compounds are present in the subsurface and inhabited buildings are currently present, or could be expected to be present in the future, near volatiles in the subsurface).*
- Tier 2 – Secondary Screening – *for specific locations, determine if the vapor intrusion pathway is considered complete or incomplete (based on evaluation of groundwater and soil data). This is considered a semi-site specific evaluation.*
- Tier 3 – Site-Specific Pathway Assessment – *if Tier 2 concludes it is necessary, collect and evaluate indoor air samples and also characterize background/ambient air quality.*

4.5.3.1 Tier 1 Investigation

The nature and extent of VOCs and the more volatile SVOCs in shallow overburden groundwater will be characterized by groundwater sampling and analysis at the monitoring well locations discussed below. The proposed sampling locations provide spatial coverage of the areas on-Property where occupied structures could be placed. There is currently one on-ground occupied structure at the Property – the Plant B groundwater treatment building. The remaining buildings at the former Facility are not occupied, and the buildings that housed the former offices, laboratories, maintenance area, and pilot plant are not currently serviced by electricity. The temporary trailer at the Site is not constructed on-grade. The proposed sampling locations also provide spatial coverage of areas adjacent to the Property where occupied structures exist or could reasonably be expected. The proposed sampling and analysis program has been designed to characterize nature and extent of “volatile” compounds in shallow groundwater at the Property and in nearby “downgradient” areas as shown in Figure 4.5-2.

Figure 4.5-2 identifies the occupied buildings at the former facility and in the surrounding area. The identification of occupied buildings is not an identification of impacted buildings, but rather identification of locations of potential vapor intrusion (in the event that volatile compounds are detected in shallow groundwater at those locations). The portion of the former Facility located to the north of the South Ditch (excluding the containment area, the identified wetlands, storm water retention basin, and the Central Pond) is considered a potential redevelopment area and it will be assumed in this investigation that occupied buildings could be constructed within that area in the future. There are currently occupied industrial/commercial buildings in the proximity of the Site located on Eames Street, Jewel Drive, Main Street (primarily the eastern side of the street), Woburn Street, New Boston Street and Breed Avenue. There are current residences in the proximity of the Site located at the eastern end of Eames Street, along the western side of Main Street, on Cook Avenue, and Border Avenue. Because of their proximity to the Site, these areas will be evaluated with respect to Site-related shallow groundwater impacts. Other occupied buildings further from the former Facility are less likely to have Site-related shallow groundwater impacts and are not considered in this vapor intrusion investigation.

The USEPA 2002 Vapor Intrusion Guidance states, "Additionally, we recommend groundwater concentrations be measured or reasonably estimated using samples collected from wells screened at, or across the water table." The sampling and analysis of groundwater to support the vapor intrusion pathway will be conducted at "shallow" monitoring wells that are screened across the water table or (at locations where no well is screened across the water table) within 5 feet of the water table. The water table is the locus of the transfer of vapors from groundwater to soil vapor in the unsaturated zone. Sampling of groundwater in the area of the water table therefore is appropriate for evaluation of the potential for vapor intrusion from groundwater. Sampling and analysis of deep groundwater rather than of shallow groundwater would not be appropriate for investigation of the vapor intrusion pathway. Groundwater samples will be collected from the monitoring wells identified in Table 4.5-1 and in Figure 4.5-2, to support the vapor intrusion investigation; these samples will be analyzed for VOCs and SVOCs.

Table 4.5-2 indicates what portion of the Site will be evaluated by each sampling location (for example, "future on-Property industrial/commercial area"). As shown in the table and in Figure 4.5-2, the proposed sampling program provides spatial coverage of the area north of the South Ditch at the former Facility (future industrial/commercial use), the Jewel Drive area (industrial/commercial use), the Eames Street area (primarily industrial/commercial), the Main Street area (mix of residential/industrial/commercial use), and the Woburn Street/New Boston Street area to the east of the former Facility (primarily industrial/commercial land use). The Cook Avenue and Border Avenue area will be evaluated by the shallow monitoring wells located at the southwest corner of the former facility property, since those wells are upgradient of these two areas.

The data (list of detected compounds) will be used to determine, consistent with the USEPA 2002 guidance, if there are substances in the subsurface that are sufficiently volatile and sufficiently toxic to potentially result in cancer risk greater than 10^{-6} and/or a non-cancer HI greater than 1. Historical data suggest that there are compounds present in shallow groundwater that are sufficiently volatile and sufficiently toxic to represent a potential vapor intrusion pathway. Table 1 of the USEPA 2002 guidance lists compounds that are sufficiently "volatile and toxic" and that table will be used to identify locations or areas where further vapor intrusion screening will be conducted. A similar screening will be conducted for unsaturated zone soil to identify locations or areas where further vapor intrusion evaluation will be conducted. Figures 4.1-1 and 4.2-1 indicate the locations of on-property surface soil (0 – 1 foot bgs) and subsurface soil (primarily 1 – 10 feet bgs) samples that will be analyzed for VOCs and SVOCs.

4.5.3.2 Tier 1I Investigation

The process will continue after areas are identified where there are compounds of sufficient volatility and toxicity in shallow groundwater and where there is also an occupied building or where an occupied structure could likely be present in the future. The next step will be to compare maximum detected concentrations in shallow groundwater of each VOC and sufficiently volatile and toxic SVOCs to the groundwater screening values in Table 2c of the 2002 USEPA Vapor Intrusion Guidance. All compounds with maximum concentrations lower than the vapor intrusion-based groundwater screening values will be eliminated from further consideration. For the remaining compounds, chemical concentrations (one well at a time) will be compared to groundwater screening values in Table 2c of the USEPA's Vapor Intrusion Guidance of 2002 (values from the table will be updated by Olin if toxicity values have changed since 2002 and the risk-based concentrations calculated by USEPA Region 1 (2002) will replace the MCL-based values that are in the 2002 table). For compounds detected in groundwater that are not included in Table 2c of the 2002 guidance, Olin will determine if they are sufficiently volatile and toxic and calculate appropriate screening values consistent with the 2002 guidance.

The groundwater screening values listed in Table 2c of the 2002 guidance are based on an assumed residential land use and associated exposure scenario. When evaluating industrial/commercial buildings with the Table 2c screening values, the evaluation is likely more conservative than is necessary to protect human health for non-residential exposure scenarios. The 2002 guidance recommends that for non-residential buildings, adjustments be made for non-residential exposure durations, building-specific air volumes and air exchange rates as well as other relevant factors. Consistent with the 2002 guidance, Table 2c screening values will be adjusted to reflect industrial/commercial exposure scenarios. Both Table 2c residential screening values and adjusted industrial/commercial screening values will be presented and will be applied in the screening of shallow groundwater analytical data. For a well with no concentrations above the Table 2c residential values, no additional vapor intrusion evaluation will be conducted.

For monitoring wells with groundwater samples that have no detected concentrations of sufficiently volatile and toxic compounds, the vapor intrusion pathway will be considered insignificant and will not be evaluated further. For a well with one or more compounds with concentrations above the updated and adjusted Table 2c screening values, additional vapor intrusion investigation will be proposed as described below.

If a groundwater concentration is more than fifty times the corresponding Table 2c groundwater screening value (as described in Question 5a of the 2002 Vapor intrusion Guidance), a Tier III site-specific evaluation, including indoor air testing (described below), will be conducted.

If a groundwater concentration is above the Table 2c screening level, but not more than fifty times the screening level, the semi-site-specific evaluation will continue per Question 5b through 5f of the 2002 Vapor Intrusion Guidance. This semi-site-specific evaluation is a two-pronged approach that addresses groundwater and soil vapor data separately and sequentially.

Figure 3b of the 2002 Vapor intrusion Guidance will be consulted to determine the appropriate groundwater: indoor air attenuation factor to be used for comparing groundwater data to the target media-specific concentrations presented in Table 3c of the 2002 Vapor Intrusion Guidance. The use of this figure is described in item 2. on page 34 of the 2002 Vapor Intrusion Guidance. The comparison will be conducted per Question 5e of that guidance. If the groundwater concentrations are below the concentrations in Table 3c, the pathway will be considered incomplete.

If the groundwater concentrations are above the Table 3c concentrations and soil gas data are available, a comparison of soil vapor concentrations to Table 3c soil vapor will be conducted. Figure 3a of the 2002 Vapor Intrusion Guidance will be consulted to determine the appropriate soil vapor: indoor air attenuation factor to be used in the comparison of soil vapor data to the Table 3c concentrations. The use of this figure is described in item 2. on page 34 of the 2002 Vapor intrusion Guidance. If soil vapor concentrations are below the Table 3c concentrations, the pathway will be considered incomplete. If the soil vapor concentrations are greater than the Table 3c soil vapor concentrations, a Tier III site-specific evaluation will be conducted.

If the groundwater concentrations are above the Table 3c concentrations and soil gas data are not available, a Tier III site-specific evaluation will be conducted as described below.

4.5.3.3 Tier 1II Investigation

If a Tier III evaluation is needed, then an additional investigation work plan will be prepared to further evaluate the vapor intrusion pathway (Site-specific evaluation as identified in Figure 4.5-1). The additional investigation work plan would include any needed addenda to the QAPP. The additional investigation could potentially include the following elements:

- Soil Vapor Sampling and Analysis
  - Deep soil vapor samples between well and building
  - Sub-slab soil vapor samples
  - Soil vapor sampling directly above soils impacted by volatiles
  - TO-15 analysis for VOCs
  - Methods appropriate for lighter SVOCs

- Indoor Air Sampling and Analysis
  - 24 hr (at least two events)
  - TO-15 for VOCs
  - Methods appropriate for lighter SVOCs

- Conduct Johnson & Ettinger Vapor Intrusion Modeling to determine the need and the appropriate locations for further Site-specific sampling and analysis for the vapor intrusion pathway.

4.5.3.4 Soil Investigation

Areas where there are compounds of sufficient volatility and toxicity (per the 2002 guidance) in the unsaturated zone soil and there is also an occupied building or where an occupied structure could likely be present in the future will be identified. There is no indication, based on historical data, that there are Site-related VOC unsaturated soil impacts off-Property. Therefore, the evaluation of the vapor intrusion pathway relative to sources of volatiles in soil will be limited to the portions of the former Facility property where there are currently occupied buildings or where occupied building could reasonably be built under a redevelopment scenario (not in the conservation area south of the South Ditch and not in wetlands or within the containment area).

In areas where volatiles are detected in unsaturated zone soils, a work plan will be developed to further investigate the vapor intrusion pathway. Such a work plan may include soil vapor sampling or a modeling approach for evaluation of the pathway.

5.0 OU2 INVESTIGATION

The OU2 sampling and analytical program will consist of two sampling events to collect surface water and one sampling event to collect sediment and stream gauging data from off-Property locations. The sampling locations and analyses are discussed in the following sections.

5.1 SURFACE WATER SAMPLING AND ANALYTICAL PROGRAM

Surface water samples will be collected from the East Ditch and downstream areas, the off-PWD, and in the MMB Wetland area.

5.1.1 Historical Sampling and Analysis, Nature and Extent

Surface water sampling in the East Ditch was initiated in 1977 and 1978, and additional sampling has been conducted since the early 1980's. East Ditch surface water samples were collected as part of several different investigations as discussed in detail in Section 2 of the Draft FRI (MACTEC, 2007). Surface water samples have been collected along the length of the East Ditch starting upstream of the Eames Street Bridge over the railroad tracks and to the south to the Hall's Brook Holding Area. Figure 4.3-1 identifies the historical surface water sampling locations.

Surface water in the off-PWD was sampled between 1986 and 2003. The surface water sampling events are primarily from a 1995 Supplemental Phase II surface water and groundwater investigation (Geomega, 1996). Storm water runoff and storm water runoff baseline sampling was conducted in 2002 and 2003.

Surface water sampling in the MMB Wetland area began in 2001 and continued until 2006 to evaluate the potential for migration of Site-impacted groundwater to surface water. Surface water samples were collected from both the MMB and the Sawmill Brook during that time. Those sample locations are shown in Figure 5.1-1.

Historical OU2 surface water investigations have been discussed in detail in Section 2 of the Draft FRI (MACTEC, 2007). The summary of the historical OU2 surface water analytical data collected over the past ten years is presented in Table 5.1-1. This summary includes data from the East Ditch and downstream areas, the off-PWD, and the MMB Wetland area. In addition to the Site-related parameters detected in OU1 surface water, there are several VOCs and SVOCs detected in OU2 surface water (particularly in the East Ditch).

5.1.2 Sample Locations

The proposed surface water sampling and analysis program for OU2 has been developed consistent with the objectives identified in Section 3.2. These objectives include confirmation and refinement of previous investigation findings, confirmation of nature and extent of Site-related contaminants, collection of surface water flow measurements in the MMB Wetland area, and collection of data to support risk assessment activities. Sampling and analysis is proposed for three separate areas: the East Ditch and downstream area located to the east and southeast of the facility, the off-PWD, and the MMB Wetland located to the west of the facility. The proposed surface water samples and analytical program for OU2 is summarized in Table 4.3-2. The proposed surface water sample locations in the East Ditch and the off-PWD are identified and shown in Figure 5.1-2.

Surface water temperature profiling will be conducted in MMB, Sawmill Brook, and Landfill Brook prior to collecting surface water samples. The purpose of the profiling is to identify potential point discharge locations of groundwater along the stream bottom. Proposed surface water sample locations will be adjusted based on this data to allow identified discharge locations to be monitored by collection of co-located surface water and sediment samples. A water quality meter temperature probe will be used to take measurements at approximately 50 foot stations recording temperature at the bottom of the stream channel. The temperature probe will be affixed to a staff with a disc shaped foot to allow consistent measurement elevations of about 6-inches from the stream bottom. Station locations will be recorded using a global positioning system (GPS) with sub-meter accuracy. Collecting a continuous temperature profiles is not feasible due to extreme difficulty in navigating MMB and Sawmill Brook channels, and interfacing a temperature probe to a GPS system that would accurately reflect location of the instrument as it is moved in an upstream direction.

Surface water in the East Ditch will be sampled from five locations along the length of the ditch: EDSD/SW0 [upstream], EDSD/SW1 (historical location EDBS5) [near upstream], EDSD/SW2 (historical location EDBS6) [adjacent to facility], EDSD/SW5 (historical location EDBS11) [downstream], and EDSD/SW8 [far downstream]. These sampling locations are approximately 1,000 feet north of the northern Property boundary to approximately 3,500 feet south of the southern Property boundary and are adequate to confirm prior data.

Surface water in the off-PWD will be sampled from three locations: OPWD-SD/SO/SW-S, OPWD-Prop1, and OPWD-Prop2. These samples are intended to assess and confirm surface water quality in the off-Property area of the Upper DAPL Pool and to characterize the surface water that is flowing into the South Ditch.

The proposed surface water sample locations in the MMB Wetland area are identified in Table 4.3-2 and shown in Figure 5.1-3. These samples are proposed to assess and confirm historical data and to evaluate potential groundwater impacts to MMB Wetland surface water. Historical data generally do not indicate any Site-related groundwater impacts to surface water. Potential false positive detections of NDMA in MMB Wetland surface water will be further evaluated via the proposed sampling and analysis program. Surface water will be sampled from eleven locations throughout the MMB Wetland area (including both MMB and Sawmill Brook).

Additionally, the work plan will add three sample locations in Landfill Brook. One in the headwater wetlands, one across from the WSL, and one upstream of the confluence of Landfill Brook with the East Ditch/New Boston Drainway system. A drive point piezometer will be installed at each location to measure water levels and surface water elevations to determine the hydraulic gradient between Landfill Brook and underlying groundwater. Surface water samples will be analyzed for the comprehensive analytical suite (VOCs, SVOCs, NDMA, inorganics, and metals).

5.1.3 Analytes and Frequency of Analysis

Surface water samples in the East Ditch, off-PWD, and MMB Wetland area will be collected in two separate sampling events to characterize surface water quality during both surface water low flow (fall) and high flow (spring) time periods. All OU2 surface water samples will be analyzed for the standard comprehensive analyte list and low-level NDMA and all OU2 surface water samples will be analyzed for two or more “additional Site-specific analytes” as identified in Table 4.3-2.

5.2 SEDIMENT SAMPLING AND ANALYTICAL PROGRAM

Sediment samples will be collected along the East Ditch and downstream areas, the off-PWD, and in the MMB Wetland area.

5.2.1 Historical Sampling and Analysis, Nature and Extent

Sediment sampling in the East Ditch and off-PWD was initiated in the early 1990's as part of the Phase II Surface Water/Sediment Investigations (CRA, 1993). Sediment samples were also collected in 2003 and 2004 as part of additional investigations of the East Ditch. Sediment sampling in the MMB Wetland area was conducted in 2001 and 2002.

The historical OU2 sediment sampling is discussed in more detail in Section 2 of the Draft FRI (MACTEC, 2007). Figure 4.4-1 shows historical sediment sampling locations. The summary of the historical sediment analytical data collected to date is presented in Table 5.2-1. The most frequently detected organic compounds are PAHs.

5.2.2 Sample Locations

The proposed sediment sample locations for the East Ditch and downstream areas are identified and shown in Figure 5.1-2. Sediment samples in the East Ditch will be co-located with the surface water samples collected along the length of the ditch. Sediment in the East Ditch will be sampled from five locations along the length of the ditch: EDSD/SW0, EDSD/SW1 (EDBS5), EDSD/SW2 (EDBS6), EDSD/SW5 (EDBS11), and EDSD/SW8. The sampling effort will include locations approximately 1,000 feet north of the northern Property boundary to approximately 3,500 feet south of the southern Property boundary.

The proposed sediment sample locations in the off-PWD are identified and shown in Figure 5.1-2.

The proposed sediment sample locations in the MMB Wetland area (from both MMB and Sawmill Brook) are identified and shown in Figure 5.1-3. Sediment samples in the MMB Wetland area will be co-located with surface water samples collected from 11 locations including: MMB-SW/SD-1, MMB-SW/SD-2, MMB-SW/SD-3, MMB-SW/SD-4, MMB-SW/SD-5, MMB-SW/SD-6, MMB-SW/SD-8, MMB-SW/SD-8A, MMB-SW/SD-9, MMB-SW/SD-10, and MMB-SW/SD-11.

5.2.3 Analytes and Frequency of Analysis

All OU2 sediment samples will be analyzed for the standard comprehensive analyte list and most of the OU2 sediment samples (except at the East Ditch locations EDSD/SW0, EDSD/SW1, EDSD/SW2, and off-PWD location OPWD-SD/SO/SW-S) will be analyzed for two or more "additional Site-specific analytes" as identified in Table 4.3-2.

5.3 STREAM GAUGING

Stream gauging will be conducted at an upstream location where MMB crosses the Spinazola Landfill access road, an upstream location where the main branch of Sawmill Brook, crosses Chestnut Street, and after the confluence of these two brooks at the former canal bridge structure to determine stage and flow of the surface water entering and exiting the MMB Wetland complex. These data will be collected monthly over a one year period. The data will be used to evaluate surface water inflows and outflows in the MMB Wetland complex as a check against previously modeled fluxes.

5.3.1 Locations

The stream channel profile will be measured and flow measurements conducted in accordance with Standard Operating Procedure (SOP) Number (No.) S-20 (Appendix B) at each of the three stream gauging locations in the MMB Wetland complex.

5.3.2 Frequency

Stream gauging will be conducted monthly over a 12-month period to establish seasonal fluctuations in the stream flow.

6.0 OU3 INVESTIGATION

This section presents the proposed investigation program for OU3. OU3 includes all groundwater both on-Property and off-Property. The groundwater investigation program includes installation of additional groundwater monitoring wells, collection and analysis of groundwater samples, collection of synoptic rounds of groundwater level measurements, continuation of the induction logging and multi-level piezometers (MLP) monitoring program, and hydraulic assessment of the Slurry Wall/Cap. Section 6 is organized as follows:

Section 6.1 Groundwater Monitoring Well Installations
Section 6.2 Groundwater Sampling and Analysis
Section 6.3 Synoptic Groundwater Water Level Measurements
Section 6.4 Induction Logging Multi-level Piezometer Monitoring Program
Section 6.5 Containment Area Slurry Wall Hydraulic Assessment
Section 6.6 Vapor Intrusion Assessment
Section 6.7 Proposed RI Residential Water Supply Sampling

6.1 PROPOSED GROUNDWATER MONITORING WELL INSTALLATIONS

Consistent with the objectives identified in Section 3.3, Section 6.1 describes the proposed installation of additional groundwater monitoring wells to satisfy data gaps identified in the Draft FRI (MACTEC, 2007) pertaining to the extent of Site-related contaminants in overburden and bedrock groundwater, and other objectives identified by USEPA in its review of the Draft FSP.

The Draft FRI identified the currently known extent of Site-related impacts in overburden groundwater and summarized the extent of that contamination in Figure 4.3-28, which is reproduced here as Figure 6.1-1. The Draft FRI Report indicated that the down gradient extent of impacted groundwater had not been determined along the Western Bedrock Valley under the MMBA, and to the south east of the Property in proximity to East Ditch in the vicinity of Presidential Way. Additional groundwater monitoring wells will be installed in these two areas to investigate the downgradient extent of Site-related groundwater quality impacts, as discussed in the following subsections. The Draft Focused RI also identified the absence of monitoring wells on the east side of East Ditch as a data gap since the eastern most wells on the Property were impacted. Additional wells are proposed in this area to investigate the lateral extent of groundwater impacts on this side of the Site.

In its review of the Draft POP USEPA has provided comments to Olin in two letters, a meeting and conference calls. During those communications, USEPA has indicated several additional data gaps for OU3 which this RI Work Plan has addressed. The general issues USEPA raised in their comments, as summarized below, request or pertain to:

- A broader, representative sampling approach for the "specialty compounds" (now referred to as "additional Site-specific analytes") in the RI Analyte List including DMF, phthalic anhydride, hydrazine, acetaldehyde, formaldehyde, nonylphenol, perchlorate, diphenylamine, tin, and the products Opex® and Kempore®;
- additional investigation of the bedrock groundwater system to understand better the nature and extent of Site-related impacts to bedrock groundwater, including areas under the MMBA; and areas near or within DAPL pools;
- verifying that the area immediately west of former Lake Poly is not a source of and does not contain DAPL; and
- that the geometry of the Western Bedrock Valley be better defined to locate down gradient monitoring wells in vicinity of MMB and Main Street east of the MBTA passenger rail line.

The additional investigations proposed to address these general issues raised by USEPA and previously identified data gaps include:

- conducting additional seismic refraction studies at two locations,
- installing additional bedrock and overburden monitoring wells, and
- expanding the number of locations which will be analyzed for the list of "additional Site-specific analytes" to be more representative of all areas of the Site (including down gradient areas) and to include a larger number of samples to be analyzed for the standard comprehensive analyte list that includes Metals, Inorganics, SVOCs, NDMA, and VOCs.

The proposed monitoring well installation locations and boring numbers are identified and shown in Figure 6.1-2. Table 6.1-1 provides estimates of the boring depth, depth to bedrock and approximate or anticipated depths of proposed well screens for overburden well installations. The bedrock well screen locations depend on the depth of water bearing fractures which require borehole specific assessments and cannot be predicted.

The drilling method for well installation will include Rotosonic methods for overburden and shallow bedrock wells (those 100 to 150 feet or less into bedrock), and air hammer methods for deep bedrock wells (those to 250 feet into bedrock). Sonic drilling methods have some advantages for drilling shallow bedrock including providing rock core and generating substantially less drilling fluid Investigation Derived Waste (IDW). To drill bedrock wells, casings shall be temporarily seated into bedrock and removed, if possible, during well construction. Bedrock boreholes shall be geophysically logged to identify water bearing fracture zones. Wells will be completed using a combination of methods including convention well construction techniques (2-inch diameter polyvinyl chloride (PVC) screens and risers) and multilevel systems where appropriate (e.g., deep overburden triplets, and some bedrock locations). The multi-level systems, where used, will be similar to as in MP-1 through MP-5 (Solinst Waterloo Systems). Olin is currently reviewing several well construction options and details on some of the deeper well triplets, and the deep bedrock locations. Olin will provide an addendum to the RI/FS Work Plan with those details prior to field mobilization for the well installation program.

For overburden wells, the shallow well pairs will be screened to monitor shallow groundwater conditions (less than twenty feet below the water table). If thick accumulations of peat or organic rich silt are encountered at the downgradient MMBA well locations, the shallow screen will be set just below these deposits. The deep well will be screened from the bedrock surface upward into the overburden. If a medium depth (middle) well screen is proposed, it will be set approximately midway between the deep well screen and the water table. The middle well screen will attempt to target transmissive geologic materials, with a preference for sand and gravel over silty sands. The final screen elevation will be based on field observations at the time of drilling.

For bedrock wells, both deep and shallow well screens and multi-ports may be utilized in well construction. The screened zone will be selected based on borehole geophysical logging results which will be used to identify water bearing fractures, fracture orientation, and hydraulic characteristics (whether they gain or lose borehole water and at what rate, if measureable). The boreholes will be logged immediately following drilling and will include in the following order:

- Caliper, temperature, natural gamma, self potential and single point resistance;
- Borehole Image Processing System (BIPS), and /or Acoustic Televiewer (ATV);
- Heat Pulse Flow Meter, (HPFM) under ambient conditions, followed by HPFM under by low stress pumping conditions if borehole conditions warrant

6.1.1 Maple Meadow Brook Aquifer

As discussed in section 4.3.2.3 of the Draft FRI, the downgradient extent of groundwater impacts has not been bounded to the north-northeast in the downgradient plume direction along the Western Bedrock Valley beneath the MMB Wetland (refer to Figure 6.1-1). Although Site-related impacts were not apparent from groundwater data from monitoring wells GW-73S/73D, near the Town Park well, this location is not necessarily downgradient of GW-65D, and is not within the deeper portion of the Western Bedrock Valley. Monitoring well pair GW-73S/73D provides a lateral delineation of impacted groundwater in this area of the Site. To augment the understanding of groundwater conditions in this area, a shallow, medium, and deep overburden, and bedrock groundwater well quadruplet (GW-400S, GW-400M, GW-400D, GW-400BR) will be placed as shown in Figure 6.1-2. This area is tentatively located between the railroad tracks and Main Street. The final well location will be based upon results obtained from seismic refraction profiling that will be performed along Main Street and which will compliment seismic profiling performed near this area. The proposed seismic profiling will begin from where MMB crosses under Main Street and continue for up to 1,000 feet south along Main Street (see Figure 6.1-2). An additional seismic line will be run in this area to the east of the railroad tracks. Olin is examining options for final well construction techniques of these wells with a possible method being an MP arrangement similar to the MP-4 and MP-5 wells which includes ports in both bedrock and overburden within the same borehole. For the bedrock well (GW-400BR) the intent is to install a well screen at the first significant water-bearing fracture or zone observed in the bedrock. Also shown on Figure 6.1-2 is the potential location of a shallow, medium and deep overburden groundwater well triplet of GW-404S, GW-404M, and GW-404D which may be installed at a later time. The installation of these GW-404-series wells will be contingent upon the sampling results obtained from the GW-400-series of wells, with the GW-404 wells being installed only if analytical results demonstrate a need for these wells being added. Geophysical studies completed by Olin and discussed in Sections 2.1.5.1 and 3.2.3 of the Draft FRI and in Appendix D of the Supplemental Phase II Report (Smith, 1977) indicate these locations will be within the main channel of the Western Bedrock Valley and would be located along the expected downgradient groundwater flow path of impacted groundwater in the MMBA. The existing seismic data in this area will be extended south along Main Street to determine the low point of the Western Bedrock Valley.

To complement the information on the potential lateral extent of groundwater impacts in bedrock along the northern portion of the MMB wetland, the bedrock well GW-407BR will be installed at the location shown in Figure 6.1-2. This well will monitor the shallow bedrock groundwater conditions and, in concert with GW-65BR, and proposed GW-65BRD, will more fully characterize potential bedrock groundwater impacts in this portion of MMBA. The borehole will be drilled to as deep as 100 feet into bedrock and the borehole will be geophysically logged to determine the depth and characteristics of water bearing fractures encountered. Well design and screen placement will be field decisions based on the borehole geophysics and drilling observations.

One additional deeper bedrock well (GW-65BRD) will be installed in the MMB area as shown in Figure 6.1-2. The objective of this well is to monitor the deeper bedrock groundwater in an area already monitored by the well triplet of GW-65S, GW-65D, and GW-65BR. Groundwater samples collected from this well will be analyzed to determine if deeper bedrock groundwater impacts are observed in this area of the downgradient portion of the MMBA. The borehole will be drilled approximately 100 feet into bedrock and geophysically logged. The number and location of well screens will be determined based on the results of the borehole geophysics.

6.1.2 Areas Southeast and East of the Olin Property

As discussed in Section 4.3.3.2.2 of the Draft FRI Report (MACTEC, 2007), Site-related constituents were detected in groundwater samples from monitoring wells downgradient and to the southeast of the Property in the vicinity of the GW-80 well cluster. As shown in Figure 6.1-2, one shallow and deep well pair (GW-401) will be installed farther downgradient of the GW-80 wells on the eastern side of the MBTA rail line in the vicinity of New Boston Street to complete the contaminant delineation and verify groundwater flow direction.

As shown in Figure 6.1-2, two shallow and deep groundwater well pairs (GW-402 and GW-403) will be installed on the east side of the East Ditch to confirm the boundary delineation of Site-related impacts to groundwater on that side of the Property. The locations will be subject to access approval by industrial/commercial business property owners or the town of Wilmington (if wells are located within the public road right-of-way). The inferred direction of groundwater flow in this portion of the Site is to the southeast toward and along the topographic depression formed by the MBTA rail line and East Ditch. The proposed wells will provide data pertaining to the lateral extent of Site-related groundwater impacts and provide additional data points to measure groundwater elevations and interpret the direction of groundwater flow.

6.1.3 Areas Immediately West of the Olin Property

Olin proposes to augment the existing well network in this area of the Site with two additional deep bedrock borings that will be completed as wells outside of the footprint of the DAPL pools to the north and south in cross gradient directions. These wells will be installed using rotary/air hammer drilling methods. One well (GW-405BR) (see Figure 6.1-2) will be installed at the foot of the ridge occupied by Cook Avenue, and will be drilled as approximated 250 feet deep. The objective of this well is to investigate potential bedrock migration pathways between the Site and the area to the southwest of the former Facility. The well will be geophysically logged to identify water bearing fracture zones and depending on the number of potential zones identified, it will be packer sampled to determine final well screen placements. Packer samples will be analyzed for indicator parameters, specific conductance, ammonia and chloride on-Site to assist selecting screened intervals. The wells will be constructed with conventional PVC screens to allow collection of continuous water level data in the future, if needed, to more fully understand migration pathways.

The other bedrock boring and well (GW-406BR) will be located on the opposite side nearer to the intersection of Jewel Drive and Eames Street, and will be drilled to as deep as 150 feet into bedrock. An overburden well (GW-406) will be installed at this location to provide shallow groundwater information. This well pair will be located north of the Main Street DAPL Pool/ off-Properly DAPL Pool in proximity to Former Lake Poly. The location has been adjusted from the original proposal by moving it more to the south and east as suggested by USEPA to meet additional USEPA objectives for these wells. A seismic refraction profile will be performed near this well to augment the existing seismic line already installed behind the 4/6 Jewel Drive property. This seismic line will continue past GW-406 and will provide a profile of the bedrock elevation west of the former Lake Poly Area. The seismic line will be placed on the west side of the railroad tracks due to the presence of wetlands on the east side of the tracks. The bedrock depth determined at GW-406 will be used to calibrate the modeled seismic profile.

The bedrock borehole will be geophysically logged to identify water bearing fracture zones and depending on the number of potential zones identified, it may be packer sampled to determine final well screen placements, or alternatively, it may be installed as a MP location.

6.1.4 Well Completion Methods

The conventional overburden monitoring wells will be installed using rotosonic drilling methods which use a dual casing system (outer and inner casing). Well installation procedures are described in detail in Section 8 and in SOP No. S-12 in Appendix B. A continuous soil core will be collected and logged at 10 foot intervals at the time of well installation. These wells will be constructed using conventional, slotted 2-inch diameter PVC screens and solid PVC risers. The sand pack will be designed to match the screen slot, and will extend at least two feet above the screen section, followed by three feet of bentonite chips to form a seal. The remainder of the borehole will be tremie grouted to the surface with cement-bentonite grout.

It is currently proposed that the downgradient well GW-400S/M/DBR be installed as a MP location using the Solinst Waterloo System similar to the construction of MP-5. The borehole will be completed using Rotosonic methods in which an outer eight-inch casing will be advanced to and into the bedrock surface, until moderately competent bedrock is encountered to provide a temporary seal. The inner six-inch casing will then be advanced until the first water bearing zone in the underlying fractured bedrock is encountered. This zone will be determined based on observation of the core, the condition and weathering associated with fracture surfaces, and borehole flows expressed as drilling return waters. Prior to installing additional MP wells, a SOP for that specific well construction method will be provided as an addendum to USEPA.

Monitoring well installation boring logs and well construction diagrams will be used to document installation conditions. Examples of these field data records (FDRs) are provided in Appendix C.

6.1.5 Well Development

Monitoring well development shall be performed as soon as practical after well installation but not sooner than 48 hours following placement of the grout seal. Wells will be developed by surging and pumping as described in Section 8 and in SOP No. S-6 located in Appendix B.

6.2 GROUNDWATER SAMPLING AND ANALYSIS

Consistent with the objectives identified in Section 3.3, the following section describes the proposed RI groundwater sampling and analytical program (sampling locations, the rationale for selection of sample locations, and the proposed analytical program). Two groundwater sampling events are proposed for the purpose of assessing the current concentrations of detected analytes, completing delineation of the nature and extent of contaminants in groundwater, and providing current data to support risk assessments. The two sampling events will be timed to coincide with seasonal ranges in groundwater elevation.

The description of the proposed groundwater sampling and analysis program is preceded by a summary of historical groundwater sampling and analysis. This historical data discussion is followed by a presentation of additional CSM information that was specifically requested by USEPA in comments and subsequent meetings concerning the Draft FRI. This latter subsection focuses on presentation of geologic cross sections and interpreted contour figures of specific Site contaminants.

6.2.1 Historical Groundwater Sampling and Analysis

Historical groundwater sampling has been discussed in detail in Section 2.1.6.2 and Section 2.2 of the Draft FRI (MACTEC, 2007). The nature and extent of groundwater contamination was presented in Section 4.3 of that report.

Groundwater investigations began at the Site with the installation of monitoring wells GW-1 through GW-12 at the Facility in November 1977. Since that time, a large number of groundwater monitoring points have been sampled and analyzed for specific parameter groups. Those locations include municipal, commercial, and residential water supply wells; wells installed by others at adjoining properties; and multi-level wells and piezometers installed by Olin. The majority of wells installed by Olin were vertical well pairs (couplets, triplets and quadruplets) screened in either bedrock (BR) or deep (D), middle (M), or shallow (S) portions of the overburden aquifer. Five MLPs have also been installed and sampled to characterize the vertical distribution of DAPL constituents in groundwater and to provide geochemical data characterizing DAPL, diffuse, and overlying groundwater. Thus, the cited number of locations sampled includes vertical well pairs and multiple ports at individual locations. Three of these MLPs were installed in DAPL pools (MP-1 in the containment area, MP-2 in the off-PWD Area, and MP-3 in the Main Street DAPL Pool). The fourth MLP (MP-4) was installed downgradient of the Main Street DAPL Pool, extending through the overburden into the bedrock saddle. The fifth MLP (MP-5) was installed in the MMBA within the Western Bedrock Valley.

Historical groundwater sampling results are summarized in Table 6.2-1. This table identifies, for each groundwater sample point, specific analytes and analyte groups that have been tested for, and if they have been detected. The term sample location or point refers to a specific well and depth interval such that well pairs (e.g. with BR, D, M, S designations) and MLP ports are considered discrete sample points. Table 6.2-2 summarizes the range of concentrations detected for each analyte detected in groundwater and the location of the maximum detected concentration (excluding DAPL locations). DAPL has been adequately characterized by previous investigations and the range of constituent concentrations in DAPL was reported in Table 4.3-4 in the Draft FRI (MACTEC, 2007). The values in Table 6.2-2 are presented in the context of various regulatory standards and guidance. It should be noted that the drinking water-related standards and guidance listed in the table may not be relevant for most of the on-Property groundwater samples, since most of the Property is not a drinking water source area. In a similar manner, the MCP GW-2 standards are only relevant for water table samples collected within the footprint or within 30 feet of a current or planned occupied building. This table includes data 1997 to present data provided in the Draft FRI report. The manner in which various regulatory guidance and criteria are used for assessment of risks posed by groundwater will be determined in the BHHRA. The data quality objectives for chemical data collected for groundwater are the same regardless of sample location relative to current MCP drinking water classifications.

The historical groundwater sampling has included a comprehensive list of analytes similar to the programs generally conducted under CERLA. Initial sampling of wells upon installation typically included VOCs, SVOCs, Metals, and other parameters such as Pesticides that were consistent with CERCLA lists at the time they were collected. Subsequent monitoring programs modified the list of VOCs, SVOCs and Metals that were reported based upon the analytes that were previously reported or were of particular interest to the monitoring program being implemented. Historical groundwater samples have been analyzed for VOCs and SVOCs at more than 230 discrete "points" within the groundwater system (e.g. D, M, or S well screens, or specific MP ports), NDMA has been analyzed at 192 discrete points, Metals at more than 240 discreet points (dissolved and total), Inorganics and physical parameters at more than 330 discrete points, and Pesticides at 155 points. In addition PCBs have been analyzed at 33 points, herbicides at 25 points, and PAHs at 38 points. Historical sampling and analysis has also been conducted that included approximately one third of Site-specific chemicals currently requested by USEPA under the current RI Analyte List. These analytes include Opex® and Kempore®, hydrazine, and acetaldehyde/formaldehyde. The sampling for these analytes has also been comprehensive. Opex® and Kempore® have been analyzed at 41 discrete points, hydrazine at 47 points and acetaldehyde/formaldehyde at 75 points within the aquifers. In addition other analytes within the current RI/FS program have also been analyzed including VPH at 45 discreet points, EPH at 38 points, and PCBs at 33 points. PAHs, which are not included within the current RI Analyte List, were analyzed at 33 discrete points within the overburden aquifer. In summary, the historical sampling program contained a similar analytical program to the currently proposed RI/FS analytical program and should provide historical data can be compared to newly collected data.

The groundwater sample locations where the principal analyte groups have historically been analyzed are shown graphically in Figures 6.2-1 (VOCs), 6.2-2 (SVOCs), 6.2-3 (NDMA), 6.2-4 (total metals), and 6.2-5 (filtered metals).

The distribution of Site–related groundwater contaminants was presented in Section 4.3 of the Draft FRI. Several of the associated figures have been reproduced in this work plan to facilitate subsequent discussions concerning the proposed OU3 analytical program. The figures are identified and discussed below, and they are supplemented by two additional figures (concerning VOCs) that were not previously presented in the Draft FRI Report.

6.2.1.1 VOCs

Manufacturing records for the Facility did not identify chlorinated and non-chlorinated solvents as raw materials or waste materials. One VOC mixture (diisobutylene) was identified as a raw material and waste material for manufacture of Wytox ADP. Diisobutylene is a mixture of two TMP compounds (2,4,4-Trimethyl-1-pentene and 2,4,4-Trimethyl-2-pentene). The TMP compounds are the most frequently detected VOCs at the Site (see Table 6.2-2) and because these compounds are not commonly used in other industries, are considered signature VOC compounds for the Facility. The Draft FRI Report (MACTEC, 2007) presented Figures 4.3-15 and 4.3-16 illustrating the distribution of 2,4,4-Trimethyl-1-pentene and 2,4,4-Trimethyl-2-pentene, respectively. These figures are reproduced here as Figure 6.2-6 and Figure 6.2-7, respectively. These compounds have been detected in groundwater samples from on-Property locations and in samples of DAPL and groundwater in close proximity to DAPL. The TMPs were only detected sparingly and at a few locations within the MMBA.

Benzene, toluene, ethylbenzene, and xylenes (BTEX), in addition to methyl-tert-butyl ether (MTBE) have also historically been detected in groundwater samples within the boundaries of the Site (see Table 6.2-2). Figure 4.3-17 from the Draft FRI illustrating the distribution of BTEX is reproduced here as Figure 6.2-8. BTEX groundwater concentrations are highest in the oil release area associated with Plant B, while BTEX concentrations in DAPL samples and downgradient groundwater samples (to the west of the property) are substantially lower. Although BTEX compounds are detected in DAPL and in groundwater in the vicinity of Plant B, MTBE has not been detected in DAPL indicating its detection is unrelated to historical liquid waste discharges (prior to 1972) at the Property. MTBE was approved by USEPA as a fuel additive in 1979, seven years after the connection of the facility's wastewater system to the municipal sewer system and the end of direct discharges to the land surface and groundwater. With the exception of the Plant B treatment building and the containment area, BTEX compounds are not present in groundwater under most of the Property, including the South Ditch drainage area. This indicates that other BTEX inputs to groundwater within the boundaries of the Site are likely, particularly in vicinity of GW-80, located to the east of the Property, immediately west of the CSL, and between Main Street and the MMB Wetland.

A figure depicting total chlorinated solvents was presented in the Draft FRI as Figure 4.3-18. This figure is not reproduced here, but rather is supplemented by two additional figures showing the most recent detections of chlorinated ethane compounds (Figure 6.2-9) and chlorinated ethenes and (Figure 6.2-10). The chlorinated ethanes include 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethane (1,1-DCA); and 1,2-dichloroethane (1,2-DCA). The chlorinated ethenes include tetrachloroethene (PCE); trichloroethene (TCE); 1,2-dichloroethene (1,2-DCE); and vinyl chloride (VC). With only a few samples with trace levels, the chlorinated ethenes have typically not been detected in on-Property groundwater samples, although they were present in groundwater samples from the MMBA and from the east and south of the Olin Property. The chlorinated ethenes in groundwater to the east of the Property are attributed to documented releases from the former Sanmina Facility located between the Olin Property and the MMBA, and to industrial properties located east of East Ditch. The Sanmina property is situated near a groundwater divide allowing groundwater to flow principally northwest, but also to the southeast toward the Olin Property. Similarly, 1,2-DCA also appears related, in part, to the former Sanmina facility. The occurrence of 1,1-DCA in groundwater to the South east of the Olin property is clearly unrelated to the Olin Property and must have an origin in the industrialized area near GW-80.

6.2.1.2 SVOCs

Based on frequency of detection and/or reported concentrations, the principal organic contaminants in groundwater at the Site are SVOCs. The most frequently detected SVOCs in groundwater at the Site include NDMA, NDPA, BEHP and to a lesser extent phenols (Table 6.2-2). The Draft FRI Report (MACTEC, 2007) presented the distribution of these compounds in Figures 4.3-19, 4.3-20, 4.3-21 and 4.3-23, respectively. These figures are reproduced here as Figures 6.2-11, 6.2-12, 6.2-13, and 6.2-14, respectively. Table 6.2-2 indicates that other phenolic compounds in addition to other phthalates are also present in groundwater. NDMA has not been detected in soil or sediment samples collected from the Site. Unlike NDPA and BEHP, Facility manufacturing records do not identify NDMA as a raw material, waste material, or product. NDMA and BEHP are the most widely distributed SVOCs, being detected in on-Property areas and within deeper portions of the MMBA, and are also associated with DAPL areas. On-property, BEHP is primarily distributed near Plant B and, at much lower concentrations, in the vicinity of the Upper DAPL Pool/Containment Area. Off-Property groundwater samples have contained essentially trace levels of BEHP in samples where it has been detected. NDPA has primarily been detected in groundwater in the vicinity of Plant B, former Lake Poly, and the Upper DAPL Pool/containment area. Phenol has been detected in DAPL samples from the Upper DAPL Pool/containment area, the Lower DAPL Pool, and at lower concentrations in samples from GW-83S and GW-55D. Lower concentrations were also detected in groundwater samples from the Plant B Area.

The vertical distribution of Site-related constituents in groundwater is discussed further in Section 6.2.2.

6.2.1.3 Metals

Very few metals were identified in manufacturing records as raw materials, waste materials, or products. A number of sodium compounds (including sodium dichromate), zinc oxide, chrome oxide, and aluminum chloride were identified as raw materials and/or potential waste materials for various manufacturing processes. The distribution of metals characteristically associated with releases and/or conditions at the Site (including total and filtered sodium, total and filtered chromium, total and filtered aluminum, iron, calcium, and manganese) were presented in Section 4.3 of the Draft FRI (MACTEC, 2007). It is unlikely that substantial amounts of iron, and manganese were released directly to groundwater. Of these metals, only chromium has a Federal MCL. Figures 4.3-9 and 4.3-10 from the Draft FRI for chromium in filtered groundwater and total chromium are reproduced here as Figures 6.2-15 and 6.2-16, respectively. As discussed in Sections 4.3, 5.1.2, 5.1.3, 5.3.2, and 5.3.3 of the Draft FRI, chromium concentrations in groundwater are attenuated by geochemical reactions promoting precipitation or sorption with other solutes (aluminum, sulfate, and iron) and exchange on charged mineral and oxide surfaces within the aquifer matrix. The distribution of chromium concentrations in filtered groundwater samples is shown in Figure 6.2-15. Chromium concentrations are highest in DAPL samples, and lower concentrations are reported for diffuse groundwater in the vicinity of the DAPL samples. Although chromium was detected in some samples from the MMBA, chromium was not detected in the MWSWs or in the associated sentinel wells.

6.2.1.4 Inorganic Compounds

The primary inorganic waste materials and indicator parameters that have been detected in groundwater include sulfate, chloride, and ammonia (and other nitrogen-containing substances such as nitrate and nitrite). The distribution of these inorganic analytes was discussed in Section 4.3 of the Draft FRI Report and presented in Figures 4.3-6, 4.3-7, and 4.3-8, respectively. The distribution of sulfate and ammonia are presented in a series of cross sections and contour figures and discussed in Section 6.2.2. The distribution of chloride in groundwater is similar to that of sulfate and ammonia. However, road salt also contributes to chloride concentrations in groundwater, thus background chloride concentrations are more strongly influenced by locations of roads and other areas where winter de-icing is commonly conducted. Chloride, therefore, is not discussed further in Section 6.2.2.

6.2.1.5 Other Analytes

Olin has analyzed for a number of other constituents in groundwater, some of which were used as raw materials or were produced at the Facility and others which were not but are common contaminants in the environment in urban and industrialized settings. Among these constituents, analytes which were raw materials or products include hydrazines, aldehydes (acetaldehyde and formaldehyde), and Opex® and Kempore® (the two highest volume products for the facility). PCB compounds have also been analyzed for in groundwater and transformers (potential source of PCBs) were present at the Facility. In addition, various petroleum hydrocarbon analyses have been conducted including VPH/EPH, total petroleum hydrocarbons (TPH), and oil and grease.

The other analyte groups that pertain to compounds that were not used at the facility in manufacturing processes include pesticides, herbicides, and PAHs. Pesticide and herbicide use was common practice in communities for control of pests and vegetation, while PAHs are common in fuels and combustion by-products of fuels and other combustible materials.

Hydrocarbon and pesticide analytical results were discussed in Section 4.3 of the Draft FRI and are not repeated here.

PCBs were detected at low concentrations only at two locations in on-Property groundwater: on-Property GW-10D (Aroclor 1254) and GW-54S (Aroclor 1064). The results were presented on Figure 4.3-26 in the Draft FRI and appear to be isolated occurrences.

Opex® was detected once out of 33 sample locations (Figure 6.2-17), and Kempore® four times out of 35 sample locations (Figure 6.2-18) in groundwater. Opex® was detected in GW-10D (Upper DAPL Pool area), and Kempore® was detected in MP-1 (Upper DAPL Pool area), MP-5 (Main Street DAPL Pool area), GW-87D (MMBA), and GW-LPB-11 (former Lake Poly), areas with DAPL and diffuse groundwater characteristics.

Hydrazine was previously analyzed at 40 sample locations and detected at 5 sample locations in groundwater including GW-307 and GW-308 (Plant D), GW-6D (south of Plant D), GW-43S (Off-PWD area), and GW-83M (MMBA DAPL area). Figure 6.2-19 presents the distribution of these sample results. Based on current data, hydrazine detections in groundwater are related to the vicinity of the buildings where it was stored and used (principally Plant D and Plant C) and several DAPL related areas. The process wastes from these Plants went to one or more waste disposal features (former Lake Poly, the East and West Pits, and the Acid Pits), and the detection of hydrazine at these locations is consistent with the current understanding of manufacturing history at the Property.

Of the aldehyde compounds (acetaldehyde/formaldehyde) formaldehyde has been detected in MP-1 and MP-2 (Upper DAPL Pool); GW-44D, MP-2, and MP-4 (Main Street DAPL Pool); GW-83S and GW-83D (MMBA DAPL area). Based on current data, aldehyde compound detections in groundwater are primarily in the vicinity of DAPL related areas. Formaldehyde was used as a raw material in the manufacture of resins and Wytox Pap. Records indicate there were not substantial liquid waste streams from the manufacture of these products.

6.2.2 Supplemental Conceptual Site Model Information

Since submittal of the Draft FRI Report, the USEPA has requested additional information and figures to convey CSM information concerning Site geologic and hydrogeologic conditions and distribution of important indicator parameters within groundwater. The format of this additional requested information includes cross sections and contaminant distribution contour figures. This section of the work plan introduces and discusses these additional figures that complement the Draft FRI Report (MACTEC, 2007).

Cross sections and contoured concentration distribution figures have been prepared for ammonia, sulfate, and NDMA in both deep and shallow groundwater. Shallow groundwater data represent samples collected from the top 20 feet of the overburden aquifer. Analytical data used in the contour figures includes overlying groundwater, diffuse groundwater, and DAPL. Consistent with data presented in the Draft FRI, the values presented are averages over the last ten years of data, or the most recent data for sample locations that have not been sampled since 1997. The MMBA groundwater sample locations represented in the shallow groundwater figures have characteristics of overlying groundwater (i.e., have specific conductance values less than 3,000 µmhos/cm). The deep groundwater grouping used for contouring includes DAPL, diffuse groundwater, and some overlying groundwater samples. Table 6.2-3 provides the most recent specific conductance data for groundwater and groups sample locations by indicated type including DAPL, diffuse groundwater, and overlying groundwater.

The terms deep, medium, and shallow groundwater that have historically been used at the Olin Site to name monitoring wells are not based on specific depths but rather the relative vertical position of well pairs, regardless of the actual aquifer thickness at a specific location. A number of deep and shallow well pairs within the facility have overlapping well screens. Where the saturated thickness is less than 20 feet, the shallow and deep monitoring points are a relative term. In cases where the saturated thickness is greater than 20 feet, the term shallow is intended to refer to groundwater in the top twenty feet of the saturated aquifer. Although this definition for shallow groundwater is arbitrary, it serves to illustrate where discharge of impacted groundwater to surface water is potentially occurring in the vicinity of receiving water bodies. This definition also means that some wells designated by name as shallow are deeper than 20 feet into the aquifer and are included by definition in the deeper ground data sets used for contouring.

Inclusion of all groundwater greater than below 20 feet below the water table, as deep groundwater also reduces some of the interpretive concerns with contouring groundwater contaminant concentrations in a sloping aquifer where contaminant concentrations are vertically stratified, and deeper portions of the aquifer are constrained by bedrock channels. The DAPL Pool data are contoured within the deep groundwater data set. The interpretation of groundwater contaminant contours within the MMBA require an understanding of the bedrock topography, the nature of the Western Bedrock Valley bedrock channel configuration and the long established relationship between depth, location and contaminant concentrations in the Western Bedrock Valley. To clarify these relationships, geologic sections will be presented first and contour maps, second.

6.2.3 Geologic Cross Sections

Figure 6.2-20 presents the location figure for two cross sections located on-Property which were provided previously to USEPA as supplemental information for the IRSWP. Figure 6.2-21 presents a geologic cross section through the Slurry Wall/Cap area and across the South Ditch. Figure 6.2-22 presents a cross section through the Plant B Area and across the East Ditch. Overburden geology in both areas is similar and consists of fine to medium sands coarsening downward into fine to medium or coarse sands with gravel. Depth to the water table varies; being deeper in the former facility area, where ground elevations are higher, to very shallow depth in the vicinity of South Ditch.

Figure 6.2-23 presents the location of cross sections locations along the Western Bedrock Valley within the MMBA. Figure 6.2-24 presents cross section A-A' which is oriented along the Western Bedrock Valley from Main Street DAPL Pool to the GW-65 well cluster. The section is drawn with a vertical to horizontal 8:1 which accentuates the vertical relief of topographic features. Within upland areas adjacent to the MMB Wetland complex, surficial soils consisting of fine sands, grade vertically into sands and gravels which overlie medium to coarse sands with increasing depth. Moving down the Western Bedrock Valley, these gravels and sandy deposits grade into fine to coarse sands and fine to medium sands with some gravel. The shallow surficial soils grade laterally into a thick section of peat with silt and clay (muck) in the interior of the MMB Wetland complex. An intermittent series of coarse sand and gravel deposits persists down the Western Bedrock Valley at elevations ranging from -10 to 30 feet MSL, and at one location, these gravel deposits overly silt. These relationships suggest an origin for the gravel deposits as ice contact deposits formed as retreating ice became stranded which included formation of small quiescent water bodies within the bedrock valley. The bedrock is mantled by a basal till composed of gravel and cobbles supported in a clayey sand matrix. The till deposits appear thickest in the deepest incised portions of the bedrock valley. Cross section B-B', included as Figure 6.2-25, is aligned across the Western Bedrock Valley and the MMB Wetland complex and shows similar geologic relationships.

Figures 6.2-26, 6.2-27, and 6.2-28 present the vertical distribution of ammonia, sulfate, and NDMA, respectively, on cross section A-A' along the Western Bedrock Valley in the MMBA. In a similar fashion, Figures 6.2-29, 6.2-30, and 6.2-31 present the vertical distribution of ammonia, sulfate, and NDMA, respectively, on cross section B-B' across the Western Bedrock Valley in the MMBA. These figures illustrate the vertical distribution of contaminants in groundwater discussed in the Draft FRI where the highest concentrations of the Site-related constituents are constrained within the deeper portions of the Western Bedrock Valley and attenuate rapidly with increased distance above the bedrock surface. This vertical stratification of contaminant concentrations within overburden groundwater result from the gravity driven mode of emplacement of the DAPL source material, a lack of upward vertical hydraulic gradients in the aquifer, and density characteristics of DAPL and diffuse material. A conspicuous feature of these sections is that NDMA is not detected in shallow groundwater, defined as the top 20 feet of saturated aquifer, under the MMB Wetland, while ammonia is detected at low concentrations. Within shallow groundwater in the MMBA, in proximity to peat and muck deposits, ammonia is present at low concentrations. Organic rich peat deposits are known to contain nitrogen and consequently, soluble forms of nitrogen such as ammonia. It is unlikely that ammonia in shallow groundwater underlying the MMB Wetland is attributable solely to impacts from the former manufacturing operations. NDMA is a highly soluble conservative solute and would not be expected to sorb to organic material in the peat. If NDMA is not detected in surface water, than it is unlikely that surface water is impacted by the Site-related constituents that are present in deeper groundwater.

6.2.4 Interpreted Contaminant Distribution Contours

As discussed previously, ammonia, sulfate, and NDMA were selected for contouring within both deep and shallow groundwater over the entire Site. The cross sections presented in the previous subsection illustrated the vertical stratification of contaminant concentrations within the Western Bedrock Valley in the MMBA and the continuity of these relationships along and across the bedrock channels within the Western Bedrock Valley. These relationships are equally apparent in the contour figures. Figure 6.2-32 and Figure 6.2-33 present interpreted NDMA contours for deep and shallow overburden groundwater, respectively. Figures 6.2-34 and 6.2-35**,** present interpreted distribution of ammonia and Figures 6.2-36 and 6.2-37, the interpreted distribution of sulfate, for deep and shallow groundwater, respectively.

The bedrock topography has been well defined by an extensive seismic survey program that collected reflection and refraction data along numerous appropriately located seismic survey lines. The interpreted contours in the contaminant distribution figures account for the solute concentrations and elevation of the well screens and the lateral constraints on distribution imposed by the elevation and shape of the bedrock valley, as well as the direction of groundwater flow. Thus, in the interpretation of the contour lines, all available information was used to infer the distribution of contamination between monitoring well locations. The contour figures are presented in conjunction with the bedrock topography and reflect overburden groundwater conditions. Where present, bedrock groundwater data were not used in determining these depicted contours.

Comparison of Figure 6.2-32 and Figure 6.2-33 for NDMA in deep and shallow overburden groundwater illustrates the extent to which deeper groundwater is impacted compared to shallow groundwater and shows that shallow groundwater in the MMBA is not impacted by Site-related constituents.

Areas with highest concentrations of NDMA in deep overburden groundwater are constrained within the deeper portions and depressions within the Western Bedrock Valley. Similar to the DAPL pools, these areas will tend to remain isolated from shallower groundwater that flows laterally over those low lying regions in the aquifer. Deeper groundwater in on-Property areas also has higher solute concentrations than the shallower groundwater system, even though the saturated thickness of the overburden aquifer in these areas is substantially thinner than in the MMBA. The downgradient extent of impacted groundwater southeast of the Property, as defined by existing wells, is slightly greater in the deeper groundwater, compared to the shallow groundwater.

Within the MMBA, the distribution of ammonia in deep overburden groundwater, as bounded by the 1 milligram per liter (mg/L) contour, is approximately coincidental with the lateral limit of other conservative Site-related constituents in groundwater. Outside the region of groundwater with identified Site-related groundwater impacts, sulfate concentrations from bedrock and overburden groundwater range from approximately 13 to 35 mg/L. The distribution of sulfate, as defined by lowest concentration contour interval in Figure 6.2-36 (100 mg/L), lies entirely within the limits of the 1 mg/L ammonia contour. Within deep overburden groundwater in the MMBA, sulfate concentrations of approximately 50 mg/L are coincidental with the lateral extent of other Site-related constituents in groundwater.

Finally, impacted groundwater at the CSL is characterized by concentrations of calcium, sulfate and ammonia. Calcium is associated with the management of gypsum ($CaSO_4$) residuals at that location which were periodically removed from the waste water treatment plant settling ponds and placed in the CSL. The CSL was closed with a vegetated, low permeability soil cover system in 1988.

In summary, the series of cross sections and contour figures presented and discussed above illustrate that shallow groundwater underlying the MMB Wetland complex is not impacted by contamination present in underlying deeper groundwater. Shallow groundwater in the vicinity of the Main Street DAPL Pool, on-Property areas, within the South Ditch/Ephemeral drainage area, and downgradient areas is impacted with Site-related constituents.

6.2.5 Groundwater Sampling and Analytical Program

This section describes the proposed sampling and analytical program for OU3 groundwater. This proposed program is based on the preceding review of existing historical data, which was more fully described in the Draft FRI Report. The groundwater sampling and analysis program will include sample collection from existing and proposed conventional monitoring wells and MPs.

The sampling and analysis program initially proposed in the Draft FSP included components of the standard comprehensive analyte list (metals, inorganics, SVOCs, NDMA, and VOCs) and it also focused on specific areas within the facility to analyze specific, individual "specialty compounds" (referred to in this document as "additional Site-specific analytes") including diffuse groundwater above DAPL pools. A revised program proposes to include the entire list of "additional Site-specific analytes" at those locations proposed previously for one or more of those analytes (as requested by USEPA), and by adding analysis for the "additional Site-specific analytes" in additional groundwater samples collected along the perimeter of Olin properly, bedrock wells, new wells, and specific overburden wells with diffuse groundwater characteristics or elevated indicator parameters, including wells which had more numerous detections of Site related VOCs, and SVOCs in the past. Given the addition of a substantial number of new wells with analysis for "additional Site-specific analytes", a few wells previously proposed for a limited number of these compounds were eliminated from the original program at locations that appeared redundant or duplicative. The additional sampling locations provide a more representative data set for the groundwater system across the entire Site, and should be sufficient to determine the presence and location of these ”additional Site-specific analytes”. The “additional Site-specific analytes” in groundwater include: NDMA (low level analysis), Opex®, Kempore®, EPH/VPH, nonyl phenol, DMF, phthalic anhydride, acetaldehyde/formaldehyde, hydrazine, diphenylamine, perchlorate, and hexavalent chromium.

The analytical program proposed for OU3 should be viewed as a starting point for the first round of OU3 sampling that can be adjusted for the second round. Potential adjustments could include adding additional existing location to the sampling program to complete delineation of detected analytes, or conversely, removing analytes from future sampling if their presence is not confirmed, or not confirmed within specific regions of the groundwater system. It is expected that as data gap analysis for OU3 will be performed after the first round of groundwater samples have been collected, received, validated, and evaluated.

The general objectives of the groundwater sampling and analytical program include:

- Update historical monitoring data to assess current concentrations of Site-related contaminants in overburden and bedrock groundwater.
- Continue to monitor locations within the MMBA that have shown statistically significant increasing or decreasing concentration trends since cessation of pumping within the aquifer to further evaluate geochemical trends within the MMBA.
- Monitor other deep, middle and shallow locations within the MMBA to evaluate nature and current extent of impacts and develop data to help assess potential for migration of solutes vertically and horizontally within the aquifer.
- Refine the understanding of down gradient extent of Site groundwater impacted by Site-related contaminants.
- Obtain current data to evaluate the lateral boundaries of overburden and bedrock groundwater that have been impacted by Site-related contaminants.
- Obtain current data to evaluate the vertical extent of contaminants in overburden groundwater within the MMBA.
- Obtain new data to contribute to a better understanding of the nature and extent of impacts to bedrock groundwater.
- Obtain current data to support risk assessment activities for human exposures to groundwater and for the potential vapor migration pathway.

As indicated in previous sections, different analytes have widely different distributions in groundwater due to their initial concentration, relationship to groundwater discharge areas, and fate and transport characteristics. The specific sampling objectives for each analyte group in OU3 groundwater are proposed as follows. These specific objectives are discussed by analyte groups including VOCs, SVOCs, metals, inorganics, PCBs, finished products, and raw materials.

VOCs

The sampling and analysis objective for VOCs is to assess the current distribution of TMPs and other potentially Site-related VOCs in OU3 groundwater and also to document the current distribution of chlorinated solvents and BTEX compounds, some of which may have origins other than the historical operations associated with the Olin facility.

SVOCs

The sampling and analysis objective for SVOCs is to assess the current distribution of NDMA, NDPA, BEHP, phenol, other phthalates and phenolic compounds and other SVOCs previously detected in Site groundwater. The presence of additional non-target SVOC compounds will be evaluated in the review of tentatively identified compounds (TICs). NDMA will be analyzed by both low level and standard analytical methods. NDMA is included in the USEPA 8270 method for SVOCs with a detection limit of 1 μg/L. For sample locations where historical concentrations are greater than 1 μg/L for NDMA, the USEPA 8270 method will be used.

Metals

The sampling and analysis objective for metals is to assess the current distribution of chromium and provide additional data on other metals within OU3 groundwater, including indicator parameters aluminum, iron, calcium and sodium. Tin will be included in metals analysis for groundwater.

Inorganics

The sampling and analysis objective for inorganic analytes is to develop current data on the distribution of sulfate, ammonia, and chloride as indicator parameters for DAPL and DAPL related constituents, and the general extent of Site-related impacts to groundwater.

PCBs

The sampling and analysis objective for PCBs will be to confirm the presence or absence of PCBs in the vicinity/downgradient of former transformers located on the Olin property. This assessment will be based on the current monitoring well network.

Finished Products: Opex®/Kempore®

The sampling and analysis objective for finished products will be to confirm the presence or absence of Opex® and Kempore® at locations where these finished products have previously been detected, and at representative locations for the Site.

Raw Materials: Hydrazine, Formaldehyde, Nonylphenol, Phthalic Anhydride, and Diphenylamine

The sampling and analysis objective for raw materials is to determine the presence or absence of hydrazine, formaldehyde, nonylphenol, phthalic anhydride, diphenylamine, and DMF in on-Property groundwater at locations where historical records indicate these materials may have been used in manufacturing processes. In some cases, it is not clear where specific raw materials were used and which wells would determine the presence or absence of specific analytes. However, since the time frame of their use at the facility is known, locations down gradient of or in proximity to areas where process waters were discharged (for example former Lake Poly, East and West Acid Pits) or where such disposed waste materials currently reside (Upper and Main Street DAPL Pools) can be sampled. Sampling at DAPL pools includes diffuse groundwater as it is a better matrix for analysis than DAPL and most likely to contain those constituents capable of diffusing from DAPL to overlying groundwater. In absence of specific information, these analytes will be tested for at well locations downgradient from each of the major manufacturing buildings, and in wells that provide perimeter locations to the Olin Property down gradient of the manufacturing areas. The proposed sampling includes locations where some of the raw materials, notably hydrazine, acetaldehyde or formaldehyde have been previously detected. If these compounds are detected in the first round of groundwater sampling, and are present at concentration of potential concern but their distribution is not adequately bounded, the sampling and analysis for these compounds will be expanded in the second round of groundwater sampling.

Other Material Used in Rubber and Plastics Manufacturing, Tin

The sampling and analysis objective is to determine the presence or absence of tin in groundwater, and its distribution if present.

Additional Compounds Requested by USEPA, Perchlorate

The sampling and analysis objective is to determine the presence or absence of perchlorate in groundwater and its distribution if present.

6.2.6 Proposed Sample Locations and Analytes

The proposed sample locations to accomplish the general OU3 objectives and specific analyte delineation objectives are presented in Table 6.2-4. Table 6.2-4 identifies the sample location, the proposed analytical parameters, and the rationale. These analytical parameters are consistent with the RI Analyte List discussed in Section 3.1. The rationale and comment portion of the table lists previous analysis performed at each location, provides a summary of the VOC, SVOC, metal and inorganics analytes detected, including NDMA, hydrazine, acetaldehyde/formaldehyde, Opex® and Kempore® and identifies an objective in terms of assessing current constituent concentrations. All except two of the monitoring well samples will be analyzed for the standard comprehensive analyte list. Almost all of the monitoring well samples analyzed for "additional Site-specific analytes" will be analyzed for that full list. Since not all wells are recommended for analysis of the standard comprehensive analyte list and the "additional Site-specific analytes" this section also identifies nearby wells that are proposed for analysis of the standard comprehensive analyte list and the "additional Site-specific analytes". For monitoring locations at which Site-related VOCs, SVOCs, NDMA, and specific metals such as chromium were not previously detected, it should be inferred that the purpose of including that well is to provide for delineation of the lateral or vertical extent of those analytes. For other monitoring locations where analytes proposed for analysis have been previously detected, it should be inferred that the purpose of including those wells is to provide current information on the distribution of those analytes in groundwater.

The wells have been selected to provide a broad and representative assessment of current groundwater conditions, and are sufficient to monitor the vertical distribution of Site-related impacts to groundwater, the lateral distribution of groundwater impacts, and the relationship between the bedrock and overburden groundwater systems within the current and proposed monitoring well network. The largest group of analytes to be tested for includes the standard comprehensive analyte list of metals, inorganics, SVOCs, NDMA, and VOCs. In instances where the understanding of current groundwater conditions should be known (e.g. for lateral boundary conditions, or due to the length of time since the last analyses were performed), this standard comprehensive analyte list was proposed in the sampling scheme. As stated previously, the "additional Site-specific analytes" are proposed at representative locations, including, but not limited to:

- areas around and down gradient of the former facility manufacturing buildings;
- areas located near or between former disposal pits and the Upper DAPL pools;
- areas with the most highly impacted groundwater located adjacent to or under South Ditch;
- deep overburden groundwater in the MMBA with diffuse characteristics; and
- bedrock wells with strong indications of Site-related impact.

Samples from all bedrock wells previously installed by Olin will be analyzed for metals, inorganics, SVOCs, NDMA, and VOCs and at a number of locations, the "additional Site-specific analytes" as indicated on Table 6.2-4.

The proposed sample locations are presented graphically in Figure 6.2-38 (standard comprehensive analyte list) and Figure 6.2-39 (Additional Site-Specific Analytes). The sample locations include existing wells, proposed new wells at downgradient areas, and selected ports of existing multi-level MPs. Section 6.7 describes the historical and proposed residential well sampling program. There are no active commercial or other public water supplies within the Site available for sampling.

6.2.7 Frequency of Analysis

Two groundwater sampling events will be conducted to document existing groundwater conditions during high seasonal groundwater conditions and low seasonal groundwater table conditions. It is expected that one event will occur in fall of 2009 and the other in spring 2010. Each of these sampling events will commence after completion of synoptic groundwater level measurements.

6.3 SYNOPTIC WATER LEVEL MEASUREMENTS

The proposed locations for water level measurements are listed in Table 6.3-1 and shown in Figure 6.3-1. A synoptic round of low water and high water groundwater levels from Site wells will be collected to support existing interpretations of groundwater flow directions. The locations have been selected to provide information on vertical gradients and to provide adequate coverage to allow contouring of potentiometric data. Due to the large number of available monitoring wells, all the wells do not need to be included in this effort since some wells would only produce duplicative information due to slight potentiometric surface changes and shallow gradients noted throughout the area. Measurements will be collected at 156 monitoring wells as indicated in Table 6.3-1.

6.3.1 Locations

Groundwater gradients over the MMBA are generally flat, and not all wells will need to be included to develop a comprehensive understanding of the groundwater flow patterns in the MMBA. Vertical gradients within the MMBA have been shown to be slight to neutral, with the resulting bedrock groundwater surface essentially mimicking the shallow groundwater surface. Water level measurements collected in the monitoring well pair GW-64S and GW-64D may be used as an example of relative water levels in the MMBA. Prior to the town wells being turned off, water levels in these wells fluctuated by as much as 11 feet or more, depending on whether the town wells were pumping, and seasonal effects such as low recharge or drought condition in late summer months (typically August and September). Also, vertical gradients during pumping conditions differed between these wells by tenths of feet. After pumping in the town wells stopped, groundwater generally has fluctuated around two feet or less, with gradients differing by hundredths of feet. The apparent increase in water elevation over the entire MMBA since cessation of pumping is on the order of one foot or less. This same correlation occurs between the wells GW-86S and GW-86D.

Overburden groundwater monitoring wells have been selected to provide adequate spatial coverage for mapping of horizontal gradients in deep and shallow groundwater. The well selection criteria also placed high value on selecting wells pairs that would provide the best location to evaluate vertical gradients spatially within the overburden aquifer and between the overburden and bedrock groundwater systems. All available bedrock wells are included in the program.

Drive point piezometers will be hand driven at three locations in the MMBA. The relative groundwater and surface water levels obtained from the drive point piezometers will be used to establish an understanding of groundwater-surface water interaction in the MMBA. The piezometers will be installed at MMB-SW/SD-5 (mid-point in Sawmill Brook), MMB-SW/SD-2 (mid-point in MMB), and MMB-SW/SD-1 (downstream of the confluence of Sawmill Brook and MMB).

Within on-Property areas, the groundwater sample location density is relatively high, and although gradients on-Property are typically steeper than in the MMBA, not all of these wells need be included to provide a comprehensive understanding of groundwater flow conditions in that part of the Site. In off-Property areas where groundwater divides occur and gradients are known to be flat, as many wells as possible will be measured to interpret those divides as accurately as possible.

6.3.2 Frequency

Synoptic water level measurements will be conducted two times during a 12-month period; once during low groundwater conditions and once during high groundwater conditions. It is anticipated that the synoptic water levels rounds will be conducted in spring and fall.

6.4 INDUCTION LOGGING AND MULTI-LEVEL PIEZOMETER MONITORING

An induction logging and MLP sampling program was initiated at the Site in 1992 and was conducted on an annual basis between 1997 and 2005. The purpose of this program is to monitor the elevation of the top of the DAPL and evaluate the thickness of the diffuse layer at specific monitoring locations. The logging is accomplished by lowering an inductance probe down the well casing. The probe has two coils, a transmitter coil at the top and a receiver coil at the bottom. The transmitter coil generates an electrical current which induces an electrical eddy current in the formation producing a secondary magnetic field that is detected by the receiver coil. The intensity of that magnetic field is a function of the electrical conductivity in the formation, which in turn is affected by pore fluid conductance and stratigraphy. The DAPL has high concentrations of dissolved constituents, is significantly more conductive than groundwater, and produces a strong induction log response. The last induction logging sampling event in 2005 included the following 14 wells: GW-35D, GW-42D, GW-43D, GW-44D, GW-45D, GW-58D, GW59D, GW-62BR, GW-64D, GW-69D, GW-70D, GW-85D, GW-87D, and GW-103BR.

The MLP sampling includes measurement of field parameters from productive ports in MP-1, MP-2, MP-3, and MP-4 and selective chemical analysis from specific ports to confirm major constituents and properties of DAPL, diffuse, and overlying groundwater. The chemical analysis includes chromium, iron, magnesium, sodium, chloride, sulfate, nitrate, nitrite, ammonia, aluminum, calcium, and specific gravity. MP-1 monitors the containment area; MP-2, the off-PWD DAPL portion of the upper DAPL Pool; MP-3, the Main Street DAPL Pool; and MP-4, the Main Street Bedrock Saddle.

6.4.1 Historical Sampling and Analysis, Nature and Extent

Induction logging has been performed 10 times at various monitoring wells at the Site including wells in the containment area, the off-Property DAPL area, and the Western Bedrock Valley. The 2005 induction logging event concluded that the top of the diffuse groundwater within the containment area was approximately 15 to 20 feet below the bottom of the equalization window. The conductivity in the majority of the off-Property DAPL area and the Western Bedrock Valley appears to be consistent with previous years indicating relatively static conditions in both areas. In the 2005 sampling event, the DAPL and diffuse groundwater at one well, GW-42D, appeared to show some fluctuations in conductivity. These fluctuations appear to be characteristic for this location. The top of DAPL elevations remained essentially unchanged from previous estimates.

6.4.2 Locations and Analytical Program

Induction logging will occur at GW-35D, GW-42D, GW-44D, GW-45D, GW-58D, GW59D, GW-62BR, GW-64D, GW-69D, GW-70D, GW-85D, GW-87D, and GW-103BR for comparison to prior results.

Field parameters will be measured at the following MLP ports:

MP-1: Ports 1 through 18, excluding ports 9 and 15 which are not productive;
MP-2: Ports 1 through 17;
MP-3: Ports 1 through 21, excluding ports 10, 12, and 14 which are not productive; and
MP-4: Ports 1 through 14, excluding ports 4, 6, 7, 8, and 9 which are not productive.

Chemical analysis for chromium, iron, magnesium, sodium, chloride, sulfate, nitrate, nitrite, ammonia, aluminum, calcium, and specific gravity will be conducted at the following MLP ports consistent with the 2005 program:

MP-1: Ports 1, 4, 5, 6, 7, 8, 14;

MP-2: Ports 1, 4, 6, 9, 10, 11, 15;

MP-3: Ports 1, 3, 4, 5, 7, 13, 19; and

MP-4: Ports 2, 3, 5, 10 and 13.

6.4.3 Frequency

Induction logging was last completed in May 2005 and will be conducted upon approval of the RI/FS Work Plan.

6.5 SLURRY WALL TESTING

On July 18, 2008, at an RI/FS Scoping Meeting the USEPA presented a paper for Olin's consideration titled "Hydraulic Pulse Interference Tests for Integrity Testing of Containment and Reactive Barrier Systems" authored by Grant Hocking of GeoSierra LLC. In prior communications, USEPA had requested that a non-destructive test method be identified to evaluate integrity of the slurry wall that comprises the low permeability barrier component of the Slurry Wall/Cap. Olin has agreed to apply this test method at the containment area.

USEPA's expressed objective was to determine if such a test method would be suitable to verify the integrity of the slurry wall, especially where it is in contact with DAPL. In response to that specific concern, Olin provided to USEPA (as an attachment to the December 2007 Response to Comment Letter on the Draft IRSWP) the results of the 2001 Chemical Compatibility and Quality Assurance Field Sample Test Results by J&L Testing. That testing included long term chemical compatibility testing of DAPL and the slurry mixture in tri-axial permeameters. The results indicated that hydraulic properties of the slurry mixture actually improved with extended contact with DAPL over a six month period (i.e., hydraulic conductivity decreased by 46 percent). Upon conclusion of the test, the slurry mixture was physically inspected and found to be discolored on the surface but with no other visible internal changes except that it was hard and the soil grains were partially cemented. These results are understandable because it is has been well established that precipitation of iron oxides and acid sulfate minerals occurs when DAPL comes in contact with pore waters of higher pH. The decrease in permeability is related to precipitation of these minerals from the DAPL within pore throats of the slurry mixture reducing effective porosity of the material and binding the soil particles together. These physical changes in the slurry matrix would be expected to become permanent as these mineral phases would be geochemically stable once formed.

An independent third party will be contracted by MACTEC to perform hydraulic pulse interference testing at the Site. This contractor is GeoSierra, Environmental, a subsidiary of Panther Technologies. This provides both independence and expertise with collection and evaluation of pulse inference data using specialized equipment. A draft scope for this work has been prepared by MACTEC, including detailed cross sections through proposed test alignments. This scope of work will be submitted for input and comment by GeoSierra once the subcontract agreement has been finalized. The draft submittal will be provided for USEPA review following completion and prior to initiation of work.

The test method requires cyclical injection of small slugs of water at a high flow rate producing high pressure and accurate monitoring of the pressure response with time in receiver wells positioned on the opposite side of the hydraulic structure of interest (in this case the slurry wall). In the case study cited, five individual slugs averaging 6.7 gallons were cyclically injected at 20 gallons per minute (gpm) producing injector pressures of 5 pounds per square inch (psi). Although the slug volumes are small, the pressures are potentially significant (equal to about 10 feet of water head in the case study), and potential to cause perturbations at the DAPL/Diffuse layer interface will need to be evaluated. The propagation of the pressure response in the aquifer may extend up to several hundred feet in some cases. Achievable distances specific to the Olin Site will need to be determined by field testing.

The aquifer or reservoir pressure response to the injected slug is radial. The method of data analysis is directional between the injector and receiver well locations at two points within the aquifer or reservoir. The method allows characterization of bulk aquifer parameters between those two points but may not be able to resolve vertical differences in aquifer parameters between those two points. The method should be able to confirm the bulk hydraulic characteristics of the low permeability barrier represented by the slurry wall.

Two of the wells closest to the slurry wall’s western side, and therefore suitably located for use in a test program, are driven well points (GW-24 and GW- 25), and the length and the physical condition of the screened sections is not known. Prior to designing the pulse interference test, the suitability of these existing wells will be verified in the field through optical or acoustic well logging. Similar information needs to be determined for two wells located in the interior of the containment area (OB-4 and BR-1). The general approach under consideration will be to use wells on the exterior of the slurry wall as injector wells and wells on the interior as receiver wells. The potential injector wells include GW-42S, GW-76S, GW-24, GW-25, GW-202S/D, GW-201S, and GW34SR/D. Potential receiver well locations include GW-22S/D, GW-35S/D, OB-4, BR-1, GW-CA1, GW-CA2, and PZ-24. Well pair PZ-24/PZ-25, which were recently installed on opposite sides of the slurry wall can also be used to confirm applicability of the method.

The test objectives to be addressed in a detailed test proposal will include, but may not be limited to:

1. Verifying the test method will not cause measurable affect at DAPL/Diffuse interface;
2. Selecting test wells and determining packer interval requirements based on careful review of screen interval depth and stratigraphy;
3. Determining appropriate pressures and displacements necessary for a detectable response at distances consistent with the scale of the proposed test well network by conducting a sufficient number of pre-tests (e.g., to verify the distance at which the injection pulse can be monitored);
4. Demonstrating method applicability at the Site on a closely spaced well network (PZ-24/PZ-25);
5. Evaluating effect of the equalization window on pulse interference responses;
6. Testing well pairs that allow comparison of receiver well responses screened at different vertical intervals along similar profiles;
7. Verifying repeatability of results by conducting duplicate tests at specific well pairs; and
8. Verifying repeatability of results by conducting reciprocal testing of injection and receiver wells.

The detailed testing proposal will be developed on a schedule that allows for USEPA review, comment and input, and test implementation consistent with the other proposed RI/FS activities discussed in the FSP.

6.6 VAPOR INTRUSION INVESTIGATION

The vapor intrusion investigation program and evaluation process has been described in Section 4.5. As stated in the SOW, the vapor intrusion pathway is to be evaluated for OU1 and OU3 as necessary. Section 4.5 addresses the monitoring and investigation of impacts to air. At OU1, potential vapor intrusion could be associated with volatile compounds in soil and/or shallow groundwater. For OU3, potential vapor intrusion could be associated with volatile compounds in shallow groundwater. The proposed sampling and analytical program for groundwater that has been described above includes the sampling and analysis to support the evaluation of potential vapor intrusion from groundwater at both OU1 and OU3. Section 4.5.2 discusses the specific groundwater sampling locations and analytical program that supports this vapor intrusion investigation and evaluation.

6.7 PROPOSED RI RESIDENTIAL WATER SUPPLY SAMPLING

Historical sampling and analysis of residential wells has been summarized Section 2.1.6.2.4 of the Draft FRI (MACTEC 2007). Table 2.1-13 of the Draft FRI identifies private well samples collected through the time of preparation of the FRI. Appendix C of the Draft FRI contains all of the analytical data for those samples. All data generated by subsequent sampling of private wells has been submitted to USEPA under separate cover.

The residences that were sampled in 2008 and 2009, for which data do not indicate Site-related water quality impacts, will be re-sampled on an annual basis. The annual sampling program will include VOCs, SVOCs, metals, inorganics, and NDMA consistent with the proposed comprehensive analyte suite for OU3 groundwater. The residences where potential Site-related water quality impacts have been indicated by past sampling (wells M24/L54 and M24/L94) will be sampled on a quarterly frequency. Wells identified for sampling on a quarterly basis will first be sampled for the entire RI analyte list for two quarters. Analytes that are not detected would then be dropped from further testing. Such sampling would continue until USEPA approval of the RI Report.

7.0 SAMPLE DESIGNATION AND LOCATION SURVEY

Samples collected during the RI/FS will be identified consistently, and each location will be surveyed as described below.

7.1 SAMPLE IDENTIFICATION

Samples collected during Site activities shall be assigned unique sample IDs. These IDs are necessary to identify and track each of the samples collected for analysis during completion of the project. In addition, the sample IDs shall be used to identify and retrieve the analytical results received from the laboratory, as well as other data related to the sample.

Sample IDs for previously collected samples will be included in the database as they were originally identified. No changes will be made to sample IDs for previously collected samples. The following text describes the sample designations for future sampling. It should be noted that both environmental samples and QA/QC samples will be collected and submitted for laboratory analysis. The QA/QC samples will include field duplicates, samples for matrix spikes and matrix spike duplicates, and blank samples (including equipment blanks [such as rinsate blanks] and trip blanks [TPK]). Blank samples will have sample IDs that identify the sample as a specific type of QC blank including field blanks (FBK), equipment rinsate blanks (EBK), and TPKs, and it will include a numerical identifier (ascending order assigned by the sample manager), as well. Blank samples will not contain any location ID (e.g. OC-TBK-001).

In general, sample IDs will identify, in the following order, the Site (Olin Chemical), the medium sampled, the sample location, and a QA/QC designation (for samples submitted as field duplicates, for matrix spike analysis). In addition, for soil and sediment samples, the depth interval for the sample will also be included in the sample ID. Multiple samples at a given location (groundwater samples collected over time, for example) will all have the same sample ID, but they will be identified uniquely by the combination of the sample ID and sample date. With the exception of blank samples, each sample ID will contain the sample location. Future samples collected at previously sampled locations will be identified using the previously identified sampling location.

The sample ID is not limited to a specific number of digits, except for practical limitations in listing the sample ID in report tables. Sample IDs will be assigned as described below.

In all sample IDs, the first two digits, OC, indicate the Site name (Olin Chemical).

Groundwater:

For groundwater samples, no explicit medium code will be included in the sample ID. For groundwater samples from conventional monitoring wells, piezometers, and temporary groundwater sampling locations, the sample ID will contain the location ID (shaded in the example following) and a QA/QC designation: **OC-GW-32D-XXX,** where XXX may be:

DUP	=	field duplicate sample
MS	=	matrix spike sample
MSD	=	matrix spike duplicate

For regular field samples, the QA/QC code will be left blank.

The QA/QC codes identified above will apply to environmental samples collected from any media.

For groundwater samples from MLP wells the sample ID will contain the location ID followed by the sample port number (shaded in following example) and a QA/QC designation: **OC-MP-1-17-XXX**:

Groundwater sample IDs will not contain a medium sampled code because the location IDs will contain either “MW”, “GW”, “MP”, or “PZ”, all of which indicate a groundwater sample.

Surface Water and Sediment:

Surface water and sediment sample IDs will identify the medium sampled (SW for surface water and SD for sediment), location ID (shaded in following example), upper and lower depth of sample (in feet, with one decimal point), and a QA/QC designation: **OC-SW-ISCO2-XXX, or OC-SD-ISCO2--0.0/2.0-XXX.**

Surface Soil Samples Collected by Hand Methods

Soil samples will be collected by hand methods (only surface soils collected) and by drill rigs or direct push methods (both surface soil and subsurface soil samples will be collected via these methods). Locations where soil samples will be collected only by hand methods, the sample locations will be considered surface soil locations. The location ID for surface soil locations will be designated as SS-XXX. The surface soil location IDs will be sequential starting with the number 400.

The sample ID for soil samples from surface soil locations will contain the location (e.g. SS-401), upper and lower depth of sample (in feet, with one decimal point), and QA/QC designation: **OC-SS-401-0.0/2.0-XXX**. Soil sample IDs will not contain an explicit medium sampled code, since soil sample location IDs will contain either "SS" or "SB", both of which indicate a soil sample.

Soil Samples Collected from Soil Borings

Machine-driven soil borings will be used to collect both surface soil samples and subsurface soil samples at numerous locations. These locations will be considered soil boring locations. The soil boring locations will be designated as SB-XXX. The soil boring location IDs will be sequential starting with the number 400.

The sample ID for soil samples from soil boring locations will contain the location (e.g. SB-401), upper and lower depth of sample (in feet, with one decimal point), and QA/QC designation: **OC-SB-401-3.0/9.0-XXX**. It should be noted that for soil samples, depths equal to or greater than 10 feet will be rounded to the nearest foot (no decimal point). For example, the sample OC-SB-401-3.0/10-DUP would be a duplicate sample collected from the 3 to 10 foot interval from SB-401. OC-SB-401-0.0/2.0 would be a field sample collected from the 0 to 2 foot interval from the same boring.

7.2 SAMPLE LOCATION SURVEY

Soil sample locations will initially be field located based on field observations and staked for Dig Safe clearance. Some locations may be placed with the aid of a GPS to sub-meter horizontal accuracy. After a sample location (surface soil or soil boring) has been completed, it will be re-staked with a wooden stake marked with the sample location ID and the horizontal and vertical position will be formally determined.

7.2.1 Horizontal Control

The horizontal (X,Y) position of all sample locations shall be identified with a GPS backpack unit, accurate to within one meter. The coordinates of the sample locations will be logged electronically and uploaded to the project database. In areas where dense tree cover restricts satellite reception, swing ties from GPS logged locations will be taken. In cases where the tree cover limits the accuracy of the GPS, locations will be surveyed by a Massachusetts-registered professional land surveyor.

7.2.2 Vertical Control

Elevation surveys will be conducted by a Massachusetts-registered professional land surveyor. Elevations will be referenced to the North American Vertical Datum (NAVD) of 1988 and will be measured to within at 0.01 feet for monitoring well casings and 0.1 feet for ground surfaces.

8.0 SAMPLING EQUIPMENT AND PROCEDURES

The following sections describe the general sampling equipment and procedures to be used during the RI/FS field sampling program. Field measurements and observations made during sampling will be recorded on FDRs (examples presented in Appendix C). Detailed sampling procedures and documentation requirements are provided in SOP Nos. S-1 through SOP S-21. The SOPs are standard procedures and in cases may provide more procedural options than are actually required for a specific sampling activity. This section describes the proposed sampling procedures and references appropriate SOPs and FDRs, if applicable. The SOPs for sampling and associated activities are provided within Appendix B.

Analytical methods for analysis, sample container requirements, sample preservation and hold times are provided in Table 12b of the QAPP and are discussed in Section 9 of the FSP (see Table 9.1-1).

8.1 SURFACE AND SUBSURFACE SOIL SAMPLES

Surface soil samples will be collected by hand augering or from soil borings; subsurface soil samples will be collected from soil borings completed through foundations of former and existing buildings and other OU1 locations. Surface soil samples are to be collected between zero and one foot bgs. Subsurface soil samples will be collected to a depth of 10 feet bgs. This is a variance from the SOW which defines surface soil as zero to six inches and subsurface soil as six inches to ten feet bgs.

Various soil sampling methods will be used to collect surface and subsurface soils at the Site. Soil investigation techniques include hand soil augers, rotosonic soil borings, and direct push borings. Field conditions, location, depth, and the data objectives will dictate the choice of method.

8.1.1 Soil Augers

Floodplain soil samples and some shallow upland soil samples will be collected with a stainless steel hand auger or in some cases a shovel in accordance with SOP No. S-3. Hand augers are generally comprised of a short, hollow, thin-walled auger connected to a "T" shaped handle. Clockwise rotation of the T handle with moderate downward pressure initiates the cutting and sample retrieval. Some augers are designed to accommodate an optional, plastic or metal, cylindrical sample sleeve which can be inserted into the body of the auger to facilitate sample collection and to avoid cross-contamination. The use of sampling sleeves is not necessary if adequate decontamination is performed between sampling locations and or depths.

When using the hand auger, the auger is advanced to the required depth, and then is slowly removed, and the soil sample is collected from the auger flight at the point corresponding to the required depth. If deeper samples are required, the auger is re-inserted and augering is continued. If samples are required from sandy or non-cohesive soil, the use of a hand trowel or shovel may be necessary. If a proposed sample location is deemed inaccessible or refusal is encountered before reaching target depth, a new sample location in close proximity to the original sample location will be selected.

If VOC or VPH samples are scheduled for analysis, they will be collected immediately in accordance with SOP No. S-13 "Field Preservation of VOA and VPH Soil Samples". Additional samples for other analytical parameters will be collected in the order described in Section 9. The soil remaining after the VOC sample collection should then be composited in a stainless steel bowl for collection of samples for all other analytical parameters. The soil will be homogenized with a stainless steel sampling spoon. The appropriate sample container will be selected and the sample placed in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures. Sampling observations will be recorded on the Surface Soil Sampling FDR Form and field logbook. The soil will be described in accordance with SOP No. S-11 "Procedure for Description and Identification of Soils". The hand augers will be decontaminated between collection points as identified in SOP No. S-5 "Decontamination of Field Equipment".

8.1.2 Soil Borings

Soil borings will be advanced at various locations, including through some existing slab foundations. Samples will be advanced by a rotosonic drill rig through the slab foundations. Rotosonic drilling technology uses high frequency mechanical oscillations to transmit resonant vibrations and rotary power through the drill tooling to the drill bit without the need for drilling fluids or air to effectively take overburden core samples. The rotosonic vibratory action fluidizes the soil particles, destroying the shear strength and pushing the particles away from the tip of the bit and along the sides of the drill string. This liquefaction process allows for clean, rapid and smooth penetration of overburden formations. This methodology uses a dual casing drilling approach to protect against borehole collapse while samples are being withdrawn, and allows continuous overburden core sampling with minimal disturbance and compaction. Procedures for performing sonic drilling are provided in SOP No. S-18.

Sample cores will be collected in 10 foot intervals and extruded directly from the core barrel into a polyethylene sleeve. The sleeve will be laid down on a flat logging and sampling table, marked with the footage interval, and recovery estimated. The material in the sleeve will be apportioned to depth based on recovery marking the 0-1 foot and 1-10 foot interval. The 0-1 foot interval shall be opened first by slitting the polyethylene sleeve and screened with a PID.

If VOC or VPH samples are scheduled for analysis, they will be collected immediately in accordance with SOP No. S-13 “Field Preservation of VOA and VPH Soil Samples”. The remaining soil should then be composited in a stainless steel bowl for sample collection for all other analytical parameters. The soil will be homogenized using a stainless sampling spoon. Remaining samples will be collected in the order described in Section 9. The appropriate sample container will be selected and the sample placed in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures. Sampling observations will be recorded on the Surface Soil Sampling FDR Form and field logbook.

“At locations with multiple soil sample depths, the top sample will be collected from 0 – 1 foot bgs and then a 2-foot horizon within the 1 – 10 foot interval will be selected for sampling based on PID readings, visual observation, and/or olfactory observation. If field observations do not lead to a clear choice, depths will be chosen at random and documented in the field books with preference given to samples immediately above the water table.

If VOC or VPH samples are scheduled for analysis from a 2-foot horizon within the 1-10 foot interval (selected as discussed below), the VOC and VPH samples will be collected immediately following the 0-1 foot interval sampling, before samples for other analytes to avoid the loss of volatile constituents in accordance with SOP No. S-13 “Field Preservation of VOA and VPH Soil Samples”. The remaining sample collection will continue in the same manner as described for the 0-1 foot interval. The appropriate sample container will be selected and the sample placed the sample in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures.

To the extent possible, the decision to conduct laboratory analysis of the soil samples collected from greater than 10 feet bgs will depend on the laboratory results for the soil samples collected from the 1 – 10 foot interval. The analytical results for a soil sample collected from 1 – 10 feet bgs will be compared to the USEPA RSLs for industrial land use and the Groundwater Protection Soil Screening Levels (risk-based) published in the RSL Table (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm). For any analyte group (such as SVOCs), if all detected chemicals in that analyte group have associated RSL and SSLs and all reported concentrations are below the corresponding RSLs and SSLs, then the sample collected from greater than 10 feet at that location will not be analyzed for that analyte group. If one or more chemicals in an analyte group has a reported concentration that is above either or both the RSL and SSL (or does not have RSLs), then the sample collected from greater than 10 feet at that location will be analyzed for that analyte group. A minimum of six soil samples collected from depths greater than 10 feet bgs in the areas of the former unlined impoundments in the former production area will be analyzed for the standard comprehensive analyte list plus the "additional Site-specific analyte list". Those samples will be collected and analyzed to assess the potential presence of DAPL material.

Records of each boring will be made by the Site geologist or field sampler on a Soil Boring Log FDR and the field logbook. After samples have been collected, the soil will be described in accordance with SOP No. S-11 "Procedure for Description and Identification of Soils". The down hole drilling and sampling equipment will be decontaminated between collection points as identified in SOP No. S-5 "Decontamination of Field Equipment" and as discussed in the SMP.

Soil IDW associated with drilling and soil sampling will be drummed managed at the Property as described in the SMP.

8.1.3 Direct Push

A direct push sampling system will be used to conduct soil sampling surveys inside the existing buildings on the Property. The concrete floor will either be cored or opened using a pneumatic hammer drill. The direct-push explorations shall be completed by a qualified direct push subcontractor and directed by a qualified field person. Procedures for performing direct push soil sampling are provided in SOP No. S-16.

A direct push sampling system (e.g., a Geoprobe™ system) consists of a hydraulic ram unit that has the capability of driving ¾-inch diameter rods and stainless steel sampling probes into the subsurface for sample collection. The system to be used inside buildings will be a small track mounted unit. The system advances the steel probe assembly to the desired depth using a pneumatic hammer. Soil samples will be collected using a 4-foot acetate sleeve within a 2.125-inch outside diameter (OD), or similar size, sample tube.

If VOC or VPH samples are scheduled for analysis, they will be collected immediately in accordance with SOP No. S-13 "Field Preservation of VOA and VPH Soil Samples". The volatile sample location will be selected based on PID screening results. The remaining soil should then be composited in a stainless steel bowl for sample collection for all other analytical parameters. The soil will be homogenized with a stainless steel sampling spoon. The additional samples will be collected in the order described in Section 9. The appropriate sample container will be selected and the sample placed the sample in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures. Sampling observations will be recorded on the Surface Soil Sampling FDR Form and the field logbook.

If VOC or VPH samples are scheduled from the 1-10 foot interval, they will be collected immediately following the 0-1 foot interval in accordance with SOP No. S-13 "Field Preservation of VOA and VPH Soil Samples", after the interval is screened with a PID. The remaining sample collection will continue in the same manner as described for the 0-1 foot interval. The 1-10 foot interval acetate sleeves will not be opened until the sample depth has been achieved and a representative portion of the sample can be composited. In the interim, the ends of sample tubes will be capped with aluminum foil or tube end caps if available. At that time, all sleeves from the 1-10 foot interval will be opened and screened with a PID. The composite sample for the 1-10 foot interval will be collected by opening the soil core with a stainless steel spoon or spatula and collecting a continuous profile of soil along the interval and placing it within the stainless steel bowl for homogenization. The appropriate sample container will be selected and the sample placed the sample in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures.

Records of each boring will be made by the Site geologist or field sampler on a Soil Boring Log FDR and the field logbook. After samples have been collected, the soil will be described in accordance with SOP No. S-11 "Procedure for Description and Identification of Soils". The down hole drilling and non-disposable sampling equipment will be decontaminated between collection points as identified in SOP No. S-5 "Decontamination of Field Equipment" and Section 8.6.

8.1.4 Health and Safety Air Monitoring

Monitoring of the work environment will be undertaken during soil sampling activities to ensure that the PPE and engineering controls utilized at the Site are sufficient to ensure worker safety. At a minimum, this monitoring will include evaluations for hazardous concentrations of airborne VOCs. When drilling indoors, the level of carbon monoxide and oxygen will be monitored continuously.

Although the tasks and methods used in soil sampling are not expected to create an airborne dust issue, MACTEC anticipates using water spray methods during intrusive activities to reduce the potential for airborne dust. However, whenever the Subcontractor is drilling into and through concrete, wet methods of drilling must be implemented to prevent airborne dust.

Air Sampling Equipment

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the Site, and may be used as the basis for continuing or stopping work.

Air monitoring equipment to be used on Site includes:

- PID equipped with a 11.7 or 11.8 eV Lamp.
- Benzene colorimetric detector tubes (e.g., Drager), able to detect benzene at 0.5 parts per million (ppm), and a appropriate bellows pump or similar device.
- Oxygen, LEL, and carbon monoxide meter to detect these gases during indoor drilling.

8.1.4.1 Site Monitoring Plan

8.1.4.1.1 Volatile Organic Compounds

Continuous total VOC air monitoring using direct reading instruments such as a PID will be conducted in the worker breathing zone during all subsurface investigation work. If total VOC readings are sustained at 0.5 ppm, benzene colorimetric detector tubes (e.g., Drager) will be used to determine the presence of benzene. If the benzene concentration reaches or exceeds 0.5 ppm, the level of protection will be upgraded to Level C. If benzene concentrations reach or exceed 5 ppm, the level of protection will be upgraded to Level B.

IMPORTANT: PRIOR NOTICE TO THE MACTEC SAFETY DIRECTOR IS REQUIRED BEFORE ANY USE OF LEVEL B.

If benzene is not present, Site activities may continue unless the total VOC concentration reaches or exceeds 1.4 ppm, at which time the level of protection will be upgraded to Level C. If total VOC concentrations reach or exceed 34 ppm, the level of protection will be upgraded to Level B. If the total VOC concentration reaches or exceeds 1.4 ppm in the work area (EZ), perimeter VOC monitoring using the PID will be conducted. If the ambient air concentration of VOCs exceeds 1.4 ppm at the perimeter of an EZ, the EZ perimeter will be increased if possible and monitoring continued. This HASP is not intended to serve as a plan for emergency response for VOC conditions within the community or adjacent properties. If task-specific conditions indicate a potential for such vapors to travel off-site, the work will be stopped and the conditions and procedures re-evaluated. If an event occurs that may result in the potential for off-site migration of contaminant vapors, that work activity will be stopped and an air monitoring plan will be developed as stated in Section 4.4 of the SMP.

The Site is well vegetated, and although dust is not anticipated to be problem during work activities performed in the winter months, dust conditions are possible during other times of the year. If the creation of airborne dust becomes evident, the GSS and SHSS will consult with the SHSO and PM, to determine if airborne dust monitoring will be implemented. The HASP will be revised to reflect the addition of dust monitoring at that time and an action limit based on the available Site analytical data will be used to calculate a dust action level.

8.1.4.1.2 Exhaust Gases (carbon monoxide) – Drilling Indoors

When drilling indoors, adequate ventilation shall be implemented in order to maintain acceptable oxygen levels and prevent the accumulation of carbon monoxide and other hazardous components of diesel or gasoline exhaust from the drill rig. Oxygen, LEL, and carbon monoxide monitoring shall be performed by the Subcontractor and MACTEC during all activities that have the potential to generate exhaust (e.g., operation of a drill rig) within a building structure.

Table 3-2 in the HASP summarizes the action levels for the levels of protection.

8.1.4.1.3 Direct Reading Instrumentation

Total VOC monitoring will be performed during all intrusive Site activities as follows:

- Upon initial Site entry, total VOC monitoring using a PID shall be performed to characterize background levels within the EZ. Weather conditions, including the prevailing wind direction, will be observed and recorded for each day of Site activities. A dedicated Site Health and Saftey logbook will be used to record Site Health and Safety information on a daily basis.
- If the total VOC action level is reached in the breathing zone (total VOC levels at or above 1.4 ppm), benzene colorimetric tubes (e.g., Drager) will be used to determine if benzene is present. See Section 9.1.4.2.1.
- All routine breathing zone monitoring results collected in the EZ during installation of soil boring and monitoring wells in Modified Level D will be recorded in the field logbook under control of those personnel assigned to completeing that specific activity. In the event an upgrade occurs from Level D to Level C or Level B the personal monitoring form (see Appendix F) will be used to record results of total VOC monitoring. Personal monitoring forms will be copied to the health and safety file of all MACTEC and Subcontractor personnel whose exposure conditions is represented by the monitoring conducted. The original form will be filed in the MACTEC project HASP file. The GSS shall ensure that copies of all monitoring forms are provided to Subcontractor.

8.1.4.1.4 Personal Samples for Laboratory Analyses

If necessary, personal samples for VOCs will be collected in accordance with standard industrial hygiene practices and OSHA/NIOSH. The DES&H will determine if personal samples are necessary based on Site conditions.

- Personal samples for VOC constituents will be collected on the field worker with the greatest potential for exposure in the work area for each day Site activities are performed.
- Samples will be collected over an entire shift (shifts are assumed to be 8-hours maximum).
- Samples will be sent via overnight courier to an American Industrial Hygiene Association (AIHA) accredited laboratory, and rush turnaround analyses will be requested.
- The DES&H will evaluate the sample results to determine if controls and PPE are appropriate for the exposure potential.
- Samples results will be communicated to all Site workers. Copies of analytical results and a description of the tasks performed during sample collection will be placed in each Site worker's file whose exposure is represented by the particular sample. The original analysis records will be filed in the MACTEC project HASP file.
- Based on results of the first round of sampling, personal samples may be collected on a periodic basis, and analytical turnaround time may be extended provided that significant changes have not occurred with respect to equipment, work tasks or processes, engineering controls, personnel, and environmental conditions.

- Personal and area sampling may be suspended during periods of heavy precipitation.
- All sample results shall be retained for a period of at least 30 years plus employment.

8.1.4.1.5 Equipment and Pump Calibration

All air monitoring instruments shall be calibrated according to manufacturer's instructions and standard industrial hygiene practices. Direct reading instruments shall be calibrated prior to each day's use, and at any time the operator of the instrument suspects instrument drift or malfunction. Calibrations shall be recorded in the equipment calibration logbook, or in a field logbook if instrument is recalibrated in the field.

In the event that personal sampling is required, person sampling pumps and appropriate sampling media will be used to collect breathing zone samples. The flow rate of air sampling pumps shall be set to a flow rate specified by the applicable NIOSH sampling methods. The pump flow rate shall be checked after each sampling event and recorded. The pre-sampling and post-sampling flow rates shall be used to obtain an average flowrate for the sampling period. The SHSO will provide guidance on the correct sampling media, pump flow rates, and collection times.

8.2 SURFACE WATER SAMPLES

Surface water samples will be collected in the MMB Wetland area, East Ditch, off-PWD, and South Ditch as part of the RI. Surface water samples will be collected as outlined in SOP No. S-2 and summarized below.

If both surface water and sediment are to be collected at a given sample point, the surface water sample will be collected first by a direct dip method. Because of simplicity, when sampling surface water, direct dipping of the sample container into the surface water body is desirable. If wading is required, the sample location will be approached from downstream. Wading may cause bottom deposits to rise and bias the sample and is acceptable only if a current is noticeable, and the water visibly clears up.

Sample containers will be organized in the preferred order of sampling. Using a small beaker or the sample port of the pH/specific conductivity meter, the sampler will collect a small water sample and record the temperature, pH, and specific conductivity readings in the field log book.

The sample containers will be filled by dipping them such that the top or opening is pointed upstream allowing the sample to be collected directly into the container. Care shall be taken to avoid completely submersing pre-preserved sample containers so that these chemicals are not lost and released into the water. Steps described above will be repeated as necessary to fill required sample containers. The sample containers will be preserved as described in Section 9 and the QAPP.

8.3 SEDIMENT SAMPLES

Sediment samples will be collected in the MMB Wetland area, East Ditch, off-PWD, and South Ditch as part of the RI. Sediment samples will be collected as outlined in SOP No. S-2 and summarized below.

If both surface water and sediment are to be collected at a given sample point, the surface water sample shall be collected first. Actual, Site-specific conditions and the physical sample location will determine the appropriate equipment required for sample collection. Several types of equipment used to collect sediment samples are acceptable as long as they do not violate the integrity of the sample and they provide a representative sediment sample. Sediment samples will be collected using a soil auger, a small shovel or a stainless steel trowel, scoop or spoon, depending on location conditions. During sediment sampling, the field sampler will take time to allow all surface water to run off the sampling device and sample prior to preparing laboratory samples. This will be done to reduce the water content of the sediment sample prior to homogenization and preparation of samples.

The sampler will take notes on each location and include a description of the physical appearance of the sediment. This information will be recorded in the field notebook and the Surface Water and Sediment FDR in Appendix C.

Sediment samples are scheduled for VOC analysis will be collected first as described in SOP No. 13. For off-Property VOC samples, both low concentration samples and methanol preserved samples will be collected as described in Method 5035. Low concentration samples will be collected (with 5 grams of sample) in vials containing stirrer bars and sodium bisulfate. High concentration samples are collected (with 10 grams of sample) in vials preserved with methanol. Off-Property VOC samples will consist of two vials for low concentration analysis and one vial (methanol preserved) for high concentration analysis. The sediment sample will be transferred to the vial using a plastic syringe designed to reduce the exposure of the sediment sample to air. The syringe will be advanced directly into the sediment in the stainless steel bowl. An additional soil jar will be collected for percent solids determination to be used only for the VOC sample. The jar shall be labeled "VOC percent solid" with the same sample information as the original sample.

After the VOC sample has been collected, the sediment within the stainless steel bowl will be homogenized (mixed) with a stainless steel spoon so that each sample aliquot is representative of the whole. Care should be taken to ensure that sufficient sediment is present in the stainless steel bowl to fill all of the associated sample fractions (containers) and duplicate fractions, if necessary. The sample will be allowed to settle for five minutes. As much standing water as possible will be decanted taking care not to loose any fine solids. The appropriate sample container will be selected and the sample placed the sample in the container, capped and labeled, and placed into a cooler to initiate sample storage and preservation procedures.

Non-disposable sampling equipment will be decontaminated between collection points as identified in SOP No. S-5 "Decontamination of Field Equipment" and Section 8.6.

8.4 GROUNDWATER AND HYDROLOGIC SAMPLES

The groundwater investigation component of the RI/FS will include drilling, installation of monitoring wells; sampling of monitoring wells, MLPs, and drive point piezometers; induction logging; and water level and precipitation measurements. Wells installed during the RI will be developed and sampled as outlined below and in the QAPP. Groundwater samples will be collected at two events representative of seasonal low and high groundwater conditions.

Liquid and soil IDW associated with drilling and groundwater sampling will be drummed or otherwise containerized and transported to the Property and managed as described in the SMP.

8.4.1 Conventional Wells

Conventional monitoring wells shall be completed with above-ground or flush-mount protective casings to prevent damage to the wells by vehicular operation or vandalism. Where an above-ground protective casing is desired, solid PVC riser shall extend from the screen to approximately 30 inches above ground surface. Procedures for Monitoring Well Installation are provided in SOP No. S-12.

Monitoring well development shall be performed, as soon as practical, after well installation but not sooner than 48 hours following placement of the grout seal. Detailed procedures for the development of monitoring wells are provided in SOP No. S-6. Information shall be documented on a Well Development Record (example included in Appendix C).

Development of wells shall be accomplished by pumping and surging with a submersible pump. Surging will be conducted slowly to reduce disruption to the filter pack and screen. Following surging, the well will be pumped or bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced to acceptable levels as described below. Water shall not be added to the well to aid in development. Pumping shall continue from the screened interval until a volume of water equal to or greater than three saturated well volumes has been purged.

A well is considered fully developed when the following criteria are met:

- the well water is clear to the unaided eye (based on observations of water clarity through a clear glass jar); and
- the sediment thickness remaining in the well is less than one percent of the screen length.

Should the recharge to the well be so slow that the required volume cannot be removed in two to three consecutive hours, if the water remains discolored, or excess sediment remains after the three well volume removal, the project team shall terminate purging and/or discuss other options with the project manager for improving water quality.

The cap and all internal components of the well casing above the water table shall be rinsed with deionized water to remove all traces of soil, sediment and cuttings as needed. This washing shall be conducted before and/or during development.

Non-dedicated pumps used for well development shall be decontaminated prior to use in the next well and dedicated tubing shall be used during subsequent sample collection from the well. Development fluids shall be managed as IDW as described in the SMP.

Monitoring well sampling shall be performed no earlier than 14 days following well development.

Pre-purging Activities. The following activities shall be performed immediately prior to purging each well:

- Measure and record the height of protective casing (not applicable for flush mount installations).
- After unlocking the well and removing any well cap, measure and record the ambient and well-head organic vapor levels using a PID.
- Measure and record the distance between the top of the well casing and the top of the protective casing.
- Using the electronic water level meter, measure and record the static water level from the top of the well riser and the depth to the well bottom to the nearest 0.01 foot. Upon removing the water level wire, rinse the water level wire with deionized water. The procedure for water level measurement is detailed in SOP No. S-7 and summarized in Section 8.4.3.
- Inspect the well for integrity.

Low-Flow Groundwater Sampling. Low-flow groundwater sampling is the preferred technique for groundwater sampling of monitoring wells at the Site. The low-flow purging and sampling procedure as presented by the USEPA Region I in "Low Stress (low-flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells", Revision 2, July 30, 1996 (USEPA, 1996a) is included in Appendix B. However, if low-flow sampling is not possible (i.e., insufficient water level depth in the well or groundwater recharge rate is too slow) an alternate sampling technique will be used. SOPs for both low-flow groundwater sampling and an alternate technique are identified in more detail in the SOP No. S-1 in Appendix B. The following steps outline the purging and sample collection activities for low-flow sampling.

Field parameter measurements shall be made using instrumentation and a commercially manufactured flow through cell. Dedicated high density polyethylene (HDPE) tubing shall be used. Sample collection information shall be recorded on the Low-Flow Groundwater Sampling Record (example included in Appendix B). The pH stabilization criteria of ±0.2 units specified in this section shall take precedence over the pH stabilization criteria of ±0.1 units specified in the USEPA guidance. In addition, the stabilization criteria for turbidity shall be ±10 percent for values greater than 10 Nephelometric Turbidity Units (NTU) rather than 1 NTU. The USEPA guidance shall be used for purging and sampling procedures only. Procedures to be followed for decontamination, quality control sampling, and logbook entries are also presented in this guidance but are specified within the QAPP.

The majority of wells have been installed with dedicated sampling tubes at the well screen midpoint. Historically, these wells have been sampled using a peristaltic pump (Geopump™) with variable a frequency drive. With size 15 tubing, the Geopump™ flow rate is 1.67 milliliter/revolution providing a flow rate range of 50 milliliter per minute (ml/min) to 585 ml/min (30-350 rate per minute [RPM]). Installation of dedicated sampling tubes and use of Geopumps™ will remain a standard practice for the project. If dedicated tubing is not present, or a non-dedicated bladder pump is to be used, the first step is to determine the target depth for location of the pump intake. The default target depth will be the center of the screened interval.

During sampling, sample tube or pump insertion and water levels measurements, care should be taken to minimize disturbance of the water column within the well during pre-sample measurements.

The pump shall be started at a purge rate low enough to achieve 0.3 feet of drawdown or less based on historical data. If sampling the well for the first time, the pump will be started at the lowest possible setting (or approximately 100 ml/min) and the speed slowly increased until discharge occurs. The water level will be checked and the pump adjusted until there is little or no drawdown (less than 0.3 feet), if possible. If the minimal drawdown that can be achieved exceeds 0.3 feet (at a pump rate of approximately 100 ml/min) but remains stable, purging will continue until indicator field parameters stabilize.

The pumping rate and water levels will be recorded every three to five minutes (or as appropriate) during purging on the appropriate FDR (example included in Appendix C). During purging, field parameters will be monitored using a flow through cell. The flow through cell cannot be used for turbidity measurements and the sample for turbidity measurement must be collected prior to ground water entering the flow through cell. Purging is considered complete and sampling may begin when the field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three to five minute intervals, are within the following limits:

- turbidity (± 10 percent for values >10 NTU)

- dissolved oxygen (DO) (± 10 percent)
- specific conductivity (± 3 percent)
- temperature (± 3 percent) (if achievable)
- pH (± 0.2 unit)
- Oxidation-Reduction Potential (ORP) (± 10 millivolts [mV])

The final purge volume should be greater than the stabilized drawdown volume plus the tubing extraction volume. During purging and sampling, the tubing should remain filled with water. After the monitoring parameters have stabilized, the tubing to the flow through cell will be disconnected in order to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow through cell assembly. Sample containers will be filled directly from the tubing without alterations to the pumping rate.

If one or more parameters do not stabilize a note will be made on the FDRs concerning the changes considered or implemented to try to achieve parameter stabilization, and the basis of the decision to either collect or not collect the scheduled sample. The VOC fraction shall be collected first. The VOC sample container shall be completely filled without air space within the container. The remaining samples shall be collected in the order of SVOCs, metals, inorganics and other analytes as specified in Section 9.

After sampling, the depth to the bottom of well will be measured and recorded before closing the well.

8.4.2 Multi Level Piezometers

Specific ports of several MPs currently installed on the Site will be sampled during the two groundwater events proposed for the RI. These devices will be sampled by low-flow methods. Detailed procedures for low-flow groundwater sampling are outlined in detail in SOP No. S-1. The collection of the samples shall be conducted using the same steps outlined in Section 8.4.1.

8.4.3 Induction Logging

Induction logging is conducted to document conductivity profiles which are used to ascertain the vertical location of the DAPL/Diffuse layer interface and estimate the thickness of these geochemical zones. The procedure for conducting induction logging is presented in SOP-21.

Induction logging is conducted by lowering a small probe down the casing of the monitoring well. The probe generates an electric current from a transmitter coil located near the top of the probe and induces an electric eddy current in the formation adjacent to the well. The induced current produces a secondary electromagnetic field that is detected by a receiver coil located near the bottom of the probe. The intensity of the secondary field is a function of the electrical conductivity of the formation (in particular, pore fluid conductance) and any artifacts induced by the well casing. Because DAPL comprises high concentrations of dissolved constituents, it is much more conductive than ambient groundwater and produces a strong induction-log response (GEOMEGA, 2005).

8.4.4 Groundwater Level Measurements

Two synoptic groundwater level measurement events will be completed during the RI for conditions representing low and high groundwater elevations.

The depth to groundwater shall be measured from the surveyor's mark on the well riser or, in the absence of such mark, from the highest point on the rim of the well casing or riser. (If no mark is present, field personnel will mark the highest point of the riser to be used for future measurements.) Water level measurements at the various wells shall be obtained using an electronic water level meter. The water level shall be measured to 0.01 feet. The measured value shall be checked by raising the probe one to two feet and re-measuring the water level. The probe end of the water level meter shall be decontaminated by rinsing with distilled/deionized water between monitoring wells. Procedures for performing water level measurements are provided in SOP No. S-7 “Procedures for Measuring Groundwater Levels” in Appendix B.

Water elevations will be calculated from the depth measurements. The water level elevations shall be used to construct groundwater elevation contour maps from which groundwater flow directions shall be interpreted. Vertical hydraulic gradients can be calculated from water level data at well pairs. Water level measurements for each data collection round shall be completed within 24 to 48 consecutive hours to the extent practical.

8.4.5 Precipitation Measurements

Precipitation measurements will continue to be collected and recorded during normal working hours after precipitation events using a rain gauge located on the Property. These measurements will be supplemented with other commercially or publically available precipitation data from neighboring towns.

8.4.6 Stream Gauging

Stream gauging is conducted at the Site to establish stream elevations and volumetric flow in the MMB and the Sawmill Brook. The upstream locations will be at main channel branches where the streams cross roads and the channel section can be determined though a culverted section or a section through the natural channel if it can be readily measured immediately downstream. The downstream location in the MMB will be located either at the former canal bridge or farther downstream where the MMB flows under Main Street. The final section location will be determined based on the ability to obtain reliable and repeatable measurements due to access and flow conditions. The current-meter measurement method includes the summation of the products of individual subsection areas of the chosen stream cross section and their respective average velocities. It is assumed that the measured flow velocity at each vertical sample point along the stream cross section represents the mean velocity in the individual subsection areas. A current-flow meter may be used for measuring flow velocity through flow restricting structures if natural stream sections cannot be readily measured due to depth or shape. Flow measurements will be collected and documented in accordance with SOP-20.

8.5 FIELD EQUIPMENT CALIBRATION

Field sampling instruments used during the collection of samples shall be calibrated in accordance with manufacturer specifications. Field instruments requiring calibration include hand-held monitoring equipment including: PIDs for monitoring ambient air conditions and water quality meters for turbidity, pH, specific conductivity, temperature, and DO. Instrument calibration requirements are summarized below and are described more fully in the QAPP. Calibration procedures and instrument performance data shall be recorded on a Field Instrument Calibration Record (example included in Appendix C).

8.5.1 Photoionization Detectors Calibration

The following equipment should be used when calibrating PIDs:

- PID
- Zero gas cylinder
- Span gas cylinder

- Field Instrument Calibration Record
- Field logbook

The PID should be recalibrated before the start of each day and calibration checked at the end of the day. The most commonly used PID to be used at the Site will be a Model 580B PID from Thermo Environmental Instruments, Inc. The steps for calibrating this instrument with a zero gas cylinder are included in Attachment 1 of SOP No. S-17. PIDs will have a manufacturer manual included in the case. Other PIDs used on Site will be calibrated according to product-specific manufacturer's procedures.

8.5.2 Water Quality Meters Calibration

Details for calibration of water quality meters are discussed in SOP S-4. The probe readings for pH, DO, and specific conductance are automatically corrected for temperature by the instrument. Calibration standard should be allowed to equilibrate to ambient temperature. Communications to the instrument (programming and displaying the measurement files) are performed using a display/logger. Information sent to the instrument is entered through the keypad on the display/logger. Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions.

The specific instrument calibration procedures will be followed. The calibration standard batch numbers will be recorded along with calibration results. Calibration of field instruments will be documented on a Field Instrument Calibration Record (example included in Appendix C).

8.6 DECONTAMINATION PROCEDURES FOR FIELD EQUIPMENT

Decontamination of field equipment used for sample collection shall be performed before each use. The decontamination procedures are described in detail in SOP No. S-5 within Appendix B. These procedures are applicable to sampling equipment including soil augers, trowels, scoops, stainless steel bowls and spoons, and groundwater sampling pumps. The decontamination procedure includes removal of loose soil material, washing surfaces with a phosphate free detergent (liquinox), and rinsing the equipment. Effectiveness of such procedures will be assessed by collection of equipment rinse blank samples at a frequency of 5 percent for samples collected without dedicated equipment/tubing. Dedicated groundwater sampling equipment will not require decontamination. In the case of peristaltic pumps, the pump head hose will be replaced between sample locations. In the event use of a bladder pump is required, it will be decontaminated consistent with SOP S-5.

8.7 RECORDS

A variety of data records and data reports will be generated during the sample collection, chemical analysis, and data review and reporting processes. The project record types include:

- Chain of Custody (COC) Records
- Site and field logbooks
- Sample FDRs
- Field Instrument Calibration Records

Original records will be photocopied in the field at the Site office trailer, and a copy of the records will be retained in the field office trailer for reference. Originals will be filed at MACTEC's Wakefield, MA, office.

9.0 SAMPLE HANDLING AND ANALYSIS

This section presents procedures used to prepare and handle laboratory samples and complete chemical analyses. It also covers documentation steps used to track the collection of field samples and document sample custody during shipment to the subcontract laboratories.

9.1 ANALYTICAL METHODS

The following section contains a discussion of analytical chemistry procedures planned for future investigations at the Site. Field samples may be submitted for chemical analysis in support of a variety of activities including the RI, remedial action testing and monitoring, media chemistry evaluations, groundwater monitoring, and surface water and sediment investigations.

Field samples collected during the RI will be analyzed using analytical methods published by the USEPA (as available). A summary of analytical methods is presented on Table 9.1-1. This table includes sample bottle, hold time and preservation requirements. The primary chemical analyses include VOCs, SVOCs, metals and inorganics. The list of target compounds reported for these parameters will be based on the USEPA Contract Laboratory Program (CLP) Target Compound List (TCL) and TAL. For VOCs and SVOCs, additional compounds have been added to the CLP lists to include any compounds that have been identified as target compounds for these methods under the Massachusetts Data Enhancement Program (MassDEP, 2004). Additional USEPA methods or modified USEPA methods will also be used to evaluate other potential contaminants and to measure water chemistry parameters. For some chemicals, custom procedures have been developed by subcontracted laboratories to test for unique compounds that had no published procedures. The collection of QA/QC samples (blanks, spikes and duplicates) and formal data quality reviews will be included in all investigation programs as outlined in detail in the QAPP.

During monitoring investigations completed in association with the RI or remedial actions, shorter lists or target analytes may be designated for some tasks based on Site-specific knowledge of contaminants.

9.1.1 Routine Analytical Methods

Specific details on sampling locations, sample media and planned analytical methods are presented in Sections 4, 5, and 6 for OU1, OU2, and OU3, respectively. During each sampling activity, a variety of analytical methods will be completed.

Analytical methods will be completed by subcontracted laboratories using USEPA SW-846 methods (USEPA, 1996b) for the majority of chemical parameters. Additional tests will be completed using USEPA waste water methods (600 series) [CFR Part 136], Methods for the Chemical Analysis of Waters and Wastes (USEPA, 1993), Standard Methods (American Public Health Association [APHA], 1998) and subsequent editions, American Society for Testing and Materials (ASTM) procedures, and other project specific testing procedures developed by Olin.

In 2000, the MassDEP began the Data Enhancement Process with the goal of establishing standards for the analysis of samples and reporting of data under the MCP. Draft analytical method guidance documents were prepared, and a final compendium of analytical standards was published in 2003 (MassDEP, 2003) and revised in 2004 (MassDEP, 2004). The QC limits goals published in the MCP analytical methods have been incorporated into analytical sampling and analyses completed from 2002 to present. The QC limits goals for laboratory control sample (LCS), matrix spike/matrix spike duplicate (MS/MSD), surrogates, field duplicates, and lab duplicates will continue to be the method performance objectives for RI investigations at the Site. A detailed description of the QC limits for each method is presented in the QAPP.

9.1.2 Project Specific Analytical Methods

Analytical testing may be completed for a subset of chemicals that are not routinely included in analytical programs completed at CERCLA or MCP sites. Some chemicals do not have formal published USEPA methods. The RI analyte list for the Site was presented in Section 3.1 and includes analysis for DMF, phthalic anhydride, hydrazine, formaldehyde, nonylphenol, perchlorate, diphenylamine, tin, NDMA, and the products Opex® and Kempore®. Analytical methods are not available for all these analytes in all matrices. Nonylphenol, perchlorate, and Opex®, Kempore®, will be analyzed in aqueous matrices only. For a subset of chemicals, analytical methods were developed by subcontract laboratories as performance based methods. These methods are described in detail in the project QAPP.

It should be noted that NDMA analysis in water matrices includes a low level method (Method 521). Method 521 is a high resolution/mass spectrometry (HR/MS) isotope dilution procedure that was selected to achieve a detection limit less than the California drinking water notification level of 10 nanograms per Liter (ng/L) (numerically equivalent to the MassDEP drinking water guideline for NDMA). All samples will be collected in amber-glass bottles. Method performance objectives are included in the QAPP.

A reporting limit of 5 ng/L will be used for NDMA reporting for complex matrices such as surface water. A reporting limit of 2 ng/L will be used for NDMA reporting for clean matrices such as groundwater. Groundwater samples collected from locations within known areas of higher NDMA concentrations may be analyzed by USEPA Method 8270C because there is no need for the low detection limits analysis provided by Method 521. Separating the higher concentration samples from the low concentration samples will also decrease the chance of laboratory related contamination in the Method 1625 data set. Based on historical data, samples with concentrations greater than 1.0 µg/L will be submitted to the laboratory for a modified Method 8270C analysis. The NDMA quantitation limit for the modified Method 8270C procedure will be 1.0 µg/L.

9.1.3 Order of Sample Collection

Samples for analysis will be collected in the following order:

1. VOCs/VPH
2. Hydrazine
3. SVOCs/EPH
4. NDMA (Method 1625)
5. Other Organics (order unspecified):

   DMF, phthalic anhydride, formaldehyde, nonylphenol, perchlorate, diphenylamine, Opex® and Kempore®
6. Metals
7. Inorganics

9.2 SAMPLE CONTAINERS, PRESERVATION AND HOLD TIMES

Specifications for sample collection processes and the containers and preservative used to store samples prior to analysis were determined based on requirements in the published analytical methods or USEPA Region I data validation guidelines (USEPA, 1996c; USEPA, 1989). A summary of requirements for each method and matrix is presented in Table 9.1-1 and QAPP Worksheet 12b. Laboratory analysis will be requested in accordance with the hold times outlined in Table 9.1-1.

9.3 SAMPLE CHAIN OF CUSTODY AND SHIPPING

Procedures are established to document the custody of samples that are collected during investigations and to identify and track samples delivered or shipped to the analytical laboratory for analysis. Tracking procedures are also established to verify that data for all samples are obtained from the laboratory. The sample custody process is described in detail in the QAPP and illustrated in QAPP Worksheet #16.

A computerized sample tracking program will be used to ensure that all relevant sample information is recorded accurately and completely at each stage of the sample handling process. The sample tracking program will be the primary method used to record sample collection information and print individual bottle labels. COC forms may be handwritten or computer generated. Examples of the handwritten and computer generated COC are presented in SOP No. S-9 “Sample Chain of Custody Procedure” in Appendix B.

Sample collection information may be entered into the sample tracking database by the field sampler or designated sample manager at the time of sample generation. This information includes:

- sample ID
- location ID
- date collected
- analytical methods
- containers and preservatives
- sampler name
- sample depth
- sample type (Field sample, QC Blanks, MS, duplicate)

When entered, this information is downloaded directly into the project database. An electronic COC can be generated directly from the database and sent to the laboratory. Sample Delivery Groups (SDGs) are also used to track laboratory data. The SDG numbers will be established by the laboratory and entered into the analytical database when sample results are reported by the laboratory. QC samples (QC blanks, MSs, field duplicates, and performance evaluation samples) will also be tracked. Electronic sample collection information can be exported from the sample tracking program into Microsoft® Excel® for reporting purposes.

For tasks using computer generated COC forms, sample tracking starts with information entered from the FSP sample collection specifications, or it may be entered in the field at the time of sample planning. Sample information can then be used to print labels for sample bottles. As samples are collected, further data on sample collection date, time, depth, and sample collector are entered and the status is updated to "collected". When samples are ready to be shipped, data on the SDG and shipping date are entered and the status is updated to "shipped". When the lab reports sample results, the sample tracking database system is used to build the final database containing sample chemical, survey and geological data. Finally, when the lab sends a data package the data are checked against the sample tracking file for completeness and data on lot, lab ID, preparation data and time, and analysis date and time are collected. At this point, the tracking cycle is complete. The following data are captured by Sample Tracking System:

STUDY	Area of concern or investigation
SITE_ID	Sample location ID
SITE_TYPE	Type of location (groundwater, surface soil, sediment, etc.)
SAMP_ID	Unique sample ID (see Section 7.1)
QC_TYPE	Indicates whether sample is normal, duplicate, MS or QC
MATRIX	Sample matrix (Aqueous, Non-Aqueous)
DEPTH	Depth of sample collection (if applicable)
SDATE	Sample collection date
STIME	Sample collection time
COLLECTOR	Initials of person collecting sample
SDG	Sample Delivery Group for sample
TRIP	Trip blank associated with sample
RINSATE	Rinse blank associated with sample
STATUS	Where sample is in collection process – (labels printed, sample collected, sample prepared for shipping, sample shipped to lab, lab received, data received from lab)
ARFDATE	Date sample was shipped to lab
ANALYSIS	Analysis requested from lab.

9.4 FIELD DOCUMENTATION

Records of field data will be made throughout the project to capture information that might be needed at a later time, such as during preparation of the report or for use by other investigators who were not present when the data were collected. The field activities and the collection of field samples will be documented using Site and field logbooks, FDR forms, and COC forms. Photography may also be used to document field activities.

The MACTEC FOL has the responsibility to maintain files containing all logbooks, forms, and notebooks that document daily field activities. Individual responsibilities may be delegated to other field staff, as appropriate. Special emphasis will be placed on the completeness and accuracy of all information recorded in the field logbooks, forms, and notebooks and will contain statements that are legible, accurate, and inclusive documentation of project activities. Because the logbooks, FDR forms, and COC forms provide the basis for future reports, they must contain accurate facts and observations.

9.4.1 Chain of Custody Forms

COC forms are used to document sample collection. Use of COC forms is described in Section 9.3 and the QAPP. Examples of the handwritten and computer generated COC are presented in SOP No. S-9 "Sample Chain of Custody Procedure" in Appendix B.

9.4.2 Logbooks

The MACTEC field team will follow SOP No. S-10 "Use of Field Logbooks" contained in Appendix B. Additional details covering the use of Site logbooks and field logbooks is contained in the QAPP. Site and field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. As such, entries will be described in as much detail as possible so that a particular field activity could be reconstructed without reliance on memory.

Logbooks will be hardcover permanently bound field survey books or notebooks. Logbooks will be stored in the project files when not in use. Each logbook will be identified by a project number and logbook number. All logbooks will be water resistant and have sequentially numbered pages.

The title page of each logbook will contain the following:

- The logbook number
- Project name and project number
- Site name (Olin Chemical Superfund Site) and address (51 Eames Street, Wilmington, MA)
- Logbook start date

The Site and field logbooks provide a daily hand written account of all field activities. All entries are to be made in permanent black or blue ink, and corrections are made with a single line with the author initials and date. Each page of the logbook will be dated and signed by the person completing the log. Partially completed pages will have a line drawn through the unused portion at the end of each day.

Site Logbook

The Site logbook is a record of all major tasks completed for each day or operation. Entries are made each day. The FOL responsible for on-Site field operations will complete the Site logbook. At a minimum, the Site logbook will contain the following information:

- A list of all field logbooks created for the project;
- Names and titles of all project related personnel present at the Site during each day of operation;
- A brief summary of all activities completed for each day of operation;
- A listing of any changes made to established RI program procedures; and
- A summary of any problems encountered during the day including a description of corrective actions and impacts on the project.

Field Logbook

Field logbooks are daily records of field task activities that are entered in real time by the on-Site field technicians and scientists. The following information is entered into the field logbooks:

- The date and time of each entry. The daily log should begin with weather conditions and the names and organizations of personnel performing the documented task;
- A summary of important tasks or subtasks completed during the day;
- A description of any field tests completed in association with the daily task;
- A description of any samples collected including documentation of any quality control samples that were prepared (rinse blanks, duplicates, MSs, split samples);
- Documentation of equipment maintenance and decontamination activities; and
- A summary of any problems encountered during the day including a description of corrective actions and impacts on the daily task.

9.4.3 Sample Collection and Exploration Records

FDRs document details of explorations and sample collection activities. A sample collection record is completed each time a field sample is collected. The goal of the exploration and sample collection record is to document exploration and sample collection methods, materials, dates and times and sample locations and identifiers. Field measurements and observations associated with a given exploration or sample collection task are recorded on the sample collection record. Sample collection records are maintained throughout the field program by the FOL in files that become a permanent record of field program activities. A listing of exploration and sample collection records included in Appendix C is presented below:

- Aquifer Testing Completion Checklist
- COC
- Conventional Groundwater Sampling
- Field Instrument Calibration Record
- Low Flow Groundwater Sampling
- Monitoring Well Log - Above Ground Mount
- Monitoring Well Log - Flush Mount
- Rock Coring Logs
- Soil Boring Log
- Surface Soil Sampling
- Surface Water/Sediment Sampling
- Unified Soil Classification System (USCS) Key to Soil Descriptions
- Stream Discharge Measurement Form
- Well Development Record

10.0 ECOLOGICAL ASSESSMENT AND RISK ASSESSMENT

10.1 ECOLOGICAL ASSESSMENT

The SOW indicates that an ecological assessment should be conducted to determine the nature and extent of contamination to the ecological resources on, nearby, or otherwise influenced by the Site. A reference site, or sites, may be required by USEPA to be designated and sampled to produce data for USEPA's use, in evaluating the impact of the Site on the ecological receptors. The extent of the area to be studied shall be determined by the results of the relevant field investigation data, and upon the collection and review of available information concerning the biota expected to occur on or near the Site as either resident or transient species.

At a minimum, a qualitative study shall be conducted to determine the basic environmental characteristics at the Site, and to identify and characterize ecological communities, habitat types, and species which are present on or surrounding the Site. If necessary, further qualitative or quantitative assessments, bioassays, or tissue sampling may be required to better determine the actual impact of the Site on the environment and to support the ecological risk assessment to be prepared by the Respondents. Previous Site investigations and ecological risk assessments have collected and summarized the information to be included in the qualitative study described above.

Specific attention shall be placed on the Section 404(b)(1) Guidelines of the Clean Water Act regarding wetlands. Specifically, Executive Order 11990 "Protection of Wetlands," May 24, 1977, concerns all impacts to wetlands and Executive Order 11988 "Floodplain Management" is involved where actions are to be evaluated in regard to projects which may impact a floodplain.

The elements of the FSP do include consideration of the future ecological risk assessments. A separate FSP for the ecological risk assessments is not currently anticipated, since considerable investigation and evaluation of ecological receptors has previously been conducted. The SOW requires an evaluation of the applicability of the elements listed below, and a plan to implement those elements determined to be applicable. Further, the SOW indicates that a plan need not be submitted to collect certain data provided that sufficient data have already been obtained and presented in the Draft FRI. The previous ecological assessments and ecological risk assessments were not included in the Draft FRI, but Appendix F of the Draft FRI identifies all reports that contain these elements. Each previous ecological assessment and ecological risk assessment was summarized in detail in Appendix F of the Draft FRI. In addition, the Response to Comment

Letter prepared by Olin and dated January 30, 2009 provided in detail a summary of the previous work that had been done that constituted an ecological assessment and that met the requirements for an ecological assessment as described in the SOW.

The elements that have been considered, and have been determined to have been addressed by previous work efforts, include:

a. an accurate delineation of the wetland boundary using the U.S. ACE, 1987, Wetlands Delineation Manual with N.E. Division Field Data Collection Sheets, and classification of the wetland types using the Classification of Wetlands and Deep-water Habitats of the United States (FWS/OBS-79/3I, US Fish and Wildlife Service, 1979) and determination of the functions and values of the wetlands and an accurate description and delineation of the ten (10) year and hundred (100) year floodplain;

b. a description of habitat types including a map of major habitats present at the Site and a list of plant and animal species, both resident and transient;

c. a determination of the status of those species identified in terms of sport or commercial usage, protected status, endangered, threatened, or of special concern;

d. sampling of environmental receptors for analysis of community composition, abundance, or body burden of contaminants;

e. sampling of chemical and physical parameters for surface water and sediments (e.g. grain size, total organic carbon, DO, etc.);

f. toxicity testing of indicator species, if required, to determine effects of contaminated Site media on the environment;

g. an evaluation of how the contamination from the Site has affected the receptors, including a discussion of fate and transport of the contaminants to the various habitat types or organisms;

h. an evaluation of whether contamination has affected the health of the wetland and other major habitats present at the Site (e.g. reduced plant growth or vigor or contributed contaminants to the food web); and

i. a discussion of how each remedial alternative under consideration affects the wetland, biota, and their functions and values.

11.0 REFERENCES

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TABLES

Table 3.1-1
Remedial Investigation Analyte List

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Analyte	CASRN
Volatile Organic Compounds	
1,1,1,2-Tetrachloroethane*	630-20-6
1,1,1-Trichloroethane	71-55-6
1,1,2,2-Tetrachloroethane	79-34-5
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1
1,1,2-Trichloroethane	79-00-5
1,1-Dichloroethane	75-34-3
1,1-Dichloroethene	75-35-4
1,1-Dichloropropene*	563-58-6
1,2,3-Trichlorobenzene	87-61-6
1,2,3-Trichloropropane	96-18-4
1,2,4-Trichlorobenzene	120-82-1
1,2,4-Trimethylbenzene*	95-63-6
1,2-Dibromoethane	106-93-4
1,2-Dichlorobenzene	95-50-1
1,2-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
1,3,5-Trimethylbenzene*	108-67-8
1,3-Dichlorobenzene	541-73-1
1,3-Dichloropropane*	142-28-9
1,4-Dichlorobenzene	106-46-7
1,4-Dioxane*	123-91-1
2,4,4-Trimethyl-1-pentene	107-39-1
2,4,4-Trimethyl-2-pentene	107-40-4
2,2-Dichloropropane*	594-20-7
2-Butanone (MEK)	78-93-3
2-Chlorotoluene*	95-49-8
2-Hexanone	591-78-6
4-Chlorotoluene*	106-43-4
4-Methyl-2-pentanone (MIBK)	108-10-1
Acetone	67-64-1
Benzene	71-43-2
Bromobenzene*	108-86-1
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9
Butylbenzene*	104-51-8
Carbon Disulfide	75-15-0
Carbon Tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
Cis-1,2-Dichloroethene	156-59-2
cis-1,3-Dichloropropene	10061-01-5
Cyclohexane	110-82-7
Dibromo-3-chloropropane*	96-12-8
Dibromochloromethane	124-48-1
Dibromomethane*	74-95-3
Dichlorodifluoromethane	75-71-8
Diethyl ether*	60-29-7
Diisopropyl Ether*	108-20-3
Ethyl Tertiary Butyl Ether*	637-92-3
Ethylbenzene	100-41-4
Hexachlorobutadiene*	87-68-3

Table 3.1-1
Remedial Investigation Analyte List

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Analyte	CASRN
Isopropylbenzene	98-82-8
Methyl acetate	79-20-9
Methyl tert-butylether	1634-04-4
Methylcyclohexane	108-87-2
Methylene Chloride	75-09-2
m-Xylene*	108-38-3
Naphthalene*	91-20-3
n-propylbenzene*	103-65-1
o-Xylene*	95-47-6
p-Isopropyltoluene*	99-87-6
p-Xylene*	106-42-3
Sec-butylbenzene*	135-98-8
Styrene	100-42-5
Tert-amyl Methyl Ether*	994-05-8
Tert-butylbenzene*	98-06-6
Tetrachloroethene	127-18-4
Tetrahydrofuran*	109-99-9
Toluene	108-88-3
Trans-1,2-Dichloroethene	156-60-5
trans-1,3-Dichloropropene	10061-02-6
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
Vinyl Chloride	75-01-4
Xylenes (total)	1330-20-7
Semivolatile Organic Compounds	
1,1-Biphenyl	92-52-4
1,2,4,5-Tetrechlorobenzene	95-94-3
1,2,4-Trichlorobenzene*	120-82-1
1,2-Dichlorobenzene*	95-50-1
1,3-Dichlorobenzene*	541-73-1
1,4-Dichlorobenzene*	106-46-7
2,3,4,6-Tetrachlorophenol	58-90-2
2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2
2,4-Dichlorophenol	120-83-2
2,4-Dimethylphenol	105-67-9
2,4-Dinitrophenol	51-28-5
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
2-2'-oxybis(1-Chloropropane)	108-60-1
2-Chloronaphthalene	91-58-7
2-Chlorophenol	95-57-8
2-Methylnaphthalene	91-57-6
2-Methylphenol	95-48-7
2-Nitroaniline	88-74-4
2-Nitrophenol	88-75-5
3,3'-Dichlorobenzidine	91-94-1
3-Methylphenol*	108-39-4
3-Nitroaniline	99-09-2
4,6-Dinitro-2-Methylphenol	534-52-1
4-Bromophenyl-phenylether	101-55-3
4-Chloro-3-Methylphenol	59-50-7
4-Chloroaniline	106-47-8
4-Chlorophenyl-phenylether	7005-72-3
4-Methylphenol	106-44-5
4-Nitroaniline	100-01-6

Table 3.1-1
Remedial Investigation Analyte List

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Analyte	**CASRN**
4-Nitrophenol	100-02-7
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Acetophenone	98-86-2
Aniline*	62-53-3
Anthracene	120-12-7
Atrazine	1912-24-9
Azobenzene*	103-33-3
Benzaldehyde	100-52-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Benzoic acid	65-85-0
Benzophenone	119-61-9
Benzyl alcohol	100-51-6
bis(2-Chloroethoxy)methane	111-91-1
bis(2-Chloroethyl) ether	111-44-4
Bis(2-Ethylhexyl) phthalate	117-81-7
Butylbenzylphthalate	85-68-7
Caprolactam	105-60-2
Carbazole	86-74-8
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Dibenzofuran	132-64-9
Diethylphthalate	84-66-2
Dimethylphthalate	131-11-3
Di-n-butylphthalate	84-74-2
Di-n-octylphthalate	117-84-0
Diphenyl oxide	101-84-8
Fluoranthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3
Hexachlorocyclopentadiene	77-47-4
Hexachloroethane	67-72-1
Indeno(1,2,3-cd)pyrene	193-39-5
Isophorone	78-59-1
Naphthalene	91-20-3
Nitrobenzene	98-95-3
N-nitrosodimethylamine	62-75-9
N-Nitroso-di-n-propylamine	621-64-7
N-nitrosodiphenylamine	86-30-6
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Phenol	108-95-2
Pyrene	129-00-0

Table 3.1-1
Remedial Investigation Analyte List

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Analyte	CASRN
Polycyclic Aromatic Hydrocarbons	
1-Methylnaphthalene	90-12-0
2-Methylnaphthalene	91-57-6
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(b)fluoranthene	205-99-2
Benzo(g,h,i)perylene	191-24-2
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0
Polychlorinated Biphenyls (PCB)	
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5
Aroclor 1262	37324-23-5
Aroclor 1268	11100-14-4
Total PCBs	NA
Metals	
Aluminum	7429-90-5
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7740-43-9
Calcium	7440-70-2
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7740-50-8
Hexavalent Chromium	18540-29-9
Iron	7439-89-6
Lead	7439-92-1
Magnesium	7439-95-4
Manganese	7439-96-5
Mercury	7439-97-6
Nickel	7440-02-0
Potassium	7440-09-7
Selenium	7782-49-2
Silver	7440-22-4
Sodium	7440-23-5
Tin	7440-31-5
Thallium	7440-28-0
Vanadium	7440-62-2
Zinc	7440-66-6

Table 3.1-1
Remedial Investigation Analyte List

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Analyte	**CASRN**
Inorganics	
Alkalinity	11-43-8
Ammonia	7664-41-7
Bromide	24959-67-9
Chemical Oxygen Demand	E-10107
Chloride	16887-00-6
Hardness	E-11778
Nitrate	14797-55-8
Nitrite	14797-65-0
Perchlorate	14797-73-0
pH	NA
Specific Conductance	NA
Sulfate	14808-79-8
Total Dissolved Solids (TDS)	E-10173
Total Organic Carbon	E-10195
Total Suspended Solids (TSS)	E-10173
EPH	
C11-C22 Aromatics	STL00058
C19-C36 Aliphatics	STL00087
C9-C18 Aliphatics	STL00306
VPH	
C5-C8 Aliphatics	STL00202
C9-C12 Aliphatics	STL00191
C9-C10 Aromatics	STL00133
Specialty Analytes	
Diphenylamine	122-39-4
Acetaldehyde	75-07-0
Formaldehyde	50-00-0
Hydrazine	302-01-2
Kempore ®	123-77-3
N,N-Dimethylformamide (DMF)	68-12-2
N-nitrosodimethylamine	62-75-9
Nonylphenol	25154-52-3
Opex ®	101-25-7
Phthalic anhydride	85-44-9

* Analyte is on the Massachusetts Contingency Plan list.

NA = Not applicable
CASRN = Chemical Abstract Services Registry Number

Prepared by / Date: MH 8/1/2008
Checked by / Date: MJM 10/15/2008
Revised by / Date: MH 1/5/2008

Table 3.2-1
Proposed Background Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location ID	Sample ID	Proposed Analyses						
		VOCs	SVOCs	Metals	Ammonia	Chloride	Sulfate	TOC
BS021REF	BS021REF	X	X	X	X	X	X	X
SSBK-015/SSBK-102	SS015XXBKX	X	X	X	X	X	X	X
SSBK-016/SSBK-105	SS016XXBKX	X	X	X	X	X	X	X
SSBK-017/SSBK-101	SS017XXBKX	X	X	X	X	X	X	X
SSBK-018/SSBK-103	SS018XXBKX	X	X	X	X	X	X	X
SSBK-019/SSBK-104	SS019XXBKX	X	X	X	X	X	X	X

Prepared by / Date: BJR 08/06/09
Checked by / Date: MH 08/12/09

Table 3.2-2
Proposed Background Surface Water and Sediment Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location ID	Sample ID	Proposed Analyses				
		VOCs	SVOCs	Metals	Inorganics[1]	Physical/Field Parameters[2]
SURFACE WATER						
SDBK-001	SW001XXBKX	X	X	X	X	X
SDBK-002	SW002XXBKX	X	X	X	X	X
SDBK-003	SW003XXBKX	X	X	X	X	X
SDBK-004	SW004XXBKX	X	X	X	X	X
SDBK-014	SW014XXBKX	X	X	X	X	X
SEDIMENT						
SDREF-012	BS012REF	X	X	X	X	X
SDBK-001	SD001XXBKX	X	X	X	X	X
SDBK-002	SD002XXBKX	X	X	X	X	X
SDBK-003	SD003XXBKX	X	X	X	X	X
SDBK-004	SD004XXBKX	X	X	X	X	X
SDBK-014	SD014XXBKX	X	X	X	X	X

[1] Inorganics for sediment include: ammonia, chloride, and sulfate. Inorganics for surface water include: ammonia, chloride, sulfate, nitrate/nitrite, and bromide.

[2] Physical/Field Parameters include hardness, pH, turbidity, total organic carbon, total suspended solids, dissolved oxygen, and percent solids.

Prepared by / Date: BJR 08/06/09
Checked by / Date: MH 08/12/09

Table 4.1-1
Proposed Surface Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location	Location ID	Area	Proposed Analyses: VOCs	SVOCs	NDMA	EPH/VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyd	Hydrazine	Diphenylamine	PCBs	Metals	Hexavalent Chromium	Ammonia	Chloride	Sulfate	TOC
AREA A1																		
A1-Prop1	SB-435	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	
A1-Prop2	SS-411	Perimeter Location	X	X									X		X	X	X	
A1-Prop3	SB-448	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	X
A1-Prop4	SB-453	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	
A1-Prop5	SS-415	Perimeter Location	X	X									X		X	X	X	
AREA A2																		
A2-Prop1	SB-449	North of West Warehouse	X	X	X		X	X	X	X	X	X	X		X	X	X	
A2-Prop2	SB-454	North of East Warehouse	X	X									X		X	X	X	
A2-Prop3	SB-456	West Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	
A2-Prop4	SB-457	East Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	
A2-Prop5	SB-459	East of East Warehouse	X	X	X		X	X	X	X	X	X	X		X	X	X	X
A2-Prop6	SS-416	Transformer 4	X	X								X	X	X	X	X	X	
A2-Prop7	SB-461	Transformer 4										X						
A2-Prop9	SB-466	South of West Warehouse	X	X									X		X	X	X	X
A2-Prop10	SB-469	Former Wastewater Treatment Plant	X	X									X	X	X	X	X	
A2-Prop11	SB-470	Former Wastewater Treatment Plant	X	X									X	X	X	X	X	
A2-Prop12	SB-472	Former Acid Pits-Near Containment Area	X	X	X		X	X	X	X	X	X	X		X	X	X	
AREA A3																		
A3-Prop1	SB-458	Outside Plant D	X	X	X		X	X	X	X	X		X		X	X	X	
A3-Prop2	SB-460	Plant D	X	X			X						X		X	X	X	
A3-Prop3	SB-463	Near Hx Hydrazine tank location	X	X						X			X		X	X	X	
A3-Prop4	SB-464	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	
A3-Prop5	SB-462	Plant D	X	X									X		X	X	X	
A3-Prop6	SB-465	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	X
A3-Prop7	SS-417	Transformer 5	X	X								X	X		X	X	X	
A3-Prop8	SB-467	Transformer 5										X						
A3-Prop10	SB-468	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	
A3-Prop11	SB-471	South of Hx Hydrazine Tank	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A4																		
A4-Prop1	SB-433	North of C-2, Boiler room	X	X									X		X	X	X	
A4-Prop2	SS-409	Transformer 2	X	X								X	X		X	X	X	
A4-Prop3	SS-410	Transformer 2										X						
A4-Prop4	SB-437	Plant C-2	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop5	SB-438	Maintenance Shop	X	X									X		X	X	X	
A4-Prop6	SB-439	Boiler House	X	X									X		X	X	X	
A4-Prop7	SB-440	UST behind Boiler House	X	X		X							X		X	X	X	
A4-Prop8	SB-441	UST behind Boiler House	X	X		X							X		X	X	X	
A4-Prop9	SB-442	Historical Surface Water Feature between Plant B tank farm and Plant D tank farm	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop10	SB-445	Outside Plant C-3	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop11	SB-446	Stockroom	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop12	SB-447	UST behind Boiler House	X	X		X							X		X	X	X	X
A4-Prop13	SB-452	Historical Surface Water Feature between Plant B tank farm and Plant D tank farm	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop14	SB-450	Shed, near Plant C-3	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop15	SB-451	Outside Boiler House	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop16	SB-455	Urea Silo													X			
A4-Prop17	SS-412	Transformer 3	X	X								X	X		X	X	X	
A4-Prop18	SS-413	Transformer 3										X						
A4-Prop19	SS-414	Perimeter Location	X	X									X		X	X	X	
AREA A5																		
A5-Prop1	SB-415	North of Plant A	X	X									X		X	X	X	
A5-Prop2	SB-418	Outside Plant A	X	X					X				X		X	X	X	
A5-Prop3	SB-419	Plant A	X	X	X		X	X	X		X		X		X	X	X	
A5-Prop4	SB-426	North of Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	X
A5-Prop5	SB-431	Plant C-1	X	X						X			X		X	X	X	
A5-Prop6	SB-432	Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	
A5-Prop7	SB-436	Plant C-1	X	X						X			X		X	X	X	
A5-Prop8	SB-443	Plant C-1	X	X	X		X	X		X	X		X		X	X	X	
A5-Prop9	SB-444	South of Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	

Table 4.1-1
Proposed Surface Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location	Location ID	Area	Proposed Analyses															
			VOCs	SVOCs	NDMA	EPH/VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyd	Hydrazine	Diphenylamine	PCBs	Metals	Hexavalent Chromium	Ammonia	Chloride	Sulfate	TOC
AREA A6																		
A6-Prop1	SS-400	Perimeter Location	X	X									X		X	X	X	
A6-Prop2	SS-402	Perimeter Location	X	X									X		X	X	X	
A6-Prop3	SB-400	Butler Building	X	X									X		X	X	X	
A6-Prop4	SB-403	Finished Product Storage 1	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop5	SB-406	Wetland west of bldgs	X	X									X		X	X	X	
A6-Prop6	SB-407	Between Finished Product Storage 1 and 2	X	X	X		X	X	X	X	X		X		X	X	X	X
A6-Prop7	SB-410	East of Finished Product Storage 2	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop8	SB-413	West of Finished Product Storage 2	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop9	SB-414	Finished Product Storage 2	X	X									X		X	X	X	
A6-Prop10	SS-407	Between Finished Product Storage 2 and 3	X	X									X		X	X	X	
A6-Prop11	SS-406	Perimeter Location	X	X									X		X	X	X	
A6-Prop12	SS-408	East of Finished Product Storage 3	X	X									X		X	X	X	
A6-Prop13	SB-422	Finished Product Storage 3	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop15	SB-430	South of Finished Product Storage 3	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A7																		
A7-Prop1	SS-401	Perimeter Location	X	X									X		X	X	X	
A7-Prop2	SB-401	Office/Laboratory Building	X	X									X		X	X	X	
A7-Prop3	SB-402	Office/Laboratory Building	X	X	X		X	X	X	X	X		X		X	X	X	X
A7-Prop4	SS-405	Perimeter Location	X	X									X		X	X	X	
A7-Prop5	SS-403	Transformer 1										X						
A7-Prop7	SS-404	Transformer 1	X	X								X	X		X	X	X	
A7-Prop8	SB-405	East of Office Bldg	X	X									X		X	X	X	
A7-Prop9	SB-408	Office/Laboratory Building	X	X									X		X	X	X	
A7-Prop10	SB-409	Northwest Leach Field	X	X	X		X	X	X	X	X		X		X	X	X	
A7-Prop11	SB-411	Pilot Plant/Laboratory	X	X	X		X	X	X	X	X		X		X	X	X	
A7-Prop12	SB-412	East of Pilot Plant	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A8																		
A8-Prop1	SB-416	Outside Plant B Production Area	X	X	X		X	X	X	X	X		X		X	X	X	
A8-Prop2	SB-417	Perimeter Location	X	X									X		X	X	X	
A8-Prop3	SB-421	Plant B Tile Field	X	X	X	X	X	X	X	X	X		X		X	X	X	X
A8-Prop4	SB-420	Plant B Production Area	X	X	X			X	X		X		X		X	X	X	
A8-Prop5	SB-423	Southwest corner of Plant B Production Area	X	X					X				X		X	X	X	
A8-Prop6	SB-424	Formaldehyde Tank, Near Plant B	X	X	X		X	X	X	X	X		X		X	X	X	
A8-Prop7	SB-425	Ammonia Tank, Near Plant B	X	X	X			X			X		X		X	X	X	
A8-Prop8	SB-427	Behind Plant B Treatment Building	X	X	X	X	X	X	X	X	X		X		X	X	X	
A8-Prop9	SB-428	Behind Plant B Treatment Building	X	X	X	X		X	X		X		X		X	X	X	
A8-Prop10	SB-434	Southwest corner of Plant B Treatment Building	X	X	X		X	X	X	X	X		X		X	X	X	
AREA B																		
B-Prop1	SS-419	Perimeter Location	X	X									X		X	X	X	
B-Prop2	SS-418	Open Space North of South Ditch	X	X									X		X	X	X	
B-Prop3	SB-473	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X	X	X	X	X	X
B-Prop4	SS-428	Perimeter Location	X	X									X		X	X	X	
B-Prop5	SS-427	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	
B-Prop6	SS-432	Perimeter Location	X	X									X		X	X	X	
B-Prop7	SS-436	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop8	SS-437	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop9	SS-440	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	
B-Prop10	SS-438	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop11	SS-439	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop12	SS-441	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X	X	X	X	X	X
B-Prop13	SS-443	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X	X	X	X	X	
B-Prop14	SS-445	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop15	SS-444	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop16	SS-446	Open Space North of South Ditch	X	X									X	X	X	X	X	
B-Prop17	SS-447	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X	X	X	X	X	

Table 4.1-1
Proposed Surface Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location	Location ID	Area	Proposed Analyses: VOCs	SVOCs	NDMA	EPH/VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyd	Hydrazine	Diphenylamine	PCBs	Metals	Hexavalent Chromium	Ammonia	Chloride	Sulfate	TOC
AREA C																		
C-Prop1	SS-433	CSL Access Road	X	X									X		X	X	X	
C-Prop2	SS-434	South of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	X
C-Prop3	SS-435	South of South Ditch	X	X									X		X	X	X	
C-Prop4	SS-448	CSL Access Road	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop5	SS-449	South of South Ditch	X	X									X		X	X	X	
C-Prop6	SS-450	South of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop7	SS-451	South of South Ditch	X	X									X		X	X	X	
C-Prop8	SS-442	South of South Ditch	X	X									X		X	X	X	
C-Prop9	SS-452	CSL Access Road	X	X									X		X	X	X	
C-Prop10	SS-453	South of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop11	SS-454	South of South Ditch	X	X									X		X	X	X	
C-Prop12	SS-455	South of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	X
C-Prop13	SS-456	Wetland West of Calcium Sulfate Landfill	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop14	SS-457	CSL Access Road	X	X	X		X	X	X	X	X		X		X	X	X	X
C-Prop15	SS-458	Wetland West of Calcium Sulfate Landfill	X	X									X		X	X	X	
C-Prop16	SS-460	South of South Ditch	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop17	SS-459	Wetland West of Calcium Sulfate Landfill	X	X	X		X	X	X	X	X		X		X	X	X	
C-Prop18	SS-461	Wetland West of Calcium Sulfate Landfill	X	X									X		X	X	X	
AREA D																		
D-Prop1	SS-420	Containment Area	X	X	X		X	X	X	X	X		X		X	X	X	
D-Prop2	SS-421	Containment Area	X	X									X		X	X	X	
D-Prop3	SS-422	Containment Area	X	X	X		X	X	X	X	X		X		X	X	X	
D-Prop4	SS-423	Containment Area	X	X									X		X	X	X	
D-Prop5	SS-426	Containment Area	X	X									X		X	X	X	
D-Prop6	SS-424	Containment Area	X	X	X		X	X	X	X	X		X		X	X	X	X
D-Prop7	SS-425	Containment Area	X	X									X		X	X	X	
D-Prop8	SS-430	Containment Area	X	X									X		X	X	X	
D-Prop9	SS-431	Containment Area	X	X	X		X	X	X	X	X		X		X	X	X	
D-Prop10	SS-429	Containment Area	X	X	X		X	X	X	X	X		X		X	X	X	

Prepared by / Date: MH 04/08/2009
Checked by / Date: BJR 04/09/2009

Table 4.2-1
Proposed Subsurface Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location	Location ID	Area	Proposed Analyses: VOCs	SVOCs	NDMA	EPH/VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyde	Hydrazine	Diphenylamine	PCBs	Metals	Hexavalent Chromium	Ammonia	Chloride	Sulfate	TOC
AREA A1																		
A1-Prop1	SB-435	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	
A1-Prop3	SB-448	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	X
A1-Prop4	SB-453	Former Lake Poly Area	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A2																		
A2-Prop1	SB-449	North of West Warehouse	X	X									X	X	X	X	X	
A2-Prop2	SB-454	North of East Warehouse	X	X									X	X	X	X	X	
A2-Prop3	SB-456	West Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	
A2-Prop4	SB-457	East Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	
A2-Prop5	SB-459	East of East Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	X
A2-Prop8	SB-461	Southeast of East Warehouse	X	X									X	X	X	X	X	
A2-Prop9	SB-466	South of West Warehouse	X	X	X		X	X	X	X	X		X	X	X	X	X	X
A2-Prop10	SB-469	Former Wastewater Treatment Plant	X	X									X	X	X	X	X	
A2-Prop11	SB-470	Former Wastewater Treatment Plant	X	X									X	X	X	X	X	
A2-Prop12	SB-472	Former Acid Pits-Near Containment Area	X	X	X		X	X	X	X	X	X	X	X	X	X	X	
AREA A3																		
A3-Prop1	SB-458	Outside Plant D	X	X	X			X	X		X		X		X	X	X	
A3-Prop2	SB-460	Plant D	X	X			X						X		X	X	X	
A3-Prop3	SB-463	Near Hx Hydrazine tank location	X	X						X			X		X	X	X	
A3-Prop4	SB-464	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	
A3-Prop5	SB-462	Plant D	X	X									X		X	X	X	
A3-Prop6	SB-465	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	X
A3-Prop9	SB-467	South of Plant D	X	X								X	X		X	X	X	
A3-Prop10	SB-468	Plant D Tank Farm	X	X	X		X	X	X	X	X		X		X	X	X	
A3-Prop11	SB-471	South of Hx Hydrazine Tank	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A4																		
A4-Prop1	SB-433	North of C-2 and Boiler House	X	X									X		X	X	X	
A4-Prop4	SB-437	Plant C-2	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop5	SB-438	Maintenance Shop	X	X									X		X	X	X	
A4-Prop6	SB-439	Boiler House	X	X									X		X	X	X	
A4-Prop7	SB-440	UST behind Boiler House	X	X		X							X		X	X	X	
A4-Prop8	SB-441	UST behind Boiler House	X	X		X							X		X	X	X	
A4-Prop9	SB-442	Historical Surface Water Feature between Plant B tank farm and Plant D tank farm	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop10	SB-445	Outside Plant C-3	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop11	SB-446	Stockroom	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop12	SB-447	UST behind Boiler House	X	X		X							X		X	X	X	X
A4-Prop13	SB-452	Historical Surface Water Feature between Plant B tank farm and Plant D tank farm	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop14	SB-450	Shed, near Plant C-3	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop15	SB-451	Outside Boiler House	X	X	X		X	X	X	X	X		X		X	X	X	
A4-Prop16	SB-455	Urea Silo	X	X									X		X	X	X	

Table 4.2-1
Proposed Subsurface Soil Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location	Location ID	Area	Proposed Analyses															
			VOCs	SVOCs	NDMA	EPH/VPH	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyde	Hydrazine	Diphenylamine	PCBs	Metals	Hexavalent Chromium	Ammonia	Chloride	Sulfate	TOC
AREA A5																		
A7-Prop10	SB-409	Northwest Leach Field	X	X	X		X	X	X	X	X		X		X	X	X	
A5-Prop2	SB-418	Outside Plant A	X	X					X				X		X	X	X	
A5-Prop3	SB-419	Plant A	X	X	X		X	X	X	X	X		X		X	X	X	
A5-Prop4	SB-426	North of Plant C-1	X	X	X		X	X		X	X		X		X	X	X	X
A5-Prop5	SB-431	Plant C-1	X	X						X			X		X	X	X	
A5-Prop6	SB-432	Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	
A5-Prop7	SB-436	Plant C-1	X	X						X			X		X	X	X	
A5-Prop8	SB-443	Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	
A5-Prop9	SB-444	South of Plant C-1	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A6																		
A6-Prop3	SB-400	Butler Building	X	X									X		X	X	X	
A6-Prop4	SB-403	Finished Product Storage 1	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop5	SB-406	Wetland west of bldgs	X	X									X		X	X	X	
A6-Prop6	SB-407	Between Finished Product Storage 1 and 2	X	X	X		X	X	X	X	X		X		X	X	X	X
A6-Prop7	SB-410	East of Finished Product Storage 2	X	X	X		X	X	X	X	X		X		X	X	X	
A7-Prop11	SB-411	Pilot Plant/Laboratory	X	X	X		X	X	X	X	X		X		X	X	X	
A7-Prop12	SB-412	East of Pilot Plant	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop13	SB-422	Finished Product Storage 3	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop14	SB-429	West of railroad	X	X									X		X	X	X	
A6-Prop15	SB-430	South of Finished Product Storage 3	X	X	X		X	X	X	X	X		X		X	X	X	
AREA A7																		
A7-Prop2	SB-401	Office/Laboratory Building	X	X									X		X	X	X	
A7-Prop3	SB-402	Office/Laboratory Building	X	X	X		X	X	X	X	X		X		X	X	X	X
A7-Prop6	SB-404	West of Office Bldg	X	X	X		X	X	X	X	X	X	X		X	X	X	
A7-Prop8	SB-405	East of Office Bldg	X	X									X		X	X	X	
A7-Prop9	SB-408	Office/Laboratory Building	X	X									X		X	X	X	
A6-Prop8	SB-413	West of Finished Product Storage 2	X	X	X		X	X	X	X	X		X		X	X	X	
A6-Prop9	SB-414	Finished Product Storage 2	X	X									X		X	X	X	
A5-Prop1	SB-415	North of Plant A	X	X									X		X	X	X	
AREA A8																		
A8-Prop1	SB-416	Outside Plant B Production Area	X	X	X		X	X	X	X	X		X		X	X	X	
A8-Prop2	SB-417	Northeast corner of tx bldg	X	X									X		X	X	X	
A8-Prop3	SB-421	Plant B Tile Field	X	X	X	X	X	X	X	X	X		X		X	X	X	X
A8-Prop4	SB-420	Plant B Production Area	X	X	X		X	X	X	X	X		X		X	X	X	
A8-Prop5	SB-423	Southwest corner of Plant B Production Area	X	X									X		X	X	X	
A8-Prop6	SB-424	Formaldehyde Tank, Near Plant B	X	X	X			X	X		X		X		X	X	X	
A8-Prop7	SB-425	Ammonia Tank, Near Plant B	X	X	X		X	X	X	X	X		X		X	X	X	
A8-Prop8	SB-427	Behind Plant B Treatment Building	X	X	X	X		X	X		X		X		X	X	X	
A8-Prop9	SB-428	Behind Plant B Treatment Building	X	X	X	X		X	X		X		X		X	X	X	
A8-Prop10	SB-434	Southwest corner of tx bldg	X	X	X		X	X	X	X	X		X		X	X	X	
AREA B																		
B-Prop3	SB-473	Open Space North of South Ditch	X	X	X		X	X	X	X	X		X	X	X	X	X	X

Prepared by / Date: MH 04/08/2009
Checked by / Date: BJR 04/09/2009

Table 4.3-1
Summary of Analytical Data for Surface Water - OU1 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Surface Water Background
Semivolatile Organics (mg/L)													
bis(2-EthylHexyl)phthalate	11	/	20	55%	0.01	:	0.01	0.0024	-	0.22	NP-1	2.54E-02	**0.004**
N-Nitrosodimethylamine	3	/	3	100%				0.0000057	-	0.00021	SD-17	8.59E-05	
Metals, Total (mg/L)													
Aluminum, Total	36	/	36	100%				0.106	-	60	NP-2	3.48E+00	219
Antimony, Total	1	/	3	33%	0.02	:	0.02	0.069	-	0.069	NP-2	2.97E-02	ND
Arsenic, Total	1	/	3	33%	0.01	:	0.01	0.041	-	0.041	NP-2	1.70E-02	0.247
Barium, Total	2	/	3	67%	0.01	:	0.01	0.018	-	0.045	NP-2	2.27E-02	0.989
Beryllium, Total	1	/	3	33%	0.002	:	0.002	0.0097	-	0.0097	NP-2	3.90E-03	**0.0084**
Cadmium, Total	1	/	3	33%	0.001	:	0.001	0.0014	-	0.0014	NP-2	8.00E-04	0.0118
Calcium, Total	6	/	6	100%				31	-	86	SDSW-C	5.48E+01	**30.7**
Chromium, Total	177	/	190	93%	0.005	:	0.01	0.007	-	11	SDSW-C	3.40E-01	**0.219**
Cobalt, Total	1	/	3	33%	0.01	:	0.01	0.014	-	0.014	NP-2	8.00E-03	0.168
Copper, Total	1	/	3	33%	0.02	:	0.02	0.25	-	0.25	NP-2	9.00E-02	0.544
Iron, Total	36	/	36	100%				0.37	-	81	NP-2	3.51E+00	343
Lead, Total	1	/	3	33%	0.01	:	0.01	0.028	-	0.028	NP-2	1.27E-02	1.37
Magnesium, Total	3	/	3	100%				3	-	7.7	NP-1	4.90E+00	20
Manganese, Total	3	/	3	100%				0.02	-	0.39	NP-1	1.93E-01	12.3
Nickel, Total	1	/	3	33%	0.02	:	0.02	0.034	-	0.034	NP-2	1.80E-02	0.134
Potassium, Total	3	/	3	100%				1.7	-	2	NP-2	1.83E+00	21.7
Sodium, Total	15	/	15	100%				8.7	-	140	SDSW-A SDSW-E	9.64E+01	**126**
Strontium, Total	3	/	3	100%				0.096	-	0.13	NP-1	1.15E-01	
Vanadium, Total	1	/	3	33%	0.01	:	0.01	0.038	-	0.038	NP-2	1.60E-02	0.264
Zinc, Total	1	/	3	33%	0.05	:	0.05	0.17	-	0.17	NP-2	7.33E-02	2.94
Metals, Filtered (mg/L)													
Aluminum, Filtered	83	/	141	59%	0.05	:	0.1	0.025	-	4.63	SD-17	3.15E-01	
Calcium, Filtered	1	/	1	100%				31	-	31	NP-2	3.10E+01	
Chromium, Filtered	93	/	153	61%	0.005	:	0.01	0.005	-	1.33	SD-17	6.16E-02	
Magnesium, Filtered	1	/	1	100%				2.4	-	2.4	NP-2	2.40E+00	
Manganese, Filtered	1	/	1	100%				0.026	-	0.026	NP-2	2.60E-02	
Potassium, Filtered	1	/	1	100%				1.7	-	1.7	NP-2	1.70E+00	
Sodium, Filtered	13	/	13	100%				20	-	160	SDSW-A	1.13E+02	
Strontium, Filtered	1	/	1	100%				0.09	-	0.09	NP-2	9.00E-02	

Table 4.3-1
Summary of Analytical Data for Surface Water - OU1 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Surface Water Background
Inorganics (mg/L)													
Bicarbonate alkalinity as CaCO3	23	/	23	100%				16	-	150	NP-2 NP-3	4.23E+01	
Chemical Oxygen Demand (COD)	1	/	3	33%	20	:	20	28	-	28	NP-2	1.60E+01	
Chloride	177	/	178	99%	1	:	1	18	-	540	ISCO2	1.17E+02	**110**
Hardness by Calculation	2	/	2	100%				77	-	110	ISCO1	9.35E+01	**87**
Nitrate & Nitrite as N	82	/	85	96%	0.05	:	0.05	0.063	-	6.9	ISCO2	1.33E+00	
Nitrate as N	70	/	70	100%				0.088	-	8.6	NP-2	1.36E+00	
Nitrite as N	26	/	69	38%	0.01	:	0.1	0.01	-	0.18	SDSW-C	2.77E-02	
Nitrogen, Ammonia	154	/	154	100%				0.26	-	200	ISCO1	4.63E+01	ND
Nitrogen, Total Kjeldahl as N	2	/	3	67%	1	:	1	1.1	-	79	NP-1	2.69E+01	
Odor **(TON)**	3	/	3	100%				1	-	1	NP-1 NP-2 NP-3	1.00E+00	
pH **(pH units)**	43	/	43	100%				5.47	-	7.92	NP-2	6.39E+00	
Phosphate, Total as P	3	/	3	100%				0.68	-	0.95	NP-2 NP-3	8.40E-01	
Specific Conductance **(umhos/cm)**	122	/	122	100%				152	-	4780	SD-17	9.94E+02	
Sulfate as SO4	186	/	187	99%	20	:	20	9.5	-	1400	ISCO2	2.84E+02	**24**
Total Dissolved Solids (TDS)	3	/	3	100%				430	-	750	NP-1	5.40E+02	**280**
Total Organic Carbon (TOC)	3	/	3	100%				1.3	-	35	NP-2	1.40E+01	
Total Suspended Solids	2	/	3	67%	5	:	5	7.5	-	320	NP-2	1.10E+02	
Turbidity **(NTU)**	3	/	3	100%				0.63	-	12	NP-2	4.84E+00	
Field Measurements (mg/L)													
Dissolved Oxygen	112	/	112	100%				2.4	-	15.26	PZ-20	8.60E+00	
Hardness as CaCO3	4	/	4	100%				74	-	150	ISCO2 PZ-16R SD-17	1.31E+02	
Nitrogen, Ammonia	106	/	112	95%	0.1	:	0.1	2.5	-	150	PZ-20	3.95E+01	
pH **(pH units)**	185	/	185	100%				4.2	-	7.8	PZ-17RR PZ-21	6.19E+00	
Specific Conductance **(umhos/cm)**	139	/	139	100%				200	-	6260	PZ-20	1.16E+03	

BOLD maximum concentration is greater than that background concentration
umhos/cm = microOhms per centimeter
mg/L = milligrams per Liter
ND = Not detected
NTU = Nephelometric Turbidity Units
SQL = Sample Quantitation Limit

Prepared by / Date: KJC 08/13/07
Checked by / Date: MH 08/14/07
Revised by / Date: KJC 04/03/08

Table 4.3-2
Proposed Surface Water and Sediment Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

		Proposed Analyses															
Proposed Sample Location		**VOCs**	**SVOCs**	**NDMA**	**Opex®**	**Kempore®**	**EPH/VPH**	**Nonyl phenol**	**DMF**	**Phthalic anhydride**	**Acetaldehyde/ Formaldehyde**	**Hydrazine**	**Diphenylamine**	**Metals**	**Hexavalent Chromium**	**Inorganics[1]**	**Physical/Field Parameters[2]**
	OU1																
SURFACE WATER																	
ISCO-1	South Ditch	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
PZ-17RR	South Ditch	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
PZ-16RR	South Ditch	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
SW-Prop1	South Ditch	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
ISCO-2	South Ditch	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
SEDIMENT																	
SD-SD2	South Ditch	X	X	X			X		X	X	X	X	X	X	X	X	X
SD-SD3	South Ditch	X	X	X			X		X	X	X	X	X	X	X	X	X
SDSW-E	South Ditch	X	X	X			X		X	X	X	X	X	X	X	X	X
SD-Prop1	South Ditch	X	X	X			X		X	X	X	X	X	X	X	X	X
ISCO-2	South Ditch	X	X	X			X		X	X	X	X	X	X	X	X	X
	OU2																
SURFACE WATER																	
MMB-SW/SD-1	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-2	Maple Meadow Brook	X	X	X	X	X					X	X	X	X		X	X
MMB-SW/SD-3	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-4	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-5	Maple Meadow Brook	X	X	X	X	X					X	X	X	X		X	X
MMB-SW/SD-6	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-8	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-8A	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-9	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-10	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
MMB-SW/SD-11	Maple Meadow Brook	X	X	X							X	X	X	X		X	X
EDSD/SW0	East Ditch	X	X	X	X	X								X		X	X
EDSD/SW1 (EDBS5)	East Ditch	X	X	X	X	X								X		X	X
EDSD/SW2 (EDBS6)	East Ditch	X	X	X	X	X								X		X	X
EDSD/SW5 (EDBS11)	East Ditch	X	X	X	X	X								X	X	X	X
EDSD/SW8	East Ditch	X	X	X	X	X								X		X	X
OPWD-SD/SO/SW-S	Off-Property West Ditch	X	X	X	X	X								X	X	X	X
OPWD-Prop1	Off-Property West Ditch	X	X	X	X	X					X	X		X		X	X
OPWD-Prop2	Off-Property West Ditch	X	X	X	X	X					X	X		X		X	X
LB-SD/SW1	Landfill Brook	X	X											X		X	X
LB-SD/SW2	Landfill Brook	X	X											X		X	X
LB-SD/SW3	Landfill Brook	X	X											X		X	X

Table 4.3-2
Proposed Surface Water and Sediment Sampling and Analysis Program
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Proposed Sample Location		Proposed Analyses															
		VOCs	SVOCs	NDMA	Opex®	Kempore®	EPH/VPH	Nonyl phenol	DMF	Phthalic anhydride	Acetaldehyde/ Formaldehyde	Hydrazine	Diphenylamine	Metals	Hexavalent Chromium	Inorganics[1]	Physical/Field Parameters[2]
SEDIMENT																	
MMB-SW/SD-1	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-2	Maple Meadow Brook	X	X	X							X	X		X		X	X
MMB-SW/SD-3	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-4	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-5	Maple Meadow Brook	X	X	X							X	X		X		X	X
MMB-SW/SD-6	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-8	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-8A	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-9	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-10	Maple Meadow Brook	X	X								X	X		X		X	X
MMB-SW/SD-11	Maple Meadow Brook	X	X								X	X		X		X	X
EDSD/SW0	East Ditch	X	X											X		X	X
EDSD/SW1 (EDBS5)	East Ditch	X	X	X										X		X	X
EDSD/SW2 (EDBS6)	East Ditch	X	X	X										X		X	X
EDSD/SW5 (EDBS11)	East Ditch	X	X	X					X	X	X	X	X	X	X	X	X
EDSD/SW8	East Ditch	X	X	X					X	X	X	X	X	X		X	X
OPWD-SD/SO/SW-S	Off-Property West Ditch	X	X											X	X	X	X
OPWD-Prop1	Off-Property West Ditch	X	X	X							X	X		X		X	X
OPWD-Prop2	Off-Property West Ditch	X	X	X							X	X		X		X	X
LB-SD/SW1	Landfill Brook	X	X											X		X	X
LB-SD/SW2	Landfill Brook	X	X											X		X	X
LB-SD/SW3	Landfill Brook	X	X											X		X	X

Prepared by / Date: MH 04/14/2009
Checked by / Date: MJM 04/14/2009

[1] Inorganics for sediment include: ammonia, chloride, and sulfate. Inorganics for surface water include: ammonia, chloride, sulfate, nitrate/nitrite, and bromide.
[2] Physical/Field Parameters include hardness, pH, turbidity, total organic carbon, total suspended solids, dissolved oxygen, and percent solids.

Table 4.4-1
Summary of Analytical Data for Sediment - OU1 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Concentrations	Range of Detected Concentrations	Location of Maximum Detection	Average of All Samples	Maximum Detected Background Concentration
Volatile Organics (mg/Kg)							
2,4,4-Trimethyl-1-pentene	6 / 32	19%	0.008 : 0.98	0.088 - 5.4	WDW-C18	4.80E-01	ND
2,4,4-Trimethyl-2-Pentene	4 / 32	13%	0.008 : 0.98	0.022 - 2.3	WDW-C18	2.79E-01	ND
Acetone	3 / 44	7%	0.013 : 38	0.095 - 0.34	RSD-02	5.48E+00	**0.19**
Benzene	1 / 44	2%	0.007 : 1.9	4.4 - 4.4	RSD-02	3.74E-01	ND
Chlorobenzene	1 / 44	2%	0.007 : 1.9	0.11 - 0.11	RSD-02	2.77E-01	ND
Ethylbenzene	2 / 44	5%	0.007 : 1.9	0.26 - 0.54	WDW-C18	2.88E-01	ND
m,p-Xylene	1 / 35	3%	0.14 : 1.9	0.58 - 0.58	WDW-C18	3.57E-01	
Methylene Chloride	3 / 44	7%	0.007 : 1.9	0.66 - 1.1	WDW-C5	3.91E-01	**0.013**
Semivolatile Organics (mg/Kg)							
Benzo(b)fluoranthene	1 / 78	1%	0.36 : 440	3 - 3	WDW-27	5.97E+00	**0.77**
Benzoic Acid	1 / 96	1%	1.8 : 5700	0.11 - 0.11	BS011	1.71E+02	0.26
bis(2-EthylHexyl)phthalate	57 / 96	59%	0.39 : 54	0.26 - 24827	SDC-3	7.37E+02	**2**
Di-n-butylphthalate	5 / 96	5%	0.36 : 1100	0.016 - 263	WDW-C23	3.45E+01	ND
Fluoranthene	1 / 78	1%	0.36 : 440	6.1 - 6.1	WDW-27	6.01E+00	**1.2**
N-Nitrosodiphenylamine	3 / 96	3%	0.36 : 1100	0.13 - 2.6	WDW-C19	3.40E+01	ND
Phenanthrene	1 / 78	1%	0.36 : 440	3.2 - 3.2	WDW-27	5.97E+00	**0.46**
Pyrene	1 / 78	1%	0.36 : 440	4.2 - 4.2	WDW-27	5.99E+00	**1**
Polyaromatic Hydrocarbons (mg/Kg)							
Benzo(a)anthracene	3 / 3	100%		0.31 - 3.1	BS030	1.31E+00	
Benzo(a)pyrene	3 / 3	100%		0.032 - 0.099	BS030	6.03E-02	
Benzo(b)fluoranthene	2 / 3	67%	0.088 : 0.088	0.046 - 0.067	BS032	5.23E-02	
Benzo(g,h,i)perylene	3 / 3	100%		0.13 - 0.64	BS030	3.00E-01	
Benzo(k)fluoranthene	2 / 3	67%	0.088 : 0.088	0.014 - 0.025	BS032	2.77E-02	
Chrysene	3 / 3	100%		0.061 - 0.44	BS030	1.88E-01	
Dibenzo(a,h)anthracene	3 / 3	100%		0.028 - 0.26	BS030	1.12E-01	
Fluoranthene	3 / 3	100%		0.13 - 1.8	BS030	7.07E-01	
Indeno (1,2,3-cd) pyrene	1 / 3	33%	0.026 : 0.03	0.19 - 0.19	BS030	7.27E-02	
Phenanthrene	3 / 3	100%		0.038 - 0.1	BS030	6.47E-02	
Pyrene	3 / 3	100%		0.052 - 0.16	BS030	9.70E-02	
Pesticides/PCBs (mg/Kg)							
4,4'-DDT	1 / 12	8%	0.0061 : 0.54	0.062 - 0.062	BS030	8.76E-02	
Heptachlor	1 / 12	8%	0.011 : 0.54	0.00059 - 0.00059	BS011	8.31E-02	
Hexachlorobenzene	1 / 3	33%	0.011 : 0.013	0.037 - 0.037	BS030	1.63E-02	
Inorganics (mg/Kg)							
Aluminum, Total	65 / 65	100%		1100 - 23000	SD-SD2	6.34E+03	**20400**
Antimony, Total	1 / 23	4%	0.624 : 5.1	2 - 2	BS011	8.77E-01	ND
Arsenic, Total	17 / 51	33%	2 : 27	2.1 - 35	SDC-2	6.03E+00	44

Table 4.4-1
Summary of Analytical Data for Sediment - OU1 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Maximum Detected Background Concentration
Barium, Total	37	/	38	97%	19	:	19	3.4	-	90	SDC-5	2.83E+01	106
Beryllium, Total	8	/	23	35%	0.07	:	0.3	0.12	-	2.2	RSD-10	3.37E-01	ND
Cadmium, Total	13	/	60	22%	0.062	:	5	0.212	-	1.2	WDW-27	6.62E-01	ND
Calcium, Total	13	/	13	100%				130	-	1900	BS030	5.72E+02	4100
Chromium, Total	111	/	130	85%	6	:	19	1.7	-	10000	SDC-2	5.54E+02	**24.4**
Cobalt, Total	7	/	13	54%	0.6	:	2	2.2	-	8.7	BS030	2.63E+00	23.3
Copper, Total	11	/	13	85%	1	:	1	1.4	-	22	BS030	6.05E+00	58.3
Hexavalent Chromium, Total	6	/	19	32%	0.75	:	6.9	7.9	-	95	RSD-10	9.00E+00	**1.2**
Iron, Total	65	/	65	100%				210	-	92000	SD-SD2	9.51E+03	**34100**
Lead, Total	51	/	60	85%	3	:	9	2.5	-	110	WDW-16	2.29E+01	147
Magnesium, Total	13	/	13	100%				44	-	739	BS011	2.99E+02	3900
Manganese, Total	13	/	13	100%				4	-	87	BS030	2.73E+01	776
Mercury, Total	23	/	50	46%	0.06	:	0.3	0.045	-	1.8	SDC-3	3.01E-01	**0.54**
Nickel, Total	20	/	23	87%	1	:	2	2.1	-	18	BS030	7.45E+00	21.4
Potassium, Total	7	/	13	54%	99	:	1000	68	-	210	RSD-14	1.67E+02	980
Silver, Total	1	/	38	3%	0.6	:	27	0.877	-	0.877	SD-SD4	2.92E+00	ND
Sodium, Total	5	/	13	38%	65	:	510	100	-	3200	RSD-02	3.65E+02	**332**
Thallium, Total	1	/	23	4%	0.6	:	4	0.96	-	0.96	RSD-14	6.77E-01	3.6
Vanadium, Total	23	/	23	100%				1.9	-	80	RSD-14	1.59E+01	**32**
Zinc, Total	21	/	23	91%	3	:	4	3.3	-	2060	SD-SD2	1.18E+02	**379**
Nitrogen, Ammonia	4	/	4	100%				54	-	264	BS011	1.50E+02	897
pH	15	/	15	100%				6.26	-	7.42	SDC-3	6.92E+00	
Sulfide	0	/	3	0%	350	:	440					1.97E+02	
Field Measurements (pH units)													
pH	10	/	10	100%				6.16	-	6.98	SD-SD4	6.51E+00	
EPH (mg/Kg)													
Chrysene	1	/	15	7%	0.5	:	23	1.7	-	1.7	SDC-5	4.81E+00	
Fluoranthene	1	/	15	7%	0.5	:	23	34	-	34	SDC-5	6.97E+00	
Indeno (1,2,3-cd) pyrene	1	/	15	7%	0.5	:	23	19	-	19	SDC-5	5.97E+00	
C11-C22 Aromatics (FID)	15	/	15	100%				41	-	21000	SDC-4	7.78E+03	
C11-C22 Aromatics, Unadjusted	15	/	15	100%				41	-	21000	SDC-4	7.78E+03	
C19-C36 Aliphatics (PID)	15	/	15	100%				47	-	16000	SDC-3	5.46E+03	
C9-C18 Aliphatics (FID)	15	/	15	100%				9.5	-	3100	SDC-3	1.05E+03	
EPH Concentration (Total)	15	/	15	100%				110	-	39000	SDC-3	1.43E+04	

BOLD maximum concentration is greater than that background concentration

EPH = Extractable Petroleum Hydrocarbon
FID = Flame Ionization Detector
mg/Kg = milligrams per kilogram
ND = Not detected

PCB = Polychlorinated biphenyl
PID = Photoionization Detector
SQL = Sample Quantitation Limit

Prepared by / Date: KJC 08/15/07
Checked by / Date: MH 08/17/07
Revised by / Date: KJC 04/03/08

Table 4.5-1
Vapor Intrusion Monitoring Wells
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Well ID				
GW-101	GW-305	GW-403S	GW-54S	GW-74S
GW-10S	GW-306	GW-40S	GW-55S	GW-76S
GW-13	GW-308	GW-42S	GW-56S	GW-77S
GW-14	GW-31D	GW-43S	GW-58S	GW-79S
GW-17D	GW-31S	GW-45S	GW-60S	GW-80S
GW-17S	GW-32S	GW-47	GW-62S	GW-81D
GW-202S	GW-33S	GW-48S	GW-66S	GW-CA1
GW-28D	GW-34SR	GW-5	GW-67S	SL-2
GW-28S	GW-39	GW-50S	GW-68D	SL-3
GW-29S	GW-3S	GW-51D	GW-69S	SL-6
GW-301	GW-4	GW-51S	GW-6S	
GW-302	GW-400S	GW-52D	GW-70S	
GW-303	GW-401S	GW-52S	GW-71S	
GW-304	GW-402S	GW-53S	GW-72D	

Prepared By / Date: SEH 04/28/09
Checked By / Date: BJR 4/29/09

Table 4.5-2
Vapor Intrusion Sampling Locations Grouped By Area
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Area	Use	Monitoring Well
On-Property North of the South Ditch	Future Industrial/Commercial	GW-3S
		GW-6S
		GW-13
		GW-14
		GW-17D
		GW-17S
		GW-28S
		GW-28D
		GW-29S
		GW-32S
		GW-33S
		GW-34SR
		GW-50S
		GW-51D
		GW-51S
		GW-52D
		GW-52S
		GW-53S
		GW-54S
		GW-79S
		GW-101
		GW-202S
		GW-301
		GW-302
		GW-303
		GW-304
		GW-305
		GW-306
		GW-308
		GW-CA1
Jewel Drive	Industrial/Commercial	GW-10S
		GW-28D
		GW-28S
		GW-29S
		GW-39
		GW-42S
		GW-43S
		GW-47
		GW-68D
		GW-69S
		GW-76S
		GW-77S
		GW-81D
		GW-CA1

Table 4.5-2
Vapor Intrusion Sampling Locations Grouped By Area
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Area	Use	Monitoring Well
Eames Street	Industrial/Commercial	GW-31D
		GW-31S
		GW-32S
		GW-47
		GW-70S
Main Street	Industrial/Commerical/Residential	GW-45S
		GW-58S
		GW-60S
		GW-62S
		GW-66S
		GW-67S
		GW-70S
		GW-71S
Woburn Street/New Boston Street	Industrial/Commercial	GW-4
		GW-5
		GW-50S
		GW-74S
		GW-80S
		GW-401S
		GW-402S
		GW-403S
Cook Avenue/Border Avenue	Residential	GW-40S
		GW-72D
		SL-2
		SL-3
		SL-6

Prepared By / Date: SEH 04/28/09
Checked By / Date: BJR 4/29/09

Table 5.1-1
Summary of Analytical Data for Surface Water - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Concentrations	Range of Detected Concentrations	Location of Maximum Detection	Average of All Samples	Surface Water Background
Volatile Organics (mg/L)							
1,1,1-Trichloroethane (TCA)	13 / 27	48%	0.001 : 0.001	0.0007 - 0.018	EDSD/SW1 (EDBS5)	2.58E-03	**0.004**
1,1-Dichloroethane	6 / 27	22%	0.001 : 0.001	0.00053 - 0.0026	EDSD/SW1 (EDBS5)	6.46E-04	ND
1,1-Dichloroethene	3 / 27	11%	0.001 : 0.005	0.0006 - 0.002	EDSD/SW1 (EDBS5)	6.89E-04	ND
2,4,4-Trimethyl-1-pentene	4 / 27	15%	0.001 : 0.005	0.0015 - 0.0065	EDSD/SW2 (EDBS6)	1.04E-03	ND
2,4,4-Trimethyl-2-Pentene	1 / 27	4%	0.001 : 0.005	0.00084 - 0.00084	EDSD/SW2 (EDBS6)	5.87E-04	ND
Benzene	2 / 27	7%	0.001 : 0.005	0.00059 - 0.0006	EDSD/SW3 (EDBS8)	5.81E-04	ND
Chlorobenzene	2 / 27	7%	0.001 : 0.005	0.00055 - 0.00077	EDSD/SW4 (EDBS10)	5.86E-04	ND
Chloroethane	2 / 27	7%	0.002 : 0.01	0.003 - 0.003	EDSD/SW1 (EDBS5)	1.30E-03	ND
cis-1,2-Dichloroethene	18 / 27	67%	0.001 : 0.005	0.00083 - 0.021	EDSD/SW4 (EDBS10)	5.31E-03	
Ethylbenzene	2 / 27	7%	0.001 : 0.005	0.0006 - 0.0009	EDSD/SW4 (EDBS10)	5.93E-04	ND
m,p-Xylene	10 / 27	37%	0.001 : 0.001	0.00054 - 0.0034	EDSD/SW1 (EDBS5)	7.01E-04	
Methyl-t-butyl ether (MTBE)	9 / 27	33%	0.001 : 0.005	0.00056 - 0.00095	EDSD/SW7	6.61E-04	
Tetrachloroethene (PCE)	5 / 27	19%	0.001 : 0.005	0.00052 - 0.001	EDSD/SW4 (EDBS10)	6.07E-04	0.004
Tetrahydrofuran	1 / 21	5%	0.01 : 0.05	0.011 - 0.011	EDSD/SW4 (EDBS10)	6.24E-03	
Toluene	17 / 27	63%	0.001 : 0.001	0.00098 - 0.24	EDSD/SW1 (EDBS5)	1.57E-02	**0.013**
Trichloroethene (TCE)	20 / 27	74%	0.001 : 0.005	0.0009 - 0.022	EDSD/SW4 (EDBS10)	4.39E-03	ND
Vinyl Chloride	2 / 27	7%	0.001 : 0.005	0.0017 - 0.002	EDSD/SW4 (EDBS10)	6.74E-04	ND
Semivolatile Organics (mg/L)							
N-Nitrosodimethylamine	26 / 134	19%	0.0000019 : 0.00003	0.000002 - 0.000087	OPWD-SW-N	4.34E-06	
Polyaromatic Hydrocarbons (mg/L)							
Acenaphthylene	1 / 18	6%	0.001 : 0.0015	0.00035 - 0.00035	EDSD/SW1 (EDBS5)	5.50E-04	
Anthracene	3 / 18	17%	0.00005 : 0.001	0.000013 - 0.000022	EDSD/SW5 (EDBS11)	2.85E-04	
Benzo(a)anthracene	4 / 18	22%	0.00013 : 0.001	0.000047 - 0.0022	EDSD/SW1 (EDBS5)	3.92E-04	
Benzo(a)pyrene	5 / 18	28%	0.00013 : 0.0002	0.000089 - 0.0021	EDSD/SW1 (EDBS5)	2.47E-04	
Benzo(b)fluoranthene	6 / 18	33%	0.00005 : 0.001	0.000054 - 0.0045	EDSD/SW1 (EDBS5)	5.64E-04	
Benzo(g,h,i)perylene	4 / 18	22%	0.0002 : 0.001	0.00034 - 0.0024	EDSD/SW1 (EDBS5)	4.50E-04	
Benzo(k)fluoranthene	6 / 18	33%	0.00005 : 0.001	0.000022 - 0.0023	EDSD/SW1 (EDBS5)	3.91E-04	
Chrysene	6 / 18	33%	0.00013 : 0.001	0.000083 - 0.0019	EDSD/SW1 (EDBS5)	4.46E-04	
Dibenzo(a,h)anthracene	2 / 18	11%	0.0003 : 0.0005	0.00014 - 0.0013	EDSD/SW1 (EDBS5)	2.63E-04	
Fluoranthene	4 / 18	22%	0.00013 : 0.001	0.000069 - 0.0017	EDSD/SW7	4.02E-04	
Fluorene	4 / 18	22%	0.00025 : 0.001	0.00012 - 0.007	EDSD/SW1 (EDBS5)	6.90E-04	
Indeno (1,2,3-cd) pyrene	6 / 18	33%	0.00013 : 0.0005	0.000059 - 0.0019	EDSD/SW1 (EDBS5)	3.00E-04	
Phenanthrene	9 / 18	50%	0.0001 : 0.001	0.000014 - 0.0018	EDSD/SW1 (EDBS5) EDLBSW1	5.79E-04	
Pyrene	5 / 18	28%	0.00025 : 0.001	0.00021 - 0.0054	EDSD/SW1 (EDBS5)	7.59E-04	
Herbicides (mg/L)							
DCPA	1 / 6	17%	0.00015 : 0.00016	0.00051 - 0.00051	EDSD/SW6	1.49E-04	

Table 5.1-1
Summary of Analytical Data for Surface Water - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Surface Water Background
Metals, Total (mg/L)													
Aluminum, Total	49	/	59	83%	0.05	:	0.1	0.074	-	19.2	EDSD/SW2 (EDBS6)	1.33E+00	219
Antimony, Total	1	/	42	2%	0.003	:	0.03	0.003	-	0.003	EDSD/SW1 (EDBS5)	4.02E-03	ND
Arsenic, Total	19	/	27	70%	0.002	:	0.002	0.0022	-	0.227	EDSD/SW2 (EDBS6)	1.60E-02	0.247
Barium, Total	27	/	27	100%				0.025	-	0.487	EDSD/SW2 (EDBS6)	5.61E-02	0.989
Cadmium, Total	4	/	42	10%	0.0005	:	0.002	0.001	-	0.007	EDSD/SW2 (EDBS6)	7.74E-04	0.0118
Calcium, Total	59	/	59	100%				3.35	-	68	EDLBSW1	3.27E+01	**30.7**
Chromium, Total	44	/	85	52%	0.005	:	0.01	0.006	-	0.91	ISCO3	3.58E-02	**0.219**
Cobalt, Total	3	/	42	7%	0.01	:	0.1	0.011	-	0.018	EDSD/SW2 (EDBS6)	7.00E-03	0.168
Copper, Total	9	/	42	21%	0.01	:	0.02	0.016	-	0.346	EDSD/SW2 (EDBS6)	1.86E-02	0.544
Iron as Fe+2	14	/	15	93%	0.2	:	0.2	0.57	-	6.92	OPWD-SW-S	3.15E+00	
Iron as Fe+3	12	/	15	80%	0.2	:	0.2	0.23	-	10.5	OPWD-SW-WS	2.48E+00	
Iron, Total	59	/	59	100%				0.056	-	360	EDSD/SW2 (EDBS6)	1.26E+01	**343**
Lead, Total	10	/	42	24%	0.001	:	0.005	0.0022	-	0.113	EDSD/SW2 (EDBS6)	6.51E-03	1.37
Magnesium, Total	42	/	42	100%				0.636	-	11	EDLBSW1	5.14E+00	20
Manganese, Total	42	/	42	100%				0.064	-	8.12	EDSD/SW2 (EDBS6)	8.83E-01	12.3
Mercury, Total	1	/	27	4%	0.0002	:	0.0002	0.00063	-	0.00063	EDSD/SW2 (EDBS6)	1.20E-04	0.0021
Nickel, Total	11	/	42	26%	0.005	:	0.02	0.007	-	0.065	EDSD/SW2 (EDBS6)	9.05E-03	0.134
Potassium, Total	45	/	59	76%	2	:	20	1.69	-	14	EDLBSW1	4.93E+00	21.7
Sodium, Total	59	/	59	100%				11.2	-	330	OPWD-SW-S	5.89E+01	**126**
Trivalent Chromium, Total	9	/	15	60%	0.01	:	0.01	0.011	-	0.057	EDSD/SW8	1.90E-02	
Vanadium, Total	2	/	27	7%	0.005	:	0.01	0.015	-	0.38	EDSD/SW2 (EDBS6)	1.83E-02	**0.264**
Zinc, Total	17	/	42	40%	0.025	:	0.1	0.031	-	1.48	EDSD/SW2 (EDBS6)	9.84E-02	2.94
Metals, Filtered (mg/L)													
Aluminum, Filtered	31	/	89	35%	0.05	:	0.1	0.049	-	0.839	ISCO3	9.67E-02	
Antimony, Filtered	4	/	140	3%	0.003	:	0.02	0.013	-	0.036	MMB-SW-2	5.23E-03	
Arsenic, Filtered	28	/	125	22%	0.001	:	0.01	0.001	-	0.0047	EDLBSW1	3.24E-03	
Barium, Filtered	124	/	125	99%	0.01	:	0.01	0.01	-	0.083	MMB-SW-6	3.10E-02	
Beryllium, Filtered	1	/	125	1%	0.001	:	0.002	0.000098	-	0.000098	MMB-SW-11	5.81E-04	
Calcium, Filtered	158	/	158	100%				2.5	-	71	EDLBSW1	2.64E+01	
Chromium, Filtered	16	/	173	9%	0.005	:	0.01	0.00084	-	0.378	ISCO3	7.03E-03	
Cobalt, Filtered	2	/	42	5%	0.01	:	0.02	0.013	-	0.019	OPWD-SW-WS	6.24E-03	
Copper, Filtered	5	/	42	12%	0.01	:	0.02	0.013	-	0.022	OPWD-SW-SDW	8.07E-03	
Iron, Filtered	157	/	158	99%	0.05	:	0.05	0.029	-	28.8	MMB-SW-11	1.45E+00	
Lead, Filtered	11	/	140	8%	0.001	:	0.01	0.0012	-	0.017	MMB-SW-3	2.73E-03	
Magnesium, Filtered	141	/	141	100%				0.618	-	12	EDLBSW1	4.30E+00	
Manganese, Filtered	141	/	141	100%				0.06	-	9.2	MMB-SW-6	7.70E-01	
Nickel, Filtered	9	/	140	6%	0.005	:	0.02	0.0026	-	0.082	MMB-SW-1	5.93E-03	
Potassium, Filtered	133	/	158	84%	2	:	4	1.78	-	19	EDLBSW1	4.03E+00	
Silver, Filtered	7	/	125	6%	0.002	:	0.005	0.00099	-	0.0099	MMB-SW-10	2.47E-03	
Sodium, Filtered	158	/	158	100%				9.57	-	539	OPWD-SW-S	7.00E+01	
Thallium, Filtered	9	/	125	7%	0.001	:	0.01	0.00072	-	0.0017	MMB-SW-2	2.00E-03	
Vanadium, Filtered	4	/	125	3%	0.005	:	0.01	0.00065	-	0.01	MMB-SW-3	4.70E-03	
Zinc, Filtered	32	/	140	23%	0.025	:	0.05	0.002	-	0.2	EDSD/SW7	2.72E-02	

Table 5.1-1
Summary of Analytical Data for Surface Water - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Surface Water Background
Inorganics (mg/L)													
Bicarbonate alkalinity as CaCO3	145	/	146	99%	1	:	1	3	-	118	EDLBSW1	3.49E+01	
Chloride	157	/	157	100%				12.6	-	740	MMB-SW-11	1.22E+02	**110**
Nitrate & Nitrite as N	20	/	20	100%				0.11	-	2.6	ISCO3	1.44E+00	
Nitrate as N	99	/	153	65%	0.05	:	0.05	0.021	-	3.2	EDSD/SW0	4.58E-01	
Nitrite as N	37	/	170	22%	0.01	:	0.2	0.007	-	7.9	EDSD/SW2 (EDBS6) EDSD/SW6	1.17E-01	
Nitrogen, Ammonia	186	/	190	98%	0.1	:	0.1	0.1	-	128	ISCO3	5.13E+00	ND
Nitrogen, Total Kjeldahl as N	23	/	27	85%	1	:	1	1.1	-	32.4	EDSD/SW6	1.31E+01	
Orthophosphate as P	6	/	27	22%	0.1	:	0.1	0.11	-	0.27	EDSD/SW6	7.48E-02	
pH	26	/	26	100%				4.1	-	6.84	ISCO3	6.31E+00	
Phosphorous	27	/	27	100%				0.66	-	10.4	EDSD/SW3 (EDBS8)	4.20E+00	
Specific Conductance	147	/	147	100%				207	-	2950	ISCO3	5.72E+02	
Sulfate as SO4	168	/	174	97%	2	:	2	2.6	-	864	ISCO3	4.43E+01	**24**
Total Alkalinity as CaCO3	133	/	133	100%				3	-	118	EDLBSW1	3.59E+01	
Total Organic Carbon (TOC)	15	/	15	100%				5.8	-	45	OPWD-SW-S	1.60E+01	
Turbidity	27	/	27	100%				0.14	-	47	EDSD/SW5 (EDBS11)	8.50E+00	
Field Measurements (mg/L)													
Hardness as CaCO3	1	/	1	100%				180	-	180	ISCO3	1.80E+02	

BOLD maximum concentration is greater than that background concentration
mg/L = milligrams per liter
ND = Not Detected
SQL = Sample Quantitation Limit

Prepared by / Date: KJC 07/14/08
Checked by / Date: MH 07/15/08

Table 5.2-1
Summary of Analytical Data for Sediment - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Maximum Background Detected Concentration
Volatile Organics (mg/Kg)													
2,4,4-Trimethyl-1-pentene	1	/	12	8%	0.0029	:	0.37	15	-	15	OPWD-SD-N	1.28E+00	ND
Acetone	9	/	12	75%	5.5	:	15	0.18	-	3.3	EDSD/SW4 (EDBS10)	1.91E+00	**0.19**
Carbon Disulfide	1	/	12	8%	0.003	:	0.73	0.0078	-	0.0078	EDSD/SW8	6.71E-02	ND
cis-1,2-Dichloroethene	3	/	12	25%	0.0029	:	0.73	0.011	-	0.036	EDSD/SW5 (EDBS11)	6.54E-02	
Trichloroethene (TCE)	4	/	12	33%	0.004	:	0.73	0.0038	-	0.043	EDSD/SW5 (EDBS11)	6.43E-02	ND
Semivolatile Organics (mg/Kg)													
Acenaphthylene	2	/	14	14%	0.2	:	3.9	0.021	-	0.32	EDSD/SW2 (EDBS6)	5.03E-01	**0.078**
Anthracene	3	/	14	21%	0.25	:	3.9	0.028	-	0.28	EDSD/SW2 (EDBS6)	5.03E-01	**0.088**
Benzo(a)anthracene	7	/	14	50%	0.25	:	3.9	0.26	-	2.8	EDSD/SW7	7.98E-01	**0.42**
Benzo(a)pyrene	7	/	14	50%	0.25	:	3.9	0.26	-	3.1	EDSD/SW7	8.53E-01	**0.53**
Benzo(b)fluoranthene	8	/	14	57%	0.25	:	3.9	0.31	-	4.1	EDSD/SW7	1.14E+00	**0.77**
Benzo(g,h,i)perylene	6	/	14	43%	0.25	:	3.9	0.11	-	2.5	EDSD/SW7	5.83E-01	**0.11**
Benzo(k)fluoranthene	8	/	14	57%	0.25	:	3.9	0.31	-	3.5	OPWD-SD-N	1.05E+00	**0.69**
bis(2-EthylHexyl)phthalate	7	/	14	50%	0.25	:	5.3	0.46	-	5.5	EDSD/SW4 (EDBS10)	2.21E+00	**2**
Chrysene	10	/	14	71%	0.25	:	3.9	0.17	-	4.9	EDSD/SW7	1.29E+00	**0.64**
Fluoranthene	11	/	14	79%	0.25	:	2.2	0.26	-	7.9	EDSD/SW7	1.85E+00	**1.2**
Indeno (1,2,3-cd) pyrene	6	/	14	43%	0.25	:	3.9	0.14	-	2.3	EDSD/SW7	5.75E-01	**0.12**
Phenanthrene	7	/	14	50%	0.25	:	3.9	0.18	-	4.2	EDSD/SW7	9.14E-01	**0.46**
Pyrene	11	/	14	79%	0.25	:	2.2	0.24	-	8.4	EDSD/SW7	1.99E+00	**1**

Table 5.2-1
Summary of Analytical Data for Sediment - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Maximum Background Detected Concentration
Polyaromatic Hydrocarbons (mg/Kg)													
Acenaphthylene	2	/	6	33%	0.31	:	1.7	0.092	-	0.21	EDSD/SW6	3.40E-01	
Anthracene	6	/	6	100%				0.011	-	0.34	EDSD/SW2 (EDBS6)	1.62E-01	
Benzo(a)anthracene	6	/	6	100%				0.076	-	1.6	EDSD/SW2 (EDBS6)	7.88E-01	
Benzo(a)pyrene	6	/	6	100%				0.11	-	1.2	EDSD/SW2 (EDBS6)	6.48E-01	
Benzo(b)fluoranthene	6	/	6	100%				0.15	-	1.1	EDSD/SW2 (EDBS6) EDSD/SW4 (EDBS10)	7.00E-01	
Benzo(g,h,i)perylene	6	/	6	100%				0.087	-	0.76	EDSD/SW5 (EDBS11)	4.70E-01	
Benzo(k)fluoranthene	6	/	6	100%				0.072	-	0.67	EDSD/SW2 (EDBS6)	3.87E-01	
Chrysene	6	/	6	100%				0.18	-	2	EDSD/SW2 (EDBS6)	1.03E+00	
Dibenzo(a,h)anthracene	6	/	6	100%				0.15	-	0.96	EDSD/SW4 (EDBS10)	5.62E-01	
Fluoranthene	6	/	6	100%				0.23	-	4.4	EDSD/SW2 (EDBS6)	1.89E+00	
Fluorene	5	/	6	83%	0.14	:	0.14	0.0032	-	0.071	EDSD/SW6	4.59E-02	
Indeno (1,2,3-cd) pyrene	6	/	6	100%				0.097	-	0.71	EDSD/SW2 (EDBS6)	4.75E-01	
Phenanthrene	6	/	6	100%				0.074	-	1.4	EDSD/SW2 (EDBS6)	6.31E-01	
Pyrene	6	/	6	100%				0.21	-	3	EDSD/SW2 (EDBS6)	1.44E+00	
Pesticides/PCBs (mg/Kg)													
Delta-BHC	1	/	11	9%	0.003	:	0.065	0.005	-	0.005	EDSD/SW1 (EDBS5)	9.50E-03	
Dieldrin	2	/	11	18%	0.003	:	0.023	0.152	-	0.272	EDSD/SW4 (EDBS10)	4.36E-02	
Gamma-Chlordane	1	/	1	100%				0.0036	-	0.0036	BS007	3.60E-03	

Table 5.2-1
Summary of Analytical Data for Sediment - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Maximum Background Detected Concentration
Herbicides (mg/Kg)													
Chloramben	6	/	6	100%				0.015	-	0.27	EDSD/SW3 (EDBS8)	7.67E-02	
MCPA	2	/	7	29%	0.00733	:	19	18	-	95	EDSD/SW3 (EDBS8)	2.01E+01	
Inorganics (mg/Kg)													
Aluminum, Total	13	/	13	100%				3050	-	46700	OPWD-SD-N	1.19E+04	**20400**
Antimony, Total	3	/	14	21%	0.65	:	8.6	2.81	-	18	EDSD/SW5 (EDBS11)	3.92E+00	ND
Arsenic, Total	14	/	14	100%				1.9	-	119	EDSD/SW5 (EDBS11)	3.49E+01	**44**
Barium, Total	13	/	13	100%				5.4	-	130	EDSD/SW7	3.85E+01	**106**
Beryllium, Total	7	/	13	54%	0.186	:	0.86	0.185	-	4.57	EDSD/SW4 (EDBS10)	9.75E-01	ND
Cadmium, Total	6	/	13	46%	0.17	:	0.84	0.09	-	2.2	EDSD/SW7	5.10E-01	ND
Calcium, Total	13	/	13	100%				341	-	5800	EDSD/SW5 (EDBS11)	2.37E+03	**4100**
Chromium, Total	14	/	14	100%				10	-	3120	EDSD/SW5 (EDBS11)	6.35E+02	**24.4**
Cobalt, Total	13	/	13	100%				1.6	-	59.3	EDSD/SW4 (EDBS10)	1.44E+01	**23.3**
Copper, Total	13	/	13	100%				4.2	-	270	EDSD/SW7	5.84E+01	**58.3**
Hexavalent Chromium, Total	1	/	10	10%	1.2	:	6.7	57.8	-	57.8	NPSED1	7.49E+00	**1.2**
Iron, Total	13	/	13	100%				2810	-	84400	EDSD/SW4 (EDBS10)	2.48E+04	**34100**
Lead, Total	14	/	14	100%				3	-	210	EDSD/SW8	6.27E+01	**147**
Magnesium, Total	13	/	13	100%				285	-	2800	EDSD/SW1 (EDBS5)	1.47E+03	3900
Manganese, Total	13	/	13	100%				25.5	-	3100	EDSD/SW7	6.89E+02	**776**
Mercury, Total	7	/	11	64%	0.061	:	0.13	0.157	-	0.636	EDSD/SW4 (EDBS10)	2.61E-01	**0.54**
Nickel, Total	12	/	13	92%	8.4	:	8.4	3.16	-	89	EDSD/SW7	1.90E+01	**21.4**
Potassium, Total	6	/	13	46%	260	:	1700	176	-	1930	OPWD-SD-WS	6.49E+02	**980**
Sodium, Total	4	/	13	31%	130	:	860	87	-	958	OPWD-SD-N	2.92E+02	**332**
Thallium, Total	2	/	14	14%	0.65	:	4.3	1.56	-	2	EDSD/SW2 (EDBS6)	1.27E+00	3.6
Trivalent Chromium, Total	4	/	4	100%				9.9	-	1260	NPSED1	3.73E+02	

Table 5.2-1
Summary of Analytical Data for Sediment - OU2 Current Conditions

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Parameter Name	Frequency of Detection			Percent Detected	Range of SQL Concentrations			Range of Detected Concentrations			Location of Maximum Detection	Average of All Samples	Maximum Background Detected Concentration
Vanadium, Total	13	/	13	100%				4.5	-	63.4	EDSD/SW2 (EDBS6)	2.31E+01	**32**
Zinc, Total	13	/	13	100%				10.6	-	820	EDSD/SW7	1.59E+02	**379**
Bicarbonate alkalinity as CaCO3	3	/	3	100%				2.2	-	16.3	EDSD/SW7	8.30E+00	
Chloride	4	/	4	100%				11	-	182	NPSED1	7.33E+01	
Cyanide	1	/	10	10%	0.71	:	3.7	4.7	-	4.7	EDSD/SW4 (EDBS10)	1.15E+00	
Nitrate as N	3	/	3	100%		:		3	-	15	EDSD/SW7	9.00E+00	
Nitrogen, Ammonia	20	/	28	71%	10	:	75	11.7	-	700	MMB-SD-5	1.95E+02	897
Nitrogen, Total Kjeldahl as N	8	/	9	89%	26.7	:	26.7	520	-	13600	EDSD/SW4 (EDBS10)	4.38E+03	
Orthophosphate as P	2	/	3	67%	7	:	7	1	-	2	EDSD/SW0	2.17E+00	
pH **(pH units)**	1	/	1	100%				6.26	-	6.26	NPSED1	6.26E+00	
Phosphate, Total as P	3	/	3	100%				110	-	610	EDSD/SW7	3.10E+02	
Sulfate as SO4	4	/	4	100%				22	-	94	EDSD/SW7	4.93E+01	
Total Alkalinity as CaCO3	3	/	3	100%				2.2	-	16.3	EDSD/SW7	8.30E+00	
Total Organic Carbon (TOC)	17	/	17	100%				8500	-	513000	MMB-SD-2	2.05E+05	570000

BOLD maximum concentration is greater than that background concentration
mg/Kg = milligrams per kilogram
ND = Not detected
PCB = Polychlorinated biphenyl
SQL = Sample Quantitation Limit

Prepared by / Date: KJC 06/29/07
Checked by / Date: MH 08/17/07
Revised by / Date: KJC 04/14/08

Table 6.1-1
Well Installation Estimated Completion Depths

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location Name	Estimated GW Elevation	Estimated Ground Surface Elevation	Estimated Bedrock (ft MSL)	Estimated Boring Depth (ft bgs)	Estimated Boring Elev. (ft MSL)	Estimated Bottom of Screen (ft bgs)	Estimated Top of Screen (ft bgs)	Estimated Bottom of Screen Elev. (ft MSL)	Estimated Top of Screen Elev. (ft MSL)
GW-400BR	78	84	0	159	-75	159	139	-75	-55
GW-400D	78	84	0	84	0	109	99	-25	-15
GW-400M	78	84	0	60	24	60	50	24	34
GW-400S	78	84	0	20	64	20	10	64	74
GW-404D	78	84	30	54	30	109	99	-25	-15
GW-404M	78	84	30	80	4	80	70	4	14
GW-404S	78	84	30	30	54	30	20	54	64
GW-402D	81	90	80	10	80	50	40	40	50
GW-402S	81	90	80	20	70	20	10	70	80
GW-403D	78	85	55	30	55	30	20	55	65
GW-403S	78	85	55	15	70	15	5	70	80
GW-401D	74	80	60	20	60	20	10	60	70
GW-401S	74	80	60	10	70	10	5	70	75
GW-405BR	81	90	80	250	-170	250	130	-170	-50
GW-406D	82	90	60	30	60	30	20	60	70
GW-406BR	82	90	60	150	-90	150	130	-90	-70
GW-407BR	80	85	15	100	-85	100	80	-85	-65
GW-65BRD	80	85	-20	100	-120	100	80	-120	-100

ft bgs = depth in feet below ground surface
ft MSL = elevation in feet above Mean Sea Level
*Bedrock well screen depths will be determined based upon results of borehole geophysical logging, depth shown is bottom of deepest possible screen
Bedrock boring depth and screen is depth below top of bedrock, elevation is based on estimated elevation of bedrock surface
BR= Bedrock
S= Shallow overburden, M=middle overburden, D= Deep Overburden

Prepared by : TL 4/20/2009
Checked by : PHT 4/24/2009

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
Number of Sample Points with Detected Analyte	194	181	1	107	54	2	10	283	214	334	6	2	4	11	17	10	18	14	1	1	230	225
Number of Locations Analyzed	233	236	1	192	155	33	25	295	242	334	47	39	39	75	33	17	45	38	2	9	230	225
56/58 Butters Row	N	Y		N				Y		Y		N	N	N	N		N					
ALTRON B1	Y	N		Y	N			Y	Y	Y				N							Y	Y
ALTRON B3	Y	Y		Y	N			Y	Y	Y				N							Y	Y
AN-1									Y	Y												
AN-2									Y	Y												
B-03	Y	Y			N			Y	Y	Y					Y	Y	Y	Y			Y	Y
B-05-R		N								Y												
B-07-A	N																					
B-10	Y	Y								Y							Y	Y				
B-17	N																N	N				
BR-1	N	Y		Y	Y			Y		Y											Y	Y
BUTTERS ROW 1	Y	Y		Y	N	N	Y	Y	Y	Y		N	N	N	Y	N	N	N			Y	Y
BUTTERS ROW 2	Y	Y		Y				Y	Y	Y											Y	Y
BUTTERS ROW PLANT RAW	N	N		N				Y		Y			N	N		N		N			Y	
CHESTNUT ST 1	Y	Y		Y	N	N	N	Y	Y	Y		N	N	N	Y	N	N	N			Y	Y
CHESTNUT ST 1A/2	Y	Y		Y				Y	Y	Y											Y	Y
E-10	Y	Y						Y		Y		N					N	N				
ECS-2		N		N		N			Y	Y							N	N				
ECS-6		N		N		N			Y	Y							N	N				
GT-4D	Y	Y						N		Y												
GT-4S	Y	Y						N		Y												
GT-5	Y	Y						N		Y												
GT-6D	Y	Y						Y		Y												
GT-6S	N	Y						N		Y												
GT-7	Y	Y						Y		Y												
GT-9D	Y	Y						Y		Y												
GT-9S	Y	Y						N		Y												
GW-1	Y	Y						Y	Y	Y											Y	Y
GW-100		Y								Y												
GW-101	Y	Y						Y	Y	Y					Y	Y	Y	Y				Y
GW-102		Y								Y												
GW-103BR	Y	N		Y				Y	Y	Y					N							Y
GW-103D	Y	N		Y				Y		Y					N							Y
GW-10D	Y	Y		N	Y	Y	Y	Y	Y	Y		Y	N		Y		Y	Y			Y	Y
GW-10S	Y	Y		Y	Y	N	Y	Y	Y	Y		N	N		Y		N	N			Y	Y
GW-11	Y	Y		N	N			Y	Y	Y											Y	Y
GW-12	Y	Y			N			Y	Y	Y											Y	Y
GW-13	Y	Y						Y	Y	Y					Y	N	Y	Y			Y	Y
GW-14	Y	Y						Y	Y	Y					N	Y	Y	Y			Y	Y
GW-15	Y	Y						Y	Y	Y							Y	Y			Y	Y
GW-16	Y	Y		Y				Y	Y	Y	N				Y	Y	Y	Y			Y	Y
GW-16B																	Y	Y				
GW-17D	Y	Y		N	N			Y	Y	Y		N	N								Y	Y
GW-17S	Y	Y		Y	N			Y	Y	Y	N	N	N	N							Y	Y
GW-18D	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-19D	Y	Y			Y			Y	Y	Y											Y	Y
GW-19S	Y	Y						Y	Y	Y											Y	Y
GW-2								Y	Y	Y											Y	Y
GW-20	Y	Y		N				Y	Y	Y	N			N							Y	Y
GW-201S								Y		Y												Y

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
GW-202D				Y				Y	Y	Y											Y	Y
GW-202S				Y				Y	Y	Y											Y	Y
GW-21D	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-21S	Y	Y		N	N			Y	Y	Y											Y	Y
GW-22D	Y	Y		N	Y			Y	Y	Y		N	N								Y	Y
GW-22S	Y	Y		N	N			Y	Y	Y		N	N								Y	Y
GW-23								N	N	Y											Y	Y
GW-24	Y	Y		Y				Y	Y	Y											Y	Y
GW-25	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-26	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-27D	Y	Y		Y	Y	N		Y	Y	Y		N	N								Y	Y
GW-27S	Y	Y		Y	Y			Y	Y	Y		N	N								Y	Y
GW-28D	Y	Y		Y	Y	N	Y	Y	Y	Y	N	N	N	N	Y		N	N			Y	Y
GW-28S	Y	Y		Y	Y	N	N	Y	Y	Y	N	N	N	N	N		N	N			Y	Y
GW-29D	Y	Y		Y	Y			Y	Y	Y	N	N	N	N							Y	Y
GW-29S	Y	Y		Y	N			Y	Y	Y	N	N	N	N							Y	Y
GW-2A		Y						N		Y											Y	Y
GW-301				N							N			N								Y
GW-302				Y							N			N								Y
GW-303	Y			Y							N			N			N					Y
GW-304				Y							N			N								Y
GW-305				Y							N			N								Y
GW-306				N							N			N								Y
GW-307				Y							Y			N								Y
GW-308		Y		Y		N			Y	Y	Y			N			N	N				Y
GW-30DR	Y	Y		N	Y			Y	Y	Y											Y	Y
GW-30S		N							Y	Y											Y	Y
GW-31D	Y	Y		N	N	N		Y	Y	Y											Y	Y
GW-31S	Y	Y		N	N			Y		Y											Y	Y
GW-32D	Y	Y		Y	N			Y		Y											Y	Y
GW-32S	Y	Y		Y	Y			Y		Y							N	N			Y	Y
GW-33D	Y	Y		N	Y			Y	Y	Y											Y	Y
GW-33S	Y	Y		N	Y			Y	Y	Y											Y	Y
GW-34D	Y	Y		N	Y			Y	Y	Y		N	N								Y	Y
GW-34S	Y	Y		N	N			Y	N	Y		N	N								Y	Y
GW-34SR								Y		Y												Y
GW-35D	Y	Y		N	Y			Y	Y	Y		N	Y								Y	Y
GW-35S	Y	Y		N	Y	N		Y	Y	Y		N	N								Y	Y
GW-36	Y	Y		N	Y	N		Y	Y	Y		N	N								Y	Y
GW-37	Y	Y		N	Y			Y	Y	Y		N	N								Y	Y
GW-38	Y	Y		N	Y			Y	Y	Y											Y	Y
GW-39	Y	Y		N	N			Y	Y	Y											Y	Y
GW-3D	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-3S	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-4	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-40D	Y	Y			N	N		Y	Y	Y											Y	Y
GW-40S	N	N			N			Y	Y	Y											Y	Y
GW-42D	Y	Y		Y	Y	N		Y	Y	Y											Y	Y
GW-42S	Y	N		Y	N			Y	Y	Y											Y	Y
GW-43D	Y	Y		Y	Y			Y	Y	Y	N										Y	Y
GW-43S	Y	Y		Y	N			Y	Y	Y	Y										Y	Y
GW-44D	Y	Y			Y			Y	Y	Y				Y							Y	Y
GW-44S	Y	N			N			Y	Y	Y											Y	Y
GW-45D	Y	Y		Y	Y			Y	Y	Y											Y	Y

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
GW-45S	Y	N		Y	N			Y	Y	Y											Y	Y
GW-46D	N	N		N	N			Y	Y	Y											Y	Y
GW-47	Y	N			N			Y	Y	Y											Y	Y
GW-48D	Y	N			N			Y	N	Y											Y	Y
GW-48S	Y	N			N			Y	N	Y							N	N			Y	Y
GW-49D	Y	Y			Y			Y		Y											Y	Y
GW-4D	Y	Y		Y	N			Y	N	Y											Y	Y
GW-5	N	Y		N				N	Y	Y											Y	Y
GW-50D	Y	Y		Y	Y	N		Y	Y	Y											Y	Y
GW-50S	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-51D	Y	Y			Y			Y	N	Y											Y	Y
GW-51S	Y	Y			Y			Y	Y	Y											Y	Y
GW-52D	Y	Y			N			Y	N	Y											Y	Y
GW-52S	Y	Y			N			Y	N	Y							N	N			Y	Y
GW-53D	Y	Y			Y			Y	Y	Y											Y	Y
GW-53S	Y	Y			Y			Y	N	Y							N	Y			Y	Y
GW-54D	Y	Y		Y	Y			Y	N	Y											Y	Y
GW-54S	Y	Y		Y	N	Y		Y	Y	Y											Y	Y
GW-55D	Y	Y			Y	N		Y	Y	Y											Y	Y
GW-55S	N	Y			N			Y	Y	Y											Y	Y
GW-56D	Y	N		Y	N			Y	N	Y											Y	Y
GW-56S	N	Y		Y	N			Y	N	Y											Y	Y
GW-57D	Y	Y		N	N			Y	Y	Y											Y	Y
GW-58D	Y	Y			N			Y	Y	Y											Y	Y
GW-58S	N	Y		Y	N			Y	Y	Y											Y	Y
GW-59D	Y	Y		Y	Y			Y	Y	Y	N										Y	Y
GW-59S	Y	Y		N	N			Y	Y	Y	N										Y	Y
GW-60D	Y	Y		N	N			Y	N	Y											Y	Y
GW-60S	N	N		N	Y			Y	Y	Y											Y	Y
GW-61BR	Y	N		Y	N			Y	Y	Y											Y	Y
GW-61D	Y	N		N	N			Y	N	Y											Y	Y
GW-61S	N	N		N	N			Y	Y	Y											Y	Y
GW-62BR	Y	N			N			Y	Y	Y											Y	Y
GW-62BRD	Y	Y			N			Y	Y	Y											Y	
GW-62D	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-62M	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-62S	N	N		N	N			Y	Y	Y											Y	Y
GW-63D	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-63S	Y	Y		N	N			Y	Y	Y											Y	Y
GW-64D	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-64S	Y	Y		N	N			Y	Y	Y											Y	Y
GW-65BR	Y	Y			Y			Y	Y	Y											Y	Y
GW-65D	Y	Y		Y	N			Y		Y											Y	Y
GW-65S	Y	Y		N	N			Y		Y											Y	Y
GW-66D	N	N		N	N			Y		Y											Y	Y
GW-66S	Y	Y		N	N			Y	Y	Y											Y	Y
GW-67D	Y	N		Y	N			Y	N	Y											Y	Y
GW-67S	N	N		N	Y			Y		Y											Y	Y
GW-68BR	Y	Y			N			Y	Y	Y											Y	
GW-68D	Y	Y		N	N			Y		Y											Y	Y
GW-69D	Y	Y		Y	Y			Y		Y				N							Y	Y
GW-69S	Y	N		Y	N			Y		Y											Y	Y
GW-6D	Y	Y		Y	N			Y	Y	Y	Y			N							Y	Y
GW-6S	Y	Y		Y	N			Y	Y	Y	N			N							Y	Y

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
GW-7	Y	Y						Y	Y	Y											Y	Y
GW-70D	Y	Y		Y	Y			Y		Y	N										Y	Y
GW-70S	N	N		Y	N			Y		Y	N										Y	Y
GW-71D	Y	N			N			Y		Y											Y	
GW-71S	N	N			N			Y		Y											Y	
GW-72D	Y	N			N			Y		Y											Y	Y
GW-73D	N	N		N	N			Y	Y	Y											Y	Y
GW-73S	N	N		N	N			Y	Y	Y											Y	Y
GW-74D	Y	N		N	N			Y		Y											Y	Y
GW-74S	Y	Y		N	N			Y		Y											Y	Y
GW-75D	N	N			N			Y		Y											Y	Y
GW-75S	Y	N			N			Y		Y											Y	Y
GW-76S	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-77S	Y	Y		N	N			Y	Y	Y											Y	Y
GW-78S	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-79S	Y	Y		Y	N			Y	Y	Y											Y	Y
GW-8	Y	Y						Y	Y	Y											Y	Y
GW-80BR	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-80D	Y	Y		Y	Y			Y	Y	Y											Y	Y
GW-80S	Y	Y		N	Y			Y	Y	Y											Y	Y
GW-81BR	Y	Y			Y			Y	Y	Y											Y	Y
GW-81D	Y	Y			Y			Y	Y	Y											Y	Y
GW-82D	Y	Y						Y	N	Y											Y	Y
GW-82S	N	Y						Y	N	Y											Y	Y
GW-83D	Y	Y		Y				Y	Y	Y	Y			Y							Y	Y
GW-83M	Y	Y		Y				Y	N	Y	Y			N							Y	Y
GW-83S	N	Y		Y				Y	N	Y	N			Y							Y	Y
GW-84D	Y	Y		Y				Y	Y	Y				N							Y	Y
GW-84M	Y	Y		N				Y	Y	Y				N							Y	Y
GW-84S	Y	Y		N				Y	N	Y				N							Y	Y
GW-85D	Y	Y		Y				Y	Y	Y				N							Y	Y
GW-85M	Y	Y		Y				Y	Y	Y				N							Y	Y
GW-86D	Y	Y		Y				Y	Y	Y			N	N							Y	Y
GW-86M	Y	Y		Y				Y	Y	Y				N							Y	Y
GW-86S	N	Y		N				Y	N	Y				N							Y	Y
GW-87D	Y	Y		Y	N	N	Y	Y	Y	Y		N	Y	N	Y	Y	Y	N			Y	Y
GW-88D	Y	Y		N				Y	Y	Y	N	N	N	N			Y	N				Y
GW-88M	Y	N		N				Y	Y	Y	N	N	N	N			N	N				Y
GW-88S	Y	N		N				Y	Y	Y	N	N	N	N			N	Y				Y
GW-98									Y	Y												
GW-CA1				Y				Y	Y	Y												Y
GW-CA2				Y				N		Y												
GW-LPB-11	Y	Y		Y	Y			Y	Y	Y	N	N	Y	N								
IW-1		Y								Y												
IW-10	Y	Y						Y	Y	Y					Y	Y	Y	Y			Y	Y
IW-11	Y	Y		Y	Y	N		Y	Y	Y											Y	Y
IW-12	Y	Y		Y	N			Y	N	Y											Y	Y
IW-13	Y	Y		Y	N			Y	N	Y											Y	Y
IW-2		Y								Y												
IW-3		Y								Y												
IW-4	Y	Y			N			Y		Y											Y	Y
IW-6	Y	Y						Y	Y	Y					Y	Y	Y	Y			Y	Y
LPB-40				Y							N			N								
LPB-44				Y							N			N								

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
LPB-47				Y							N			N								
M-14/L-2B	N	N		N				Y		Y		N	N	N	Y		N					
M-15/L-2C	Y	N		N				Y		Y		N	N	N	N		N					
M-2/L-7E									Y	Y												
M-24/L-116	Y	N			N				Y	Y					N							
M-24/L-117	Y	Y		N	N	N	N	Y	Y	Y					N					N		
M-24/L-33A	N	N						Y		Y		N	N	N	N		N					
M-24/L-54	Y	N		N	N	N	N		Y	Y										N		
M-24/L-63	Y	N		N	N	N	N		Y	Y				N	N					N		
M-24/L-64	Y	Y		N	N	N	N		Y	Y				N						N		
M-24/L-65	Y	Y		N	N	N	N		Y	Y										N	Y	Y
M-24/L-66	Y	N		N	N	N	N		Y	Y										N		
M-24/L-72A	Y	N		N	N	N	N		Y	Y				N	N					N		
M-24/L-74														N								
M-24/L-87A	Y	Y		N	N	N	N	Y	Y	Y				N						Y		
M-24/L-94	Y	Y		Y	N	N	N	Y	Y	Y		N	N	N	N		N			N		
M-25/L-03	Y	Y		N	N		N		Y	Y												
M-25/L-04	Y	Y		N	N		N		Y	Y												
M-25/L-05				N				Y		Y	N			N								Y
M-25/L-06	Y	Y		N	N		N		Y	Y												
M-25/L-07	Y	Y		N	N		Y		Y	Y					N							
M-25/L-08-IN	Y	Y		N	N		N		Y	Y					N							
M-25/L-08-OUT	Y	Y		N	N		Y		Y	Y												
M-38/L-1	N	N		N				Y		Y		N	N	N	N		N					
MB-1									Y	Y											Y	Y
MB-2									N	Y											Y	Y
MB-3									Y	Y											Y	Y
MG-02-A									Y	Y												
MG-02-C									Y	Y												
MP-1 #01	Y	Y		Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y		N	N			Y	Y
MP-1 #02								Y		Y											Y	
MP-1 #03								Y	Y	Y											Y	
MP-1 #04								Y	Y	Y											Y	
MP-1 #05								Y	Y	Y											Y	
MP-1 #06				Y				Y	Y	Y	N			Y							Y	Y
MP-1 #07								Y	Y	Y											Y	
MP-1 #08	Y	Y			Y	N	Y	Y		Y		N	N		Y		Y	N			Y	
MP-1 #10								Y		Y											Y	
MP-1 #11								Y		Y											Y	
MP-1 #12								Y		Y												
MP-1 #13								Y		Y											Y	
MP-1 #14								Y		Y				N								
MP-1 #16	Y	N			Y	N	Y	Y		Y		N	N		N		N	N			Y	
MP-1 #17				Y				Y	Y	Y												
MP-1 #18				Y				Y		Y	N			N							Y	Y
MP-2 #01	N	N		Y				Y	Y	Y	N			Y		Y					Y	Y
MP-2 #02								Y	Y	Y											Y	Y
MP-2 #03								Y	Y	Y											Y	
MP-2 #04								Y	Y	Y											Y	
MP-2 #06				Y				Y	Y	Y	N										Y	
MP-2 #07	N	N		Y				Y	Y	Y				N		Y					Y	
MP-2 #08								Y	Y	Y											Y	
MP-2 #09				Y				Y	Y	Y				Y							Y	Y
MP-2 #10								Y	Y	Y											Y	

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
MP-2 #11								Y	Y	Y				N							Y	Y
MP-2 #12								Y	Y	Y												
MP-2 #13								Y	Y	Y											Y	
MP-2 #14								Y	Y	Y												
MP-2 #15				N				Y	Y	Y											Y	
MP-2 #16								Y	Y	Y												
MP-2 #17				N				Y	Y	Y	N			N							Y	Y
MP-3 #01				Y				Y		Y				Y							Y	Y
MP-3 #02								Y	Y	Y											Y	
MP-3 #03								Y		Y											Y	
MP-3 #04								Y	Y	Y											Y	
MP-3 #05								Y		Y				Y							Y	
MP-3 #06								Y	Y	Y				Y							Y	Y
MP-3 #07				Y				Y	Y	Y											Y	
MP-3 #08								Y	Y	Y											Y	
MP-3 #09								Y	Y	Y											Y	
MP-3 #10								Y		Y											Y	
MP-3 #11								Y	Y	Y											Y	
MP-3 #12								Y		Y												
MP-3 #13								Y		Y											Y	
MP-3 #14								Y		Y												
MP-3 #15								Y		Y											Y	
MP-3 #16								Y		Y												
MP-3 #17								Y		Y											Y	
MP-3 #18				Y				Y		Y				N								Y
MP-3 #19				Y				Y	Y	Y											Y	
MP-3 #20								Y		Y												
MP-3 #21								Y		Y											Y	
MP-4 #01								Y		Y				N								
MP-4 #02								Y	Y	Y												
MP-4 #03								Y	Y	Y												
MP-4 #05								Y		Y												
MP-4 #08								Y		Y												
MP-4 #09								Y		Y												
MP-4 #10				Y				Y	Y	Y	N			Y								Y
MP-4 #11	Y							Y	Y	Y												
MP-4 #12	Y							Y	Y	Y												
MP-4 #13	N			Y				Y	Y	Y												
MP-4 #14	N			Y				Y	Y	Y	N			N								Y
MP-5								Y	Y	Y												Y
MP-5 #03	Y	Y		Y				Y	Y	Y	N	N	Y	N			Y	N				Y
MP-5 #05								Y	Y	Y												Y
MP-5 #06								Y	Y	Y												Y
MP-5 #08	Y	Y		Y				Y	Y	Y	N	N	N	N			Y	N				Y
MP-5 #09								Y	Y	Y												Y
MP-5 #11								Y	Y	Y												Y
MP-5 #12								Y	Y	Y												Y
MP-5 #15	Y	Y		Y				Y	Y	Y	N	N	N	N			N	N				Y
MW-203D				N																		
MW-203S				N																		
MW-204D				N																		
MW-204M				N																		
MW-204S				N																		
MW-206D				N																		

Table 6.2-1
Summary of Analytes Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Volatile Organic Compounds	Semivolatiles	Semivolatiles - Low Level	NDMA	Pesticides	PCBs	Herbicides	Metals, Filtered	Metals, Total	Inorganics / Physical	Hydrazine	Opex ®	Kempore ®	Acetaldehyde / Formaldehyde	Polynuclear Aromatic Hydrocarbons	Total Petroleum Hydrocarbons	Volatile Petroleum Hydrocarbons	Extractable Petroleum Hydrocarbons	Oil & Grease	Coliform	Field Parameters	Field - pH
MW-206S				N																		
MW-3									Y	Y												
MW-5									Y	Y												
MW-8D									Y	Y												
OB-1	N	Y						Y	Y	Y												
OB-2								N		Y												
OB-3	Y	Y						Y	Y	Y												
OB-4	N	Y						Y	Y	Y												
P5		Y								Y												
Plant B Influent	Y	Y	Y	Y				Y	Y	Y					Y	Y	Y	Y	Y			
Plant B Tank 8	N	Y						Y		Y					Y				N			
PW-1	Y	Y						N	N	Y												
PW-2	Y	Y						N		Y												
PZ-16RR																					Y	Y
PZ-17RR																					Y	Y
PZ-18R																					Y	Y
PZ-20																					Y	Y
PZ-21																					Y	Y
PZ-22																					Y	Y
PZ-23																					Y	Y
PZ-24								Y		Y											Y	Y
PZ-25								Y		Y											Y	Y
PZ-W1								Y	Y													Y
PZ-W2								Y	Y	Y												Y
PZ-W3								Y	Y	Y												Y
SB-1								Y		Y												
SB-2	Y							Y		Y												
SB-3	Y	N						Y		Y												
SB-4	Y	Y						Y		Y												
SB-5								Y		Y												
SB-6	Y	N						Y		Y												
SD-OW3				N																		
SHAWSHEEN								Y		Y											Y	
SL-1D	Y	N		N	Y			Y	N	Y	N			N							Y	Y
SL-1S	N	N			N			Y	Y	Y						N					Y	Y
SL-2	N	Y		N				Y	Y	Y	N			N		N					Y	Y
SL-3	N	N						Y	N	Y											Y	Y
SL-5	N	Y			N	N		Y	Y	Y											Y	Y
SL-6	Y	Y			N			Y	N	Y											Y	Y
SL-6D																N						
SL-7										Y												
SL-8										Y												
SVEMW-9	Y																Y					Y
TOWN PARK	Y	Y		N				Y	Y	Y											Y	Y
W-10	Y	Y						Y		Y		N					N	N				
W-101										Y											Y	

N - No parameters within parameter group were detected.
Y - At least one parameter within parameter group was detected.
Blank cell indicates parameter group was not analyzed for at location.

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Volatile Organics (mg/L)														
1,1,1-Trichloroethane (TCA)	1 / 292	0.3%	0.0001 : 1	0.0014 - 0.0014	GW-16		0.2	0.2			9.1 n	0.2	4	20
1,1-Dichloroethane	11 / 295	4%	0.00011 : 1	0.00016 - 0.02	GW-49D				0.07		0.0024 c	0.07	1	20
1,1-Dichloroethene	1 / 292	0.3%	0.00019 : 1	0.0013 - 0.0013	GW-87D		0.007	0.007			0.34 n	0.007	0.08	30
1,2,4-Trichlorobenzene	3 / 157	2%	0.00006 : 0.5	0.001 - 0.026	GW-87D		0.07	0.07			0.0082 n	0.07	2	50
1,2,4-Trimethylbenzene	4 / 153	3%	0.00008 : 0.5	0.0006 - 0.012	GW-16		NA				0.015 n			
1,2-Dichlorobenzene	4 / 156	3%	0.0001 : 0.5	0.0015 - 0.025	GW-88D		0.6	0.6			0.37 n	0.6	2	2
1,2-Dichloroethane	14 / 295	5%	0.0001 : 1	0.00055 - 0.027	GW-69D		0.005	0.005			0.00015 c	0.005	0.005	20
1,2-Dichloroethene (total)	20 / 144	14%	0.005 : 1	0.002 - 1.3	GW-80BR									
1,3,5-Trimethylbenzene	1 / 153	1%	0.00007 : 0.5	0.003 - 0.003	GW-80S		NA				0.33 n			
1,3-Dichlorobenzene	1 / 156	1%	0.0001 : 0.5	0.00055 - 0.00055	GW-29D		NA				0.012 n			
1,4-Dichlorobenzene	7 / 156	4%	0.0001 : 0.5	0.00019 - 0.0031	GW-29D		0.075	0.005			0.00043 c	0.04	2	50
2,4,4-Trimethyl-1-pentene	125 / 371	34%	0.0005 : 0.5	0.001 - 67	B-10						0.00043 c	0.005	0.2	8
2,4,4-Trimethyl-2-Pentene	98 / 371	26%	0.0005 : 0.5	0.00066 - 120	B-10									
2-Butanone (MEK)	2 / 272	1%	0.005 : 10	0.062 - 1.2	GW-49D		NA		4		7.1 n	4	50	50
2-Chlorotoluene	1 / 150	1%	0.00011 : 0.5	0.024 - 0.024	GW-88D		NA				0.73 n			
2-Hexanone	4 / 272	1%	0.005 : 5	0.004 - 2	IW-12									
4-Chlorotoluene	1 / 152	1%	0.0001 : 0.5	0.0015 - 0.0015	GW-88D		NA				2.6 n			
4-Methyl-2-Pentanone (MIBK)	2 / 272	1%	0.005 : 5	0.003 - 1.4	GW-49D				0.35		2 n	0.35	50	50
Acetone	22 / 272	8%	0.005 : 25	0.001 - 1.4	GW-49D				6.3		22 n	6.3	50	50
Benzene	14 / 294	5%	0.00008 : 1	0.00066 - 0.12	GW-49D		0.005	0.005			0.00041 c	0.005	2	10
Bromodichloromethane	3 / 295	1%	0.0002 : 1	0.008 - 0.009	ALTRON B1						0.0011 c	0.003	0.006	50
Bromoform	4 / 292	1%	0.00017 : 1	0.005 - 0.065	GW-69D						0.0085 c*	0.004	0.7	50
Carbon Disulfide	6 / 218	3%	0.0005 : 10	0.00084 - 0.036	GW-69D						1 n			
Carbon Tetrachloride	1 / 292	0.3%	0.00012 : 1	0.005 - 0.005	GW-69D		0.005	0.005			0.0002 c	0.005	0.002	5
Chlorobenzene	8 / 295	3%	0.00005 : 1	0.00013 - 0.8	GW-80BR		0.1	0.1			0.091 n	0.1	0.2	1
Chloroethane	3 / 292	1%	0.00013 : 2	0.0041 - 0.68	GW-80BR						21 n			
Chloroform	12 / 295	4%	0.00016 : 1	0.0012 - 0.064	SB-4				0.07		0.00019 c	0.07	0.05	20
Chloromethane (Methyl Chloride)	6 / 292	2%	0.00018 : 2	0.0008 - 0.011	GW-101		NA				0.0018 c			
cis-1,2-Dichloroethene	20 / 203	10%	0.00022 : 0.5	0.00021 - 0.36	GW-87D		0.07	0.07			0.37 n	0.07	0.1	50
Dibromochloromethane	4 / 294	1%	0.00016 : 1	0.002 - 0.018	GW-7						0.0008 c	0.002	0.02	50
Dibromomethane	1 / 109	1%	0.00018 : 0.5	0.001 - 0.001	GW-10D						0.37 n			
Dichlorodifluoromethane	2 / 107	2%	0.00021 : 1	0.001 - 0.001	M-24/L-117 M-24/L-87A		NA		1.4		0.39 n			
Diethyl ether	1 / 26	4%	0.001 : 0.5	0.0006 - 0.0006	GW-88M						7.3 n			
Ethylbenzene	24 / 292	8%	0.0001 : 1	0.0009 - 10	B-10		0.7	0.7			0.0015 c	0.7	20	5
Formaldehyde	5 / 113	4%	0.05 : 0.1	0.089 - 0.51	MP-3 #05		NA				7.3 n			
Isopropyl Benzene	1 / 153	1%	0.00004 : 0.5	0.0007 - 0.0007	GW-10D		NA				0.68 n			
m,p-Xylene	7 / 110	6%	0.00022 : 0.1	0.001 - 1.1	GW-80D		10	10			0.2 n			
Methylene Chloride	39 / 295	13%	0.0005 : 1	0.00044 - 0.25	B-10		0.005	0.005			0.0048 c	0.005	10	50
Methyl-t-butyl ether (MTBE)	39 / 145	27%	0.0005 : 0.5	0.00091 - 0.042	MP-5 #08				0.07	0.02	0.012 c	0.07	50	50
o-Xylene	4 / 109	4%	0.00016 : 0.5	0.0005 - 0.016	GW-80S		10	10			1.4 n	10	9	5
p-Isopropyl Toluene	4 / 152	3%	0.00008 : 0.5	0.0011 - 0.008	GW-16									
Styrene	2 / 291	1%	0.00012 : 1	0.0024 - 0.39	B-10		0.1	0.1			1.6 n	0.1	0.1	6
t-Butylbenzene	1 / 153	1%	0.00006 : 0.5	0.0016 - 0.0016	GW-16									
tert-Amyl methyl ether (TAME)	1 / 26	4%	0.005 : 2.5	0.0025 - 0.0025	MP-5 #08				0.09					
Tetrachloroethene (PCE)	9 / 292	3%	0.00004 : 1	0.00016 - 0.004	GW-58D GW-84D		0.005	0.005			0.00011 c	0.005	0.05	30
Tetrahydrofuran	3 / 32	9%	0.01 : 0.05	0.13 - 26	GW-80BR				1.3					
Toluene	27 / 291	9%	0.00013 : 1	0.0009 - 17	GW-80BR		1	1			2.3 n	1	50	40
trans-1,2-Dichloroethene	4 / 199	2%	0.00017 : 0.5	0.00015 - 0.0069	GW-87D		0.1	0.1			0.11 n	0.1	0.09	50
Trichloroethene (TCE)	37 / 295	13%	0.0001 : 1	0.00022 - 0.46	GW-58D		0.005	0.005			0.0017 c	0.005	0.03	5

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Vinyl Chloride	8 / 295	3%	0.00025 : 2	0.00034 - 0.013	GW-58D		0.002	0.002			0.000016 c	0.002	0.002	50
Xylenes, Total	12 / 193	6%	0.001 : 1	0.001 - 2.8	GW-80S		10	10			0.2 n	10	9	5
Hydrazines (mg/L)														
Hydrazine	5 / 40	13%	0.01 : 0.2	0.0027 - 0.18	GW-307						0.000022 c			
Monomethylhydrazine (MMH)	2 / 40	5%	0.01 : 0.2	0.0033 - 0.036	GW-307						0.000022 c			
Semivolatile Organics (mg/L)														
1,2,4-Trichlorobenzene	4 / 297	1%	0.0009 : 5	0.0007 - 0.007	GW-69D		0.07	0.07			0.0082 n	0.07	2	50
1,2-Dichlorobenzene	5 / 276	2%	0.0009 : 5	0.001 - 0.099	GW-49D		0.6	0.6			0.37 n	0.6	2	2
1,3-Dichlorobenzene	2 / 279	1%	0.0009 : 5	0.001 - 0.001	CHESTNUT ST 1A/2 GW-25		NA				0.00043 c	0.04	2	50
1,4-Dichlorobenzene	3 / 276	1%	0.0009 : 5	0.002 - 0.02	GW-80BR		0.075	0.005			0.00043 c	0.005	0.2	8
2,4-Dichlorophenol	2 / 272	1%	0.0009 : 5	0.001 - 0.001	GW-58D GW-69D		NA				0.11 n	0.01	30	2
2,4-Dimethylphenol	2 / 272	1%	0.0009 : 5	0.004 - 0.006	GW-49D						0.73 n	0.06	40	50
2,4-Dinitrophenol	1 / 274	0.4%	0.005 : 25	0.002 - 0.002	GW-49D						0.073 n	0.2	50	20
2,6-Dinitrotoluene	1 / 276	0.4%	0.002 : 5	0.074 - 0.074	GW-16		NA				0.037 n			
2-Chlorophenol	3 / 274	1%	0.0009 : 5	0.001 - 0.001	GW-55D GW-58D GW-69D		NA				0.18 n	0.01	20	7
2-Methylphenol (o-Cresol)	3 / 261	1%	0.0009 : 5	0.002 - 0.022	GW-80D						1.8 n			
2-Nitrophenol	2 / 274	1%	0.0009 : 5	0.009 - 0.02	GW-7									
3&4-Methylphenol	3 / 21	14%	0.005 : 5	0.0058 - 0.026	GW-80BR GW-80D						1.8 n			
4-Bromophenyl-phenylether	3 / 276	1%	0.002 : 5	0.001 - 0.006	GW-69D									
4-Chloroaniline	1 / 235	0.4%	0.0009 : 10	0.01 - 0.01	IW-4						0.0012 c	0.02	50	0.3
4-Chlorophenyl-phenylether	3 / 276	1%	0.0009 : 5	0.002 - 0.006	GW-10D									
4-Methylphenol (p-Cresol)	6 / 246	2%	0.003 : 5	0.003 - 0.19	GW-80S						0.18 n			
4-Nitrophenol	4 / 274	1%	0.005 : 25	0.001 - 0.024	GW-69D		NA							
Benzoic Acid	5 / 250	2%	0.005 : 25	0.002 - 0.031	GW-49D						150 n			
Benzyl Alcohol	1 / 259	0.4%	0.005 : 10	0.008 - 0.008	GW-69D						18 n			
bis(2-EthylHexyl)phthalate	83 / 319	26%	0.0006 : 5	0.0002 - 85	P5		0.006	0.006			0.0048 c	0.006		50
Butylbenzylphthalate	1 / 289	0.3%	0.002 : 5	0.0091 - 0.0091	GW-308		NA				0.035 c			
Diethylphthalate	21 / 292	7%	0.002 : 5	0.0002 - 0.073	M-24/L-117		NA				29 n	2	50	9
Di-n-butylphthalate	25 / 289	9%	0.002 : 5	0.0002 - 0.012	B-03		NA				3.7 n			
Di-n-octylphthalate	1 / 289	0.3%	0.002 : 5	0.018 - 0.018	GW-81D									
Isophorone	1 / 276	0.4%	0.0009 : 5	0.003 - 0.003	GW-69D		NA				0.071 c			
Naphthalene	8 / 244	3%	0.0009 : 5	0.00026 - 0.008	GW-49D		NA		0.14		0.00014 c*	0.14	1	20
N-Nitrosodimethylamine	163 / 271	60%	0.000002 : 0.01	0.0000022 - 0.026	GW-69D				0.00001		0.00000042 c			
N-Nitrosodiphenylamine	76 / 315	24%	0.0009 : 5	0.0003 - 5.2	IW-2						0.014 c			
Phenol	11 / 277	4%	0.0009 : 5	0.002 - 1	SB-4		NA				11 n	1	50	2
Pyrene	1 / 240	0.4%	0.0001 : 5	0.0005 - 0.0005	GW-86D		NA				1.1 n	0.08		0.02
Polyaromatic Hydrocarbons (mg/L)														
1-Methylnaphthalene	14 / 36	39%	0.001 : 0.01	0.002 - 0.082	GW-16						0.0023 c			
2-Methylnaphthalene	5 / 61	8%	0.0002 : 0.01	0.0019 - 0.11	GW-16						0.15 n	0.01	2	20
Acenaphthene	4 / 76	5%	0.0002 : 0.01	0.003 - 0.006	B-03		NA				2.2 n	0.02		6
Acenaphthylene	22 / 76	29%	0.0001 : 0.01	0.00162 - 0.097	IW-10						1.1 n	0.03	10	0.04
Anthracene	5 / 82	6%	0.000028 : 0.01	0.00004 - 0.003	GW-16		NA				11 n	0.06		0.03
Benzo(a)anthracene	5 / 82	6%	0.000017 : 0.01	0.000155 - 0.004	GW-16		NA				0.000029 c	0.001		1
Benzo(a)pyrene	5 / 82	6%	0.000019 : 0.01	0.000027 - 0.0023	GW-13		0.0002	0.0002			0.0000029 c	0.0002		0.5
Benzo(b)fluoranthene	6 / 82	7%	0.000033 : 0.01	0.000039 - 0.019	GW-16		NA				0.000029 c	0.001		0.4
Benzo(g,h,i)perylene	4 / 82	5%	0.000094 : 0.01	0.00058 - 0.014	GW-16		NA				1.1 n	0.05		0.02
Benzo(k)fluoranthene	3 / 82	4%	0.0000095 : 0.01	0.000034 - 0.0016	GW-13		NA				0.00029 c	0.001		0.1

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Chrysene	5 / 82	6%	0.000056 : 0.01	0.00009 - 0.0014	GW-13		NA				0.0029 c	0.002		0.07
Dibenzo(a,h)anthracene	1 / 82	1%	0.000028 : 0.01	0.0051 - 0.0051	GW-13						0.0000029 c	0.0005		0.04
Fluoranthene	10 / 76	13%	0.000019 : 0.01	0.00031 - 0.004	GW-16						1.5 n	0.09		0.2
Fluorene	3 / 82	4%	0.0001 : 0.01	0.00022 - 0.00068	GW-28D		NA				1.5 n	0.03		0.04
Indeno (1,2,3-cd) pyrene	3 / 82	4%	0.000061 : 0.01	0.0006 - 0.0024	GW-13		NA				0.000029 c	0.0005		0.1
Naphthalene	19 / 74	26%	0.0002 : 0.05	0.001 - 1	B-03		NA		0.14		0.00014 c*	0.14	1	20
Phenanthrene	8 / 82	10%	0.000044 : 0.01	0.00011 - 0.008	GW-16		NA				1.1 n	0.04		10
Pyrene	5 / 82	6%	0.0001 : 0.01	0.00091 - 0.0017	GW-101		NA				1.1 n	0.08		0.02
Pesticides/PCBs (mg/L)														
4,4'-DDD	2 / 137	1%	0.0000038 : 0.001	0.0000118 - 0.0001	GW-69D						0.00028 c	0.0002		0.05
4,4'-DDE	4 / 137	3%	0.0000038 : 0.001	0.0000053 - 0.000124	GW-10D						0.0002 c	0.00005		0.4
4,4'-DDT	4 / 137	3%	0.0000038 : 0.001	0.0000057 - 0.00012	GW-49D						0.0002 c*	0.0003		0.001
Aldrin	6 / 141	4%	0.0000019 : 0.0005	0.000012 - 0.000077	IW-11		NA				0.000004 c	0.0005	0.002	0.02
Alpha-BHC	5 / 137	4%	0.0000019 : 0.0005	0.00005 - 0.00032	GW-29D						0.000011 c			
Beta-BHC	9 / 137	7%	0.0000019 : 0.0005	0.0000028 - 0.000123	GW-10D						0.000037 c			
Delta-BHC	5 / 137	4%	0.0000055 : 0.0005	0.00007 - 0.00014	GW-27S						0.000011 c			
Dieldrin	1 / 141	1%	0.0000038 : 0.001	0.0000041 - 0.0000041	MP-1 #08		NA				0.0000042 c	0.0001	0.008	0.0005
Endosulfan I	2 / 137	1%	0.0000019 : 0.0005	0.000053 - 0.000054	GW-27S						0.22 n			
Endosulfan II	2 / 137	1%	0.0000038 : 0.001	0.0000085 - 0.000039	GW-10D						0.22 n			
Endrin	4 / 144	3%	0.0000038 : 0.001	0.0000041 - 0.000055	GW-10D		0.002	0.002			0.011 n	0.002		0.005
Endrin Aldehyde	3 / 136	2%	0.0000038 : 0.001	0.0000107 - 0.00014	GW-60S						0.011 n			
Endrin Ketone	1 / 124	1%	0.0000038 : 0.001	0.000022 - 0.000022	GW-76S						0.011 n			
Gamma-BHC (Lindane)	7 / 144	5%	0.0000019 : 0.001	0.0000034 - 0.00011	GW-25		0.0002	0.0002			0.000061 c			
Gamma-Chlordane	1 / 136	1%	0.0000019 : 0.005	0.0000029 - 0.0000029	MP-1 #08		0.002				0.00019 c*	0.002		0.002
Heptachlor	5 / 141	4%	0.0000019 : 0.01	0.000013 - 0.000089	GW-10D		0.0004	0.0004			0.000015 c	0.0004	0.002	0.001
Heptachlor Epoxide	6 / 141	4%	0.0000019 : 0.0005	0.000052 - 0.00022	GW-76S		0.0002	0.0002			0.0000074 c*	0.0002	0.007	0.002
Methoxychlor	1 / 144	1%	0.000019 : 0.005	0.0003 - 0.0003	GW-LPB-11		0.04	0.04			0.18 n	0.04		0.01
PCB-1016	1 / 29	3%	0.000095 : 0.006	0.0016 - 0.0016	GW-54S		0.0005	0.0005			0.00096 c**			
PCB-1254	1 / 29	3%	0.000095 : 0.012	0.00364 - 0.00364	GW-10D		0.0005	0.0005			0.000034 c*			
Herbicides (mg/L)														
2,4,5-T	4 / 9	44%	0.0000095 : 0.0000098	0.00001 - 0.000065	GW-10D		NA				0.37 n			
2,4,5-TP	2 / 27	7%	0.0000095 : 0.001	0.0000303 - 0.00017	MP-1 #08		0.05	0.05			0.29 n			
2,4-D	2 / 27	7%	0.00006 : 0.01	0.000108 - 0.00137	GW-10D		0.07	0.07			0.37 n			
2,4-DB	1 / 9	11%	0.000095 : 0.000098	0.00038 - 0.00038	MP-1 #16						0.29 n			
Dalapon	1 / 12	8%	0.00024 : 0.003	0.00037 - 0.00037	GW-87D		0.2	0.2			1.1 n			
Dinoseb	2 / 12	17%	0.00004 : 0.000049	0.000081 - 0.000203	GW-10D		0.007	0.007			0.037 n			
MCPA	1 / 9	11%	0.048 : 0.049	0.47 - 0.47	GW-10D		NA				0.018 n			
MCPP	1 / 9	11%	0.048 : 0.049	0.067 - 0.067	GW-10D						0.037 n			
Picloram	4 / 12	33%	0.00004 : 0.001	0.00069 - 0.041	GW-10D		0.5	0.5			2.6 n			
Opex/Kempore (mg/L)														
Kempore (Azodicarbonamide)	4 / 35	11%	0.1 : 4.5	0.91 - 3.5	GW-LPB-11									
OPEX	1 / 33	3%	0.02 : 1	0.046 - 0.046	GW-10D									
Metals, Total (mg/L)														
Aluminum, Total	45 / 99	45%	0.019 : 0.2	0.044 - 191	MB-3	7.15				0.05	37 n			
Antimony, Total	2 / 70	3%	0.005 : 0.2	0.0027 - 0.006	GW-80S	0.0173	0.006	0.006			0.015 n	0.006		8
Arsenic, Total	17 / 96	18%	0.002 : 0.2	0.005 - 0.087	GW-35S	0.00505	0.01	0.01			0.000045 c	0.01		0.9
Barium, Total	70 / 96	73%	0.005 : 0.2	0.005 - 0.399	MB-3	0.0239	2	2			7.3 n	2		50
Beryllium, Total	5 / 73	7%	0.001 : 0.02	0.00039 - 0.009	MP-3 #06	0.001	0.004	0.004			0.073 n	0.004		0.2
Boron, Total	3 / 3	100%		0.0254 - 0.0314	CHESTNUT ST 1		NA				7.3 n			
Cadmium, Total	9 / 80	11%	0.0009 : 0.02	0.001 - 0.022	GW-55D	0.005	0.005	0.005			0.018 n	0.005		0.004
Calcium, Total	178 / 179	99%	5 : 5	2.64 - 1000	GW-80BR	162								
Chromium, Total	99 / 426	23%	0.0015 : 0.03	0.0007 - 20	GW-10D	0.019	0.1	0.1			55 n	0.1		0.3

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Cobalt, Total	21 / 70	30%	0.01 : 0.05	0.00078 - 0.771	MP-4 #10	0.0478					0.011 n			
Copper, Total	33 / 76	43%	0.0019 : 0.2	0.0029 - 0.45	ALTRON B1	0.0401	1.3 TT**	1.3 TT Action Level		1	1.5 n			
Hexavalent Chromium, Total	7 / 82	9%	0.005 : 0.015	0.02 - 60	GW-7						0.11 n	0.1		0.3
Iron, Total	278 / 355	78%	0.025 : 1.5	0.03 - 440	GW-55D	30.7				0.3	26 n			
Lead, Total	13 / 95	14%	0.0019 : 0.1	0.003 - 0.4	GW-80S	0.0034	0.015 TT**	0.015 TT				0.015		0.01
Lithium, Total	1 / 1	100%		0.0012 - 0.0012	MP-2 #12						0.073 n			
Magnesium, Total	157 / 159	99%	5 : 5	0.12 - 350	GW-62BR	25.3								
Manganese, Total	109 / 128	85%	0.01 : 0.01	0.007 - 62.6	MP-4 #10	2.61	NA			0.05	0.88 n			
Mercury, Total	3 / 80	4%	0.00012 : 0.2	0.0003 - 0.00058	GW-80S	0.0002	0.002	0.002			0.00063 n	0.002		0.02
Molybdenum, Total	1 / 3	33%	0.0019 : 0.0019	0.0043 - 0.0043	CHESTNUT ST 1		NA				0.18 n			
Nickel, Total	28 / 73	38%	0.0019 : 0.04	0.002 - 0.839	MP-4 #10	0.0719	NA		0.1		0.73 n	0.1		0.2
Potassium, Total	143 / 175	82%	0.5 : 100	0.56 - 370	GW-65BR	7.22								
Selenium, Total	2 / 79	3%	0.0013 : 0.2	0.0033 - 0.01	MB-3	0.002	0.05	0.05			0.18 n	0.05		0.1
Silicon, Total	23 / 23	100%		1.8 - 47	GW-80S									
Silver, Total	1 / 80	1%	0.0016 : 0.1	0.117 - 0.117	MB-3	0.571	NA			0.1	0.18 n	0.1		0.007
Sodium, Total	189 / 190	99%	5 : 5	1.8 - 2100	GW-62BR	105			20					
Strontium, Total	5 / 5	100%		0.11 - 1.28	GW-87D		NA				22 n			
Thallium, Total	2 / 69	3%	0.005 : 0.2	0.012 - 0.03	MB-3	0.004	0.002	0.002			0.0024 n	0.002		3
Trivalent Chromium, Total	23 / 52	44%	0.005 : 0.015	0.006 - 79	GW-10D						55 n	0.1		0.6
Uranium	2 / 3	67%	0.002 : 0.002	0.003 - 0.004	BUTTERS ROW 1			0.03	0.02		0.11 n			
Vanadium, Total	10 / 70	14%	0.0015 : 0.2	0.0009 - 0.691	MB-3	0.006					0.18 n	0.03		4
Zinc, Total	28 / 76	37%	0.0086 : 0.1	0.017 - 22	GW-31D	0.027	NA			5	11 n	5		0.9
Metals, Filtered (mg/L)														
Aluminum, Filtered	305 / 791	39%	0.05 : 20	0.05 - 280	GW-69D	5.01				0.05	37 n			
Antimony, Filtered	11 / 282	4%	0.0019 : 20	0.00061 - 0.25	SB-4	0.0187	0.006	0.006			0.015 n	0.006		8
Arsenic, Filtered	29 / 232	13%	0.001 : 1	0.0015 - 0.13	MP-1 #17	0.0034	0.01	0.01			0.000045 c	0.01		0.9
Barium, Filtered	198 / 256	77%	0.01 : 1	0.006 - 0.87	GW-65BR	0.0222	2	2			7.3 n	2		50
Beryllium, Filtered	12 / 235	5%	0.001 : 0.2	0.0026 - 0.038	SB-4		0.004	0.004			0.073 n	0.004		0.2
Boron, Filtered	5 / 6	83%	0.013 : 0.013	0.013 - 0.144	GW-10D		NA				7.3 n			
Cadmium, Filtered	18 / 286	6%	0.0005 : 0.2	0.001 - 0.034	SB-4	0.005	0.005	0.005			0.018 n	0.005		0.004
Calcium, Filtered	1510 / 1516	100%	0.1 : 5	0.17 - 651	GW-19S	156								
Chromium, Filtered	383 / 1977	19%	0.001 : 0.5	0.00067 - 33	SB-4	0.0098	0.1	0.1			55 n	0.1		0.3
Cobalt, Filtered	57 / 282	20%	0.0017 : 1	0.0022 - 5.3	MP-3 #09	0.007					0.011 n			
Copper, Filtered	46 / 297	15%	0.0029 : 2	0.006 - 1.8	GW-69D	0.0115	1.3 TT**	1.3 TT Action Level		1	1.5 n			
Hexavalent Chromium, Filtered	7 / 143	5%	0.003 : 0.25	0.0082 - 0.05	MP-1 #11 MP-1 #13						0.11 n	0.1		0.3
Iron as Fe+2	51 / 77	66%	0.2 : 0.2	0.22 - 24	PZ-W2									
Iron as Fe+3	51 / 77	66%	0.2 : 0.2	0.22 - 37	PZ-W3									
Iron, Filtered	1236 / 1537	80%	0.01 : 50	0.023 - 930	GW-84D	0.151				0.3	26 n			
Lead, Filtered	16 / 283	6%	0.00078 : 1	0.00114 - 0.056	ALTRON B3	0.002	0.015 TT**	0.015 TT				0.015		0.01
Lithium, Filtered	1 / 5	20%	0.05 : 0.05	0.0777 - 0.0777	GW-87D						0.073 n			
Magnesium, Filtered	1402 / 1474	95%	0.05 : 5	0.19 - 490	SB-1	24.6								
Manganese, Filtered	1278 / 1356	94%	0.01 : 0.015	0.00039 - 540	GW-84D	1.485	NA			0.05	0.88 n			
Mercury, Filtered	3 / 229	1%	0.0001 : 0.0005	0.00021 - 0.0023	SB-5		0.002	0.002			0.00063 n	0.002		0.02
Molybdenum, Filtered	5 / 6	83%	0.0018 : 0.0018	0.0022 - 0.0047	MP-1 #08		NA				0.18 n			
Nickel, Filtered	53 / 282	19%	0.0016 : 2	0.0019 - 1.5	SB-4	0.02	NA		0.1		0.73 n	0.1		0.2
Potassium, Filtered	1321 / 1510	87%	0.02 : 50	0.26 - 340	BR-1	6.44								
Selenium, Filtered	7 / 241	3%	0.0012 : 2	0.002 - 0.006	GW-83M	0.003	0.05	0.05			0.18 n	0.05		0.1
Silicon, Filtered	27 / 27	100%		0.00409 - 39.3	GW-65BR									
Sodium, Filtered	1544 / 1550	100%	1 : 5	2 - 6000	SB-4	123			20					
Strontium, Filtered	6 / 6	100%		0.028 - 0.532	MP-1 #16		NA				22 n			
Thallium, Filtered	2 / 235	1%	0.001 : 4	0.019 - 2	SB-3	0.004	0.002	0.002			0.0024 n	0.002		3

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Trivalent Chromium, Filtered	3 / 50	6%	0.01 : 11.13	0.023 - 0.22	GW-78S						55 n	0.1		0.6
Vanadium, Filtered	10 / 240	4%	0.0019 : 1	0.002 - 0.21	GW-52S	0.006					0.18 n	0.03		4
Zinc, Filtered	85 / 271	31%	0.02 : 10	0.0052 - 5.77	GW-24	0.02675	NA			5	11 n	5		0.9
Inorganics (mg/L)														
Acidity as CaCO3	10 / 10	100%		32 - 2117	GW-7									
Alkalinity	25 / 25	100%		1 - 230	GW-61BR									
Bicarbonate alkalinity as CaCO3	1678 / 1754	96%	1 : 20	1 - 1280	MG-02-A									
Bromide	1 / 1	100%		0.06 - 0.06	MP-5									
Bromide, Filtered	7 / 27	26%	0.5 : 100	0.54 - 8	GW-58D									
Carbonate Alkalinity as CaCO3	23 / 1674	1%	1 : 20	1 - 640	GW-14									
Carbonate as C (Total)	16 / 16	100%		11 - 180	GW-50D									
Chemical Oxygen Demand (COD)	10 / 17	59%	15 : 20	22 - 210	GW-10D									
Chloride	2274 / 2280	100%	1 : 3	1 - 4890	SB-4	232				250				
CO2 as C	4 / 4	100%		7 - 171	GW-62BR									
Color, Apparent **(Color Units)**	6 / 8	75%	5 : 5	30 - 140	GW-10D					15				
Color, True **(Color Units)**	2 / 12	17%	5 : 5	10 - 650	GW-45S					15				
Cyanide	3 / 50	6%	0.01 : 20	0.0216 - 0.053	SL-5		0.2	0.2			0.73 n	0.2		0.03
Dissolved Organic Carbon (DOC)	27 / 27	100%		1.2 - 95	GW-80BR									
Dissolved Oxygen	40 / 40	100%		0.6 - 11.2	GW-73S									
Flash Point **(°F)**	3 / 3	100%		200 - 200	ECS-2 ECS-6 GW-308									
Fluoride	1 / 25	4%	0.2 : 0.5	0.12 - 0.12	MP-5		4	4		2	2.2 n			
Gross alpha **(pCi/L)**	3 / 3	100%		8.3 - 19	GW-87D			15 pCi/L						
Gross Beta **(pCi/L)**	3 / 3	100%		6.3 - 41	GW-87D			4 millirem/yr						
Heterotrophic Plate Count **(col/mL)**	5 / 5	100%		31 - 4566	B-03									
Nitrate & Nitrite as N	25 / 40	63%	1 : 1	0.069 - 9.4	MP-1 #12		10	10						
Nitrate as N	398 / 513	78%	0.05 : 10	0.05 - 18	GW-15 GW-6S		10	10			58 n			
Nitrite as N	125 / 400	31%	0.005 : 1	0.001 - 13.4	GW-86M		1	1			3.7 n			
Nitrogen, Ammonia	2212 / 2450	90%	0.01 : 0.5	0.042 - 2300	GW-45S		NA							
Nitrogen, Total Kjeldahl as N	16 / 23	70%	0.1 : 1	0.27 - 230	GW-10D									
Odor **(TON)**	6 / 6	100%		1 - 4	GW-10D					3				
Orthophosphate as P	20 / 59	34%	0.02 : 0.5	0.02 - 307	IW-3									
Oxidation Reduction Potential **(mv)**	11 / 11	100%		165 - 350	GW-10S									
pH **(pH units)**	1805 / 1805	100%		3.2 - 12.31	GW-65BR					6.5				
Phosphate, Total as P	12 / 18	67%	0.1 : 1	0.12 - 1.5	BUTTERS ROW 1									
Phosphorous	4 / 27	15%	0.1 : 1	0.23 - 1.3	GW-77S		NA				0.00073 n			
Radium 226 **(pCi/L)**	3 / 3	100%		1.1 - 1.6	CHESTNUT ST 1			5 pCi/L						
Radium 228 **(pCi/L)**	3 / 3	100%		0.3 - 1.1	GW-87D			5 pCi/L						
Radon **(pCi/L)**	3 / 3	100%		1100 - 2300	CHESTNUT ST 1									
Specific Conductance **(umhos/cm)**	2008 / 2008	100%		16.2 - 19500	MP-4 #10									
Specific Gravity **(g/mL)**	36 / 36	100%		0.9 - 1.02	MP-4 #10									
Specific Gravity **(Ratio)**	23 / 23	100%		0.96 - 1.12	MP-3 #06									
Sulfate as SO4	2268 / 2297	99%	0.1 : 40	0.33 - 22900	SB-4	48.76				250				
Sulfide	9 / 27	33%	1 : 1	1 - 6	GW-77S GW-80S									
Total Alkalinity as CaCO3	584 / 592	99%	1 : 50	1.8 - 533	GW-62BRD									
Total Dissolved Solids (TDS)	173 / 177	98%	50 : 50	26 - 12900	MP-4 #10					500				
Total Organic Carbon (TOC)	128 / 133	96%	1 : 1	1.2 - 240	MP-4 #10									
Total Suspended Solids	1 / 9	11%	5 : 5	48 - 48	GW-87D									
Turbidity **(NTU)**	26 / 27	96%	0.1 : 0.1	0.12 - 110	GW-80BR			TT						

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)		Massachusetts MCL (mg/L)		Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)		GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)
Coliform (/100 mL)																	
Total Coliform Bacteria	1 / 9	11%	1 : 1	2 - 2	M-24/L-87A												
Field Measurements (mg/L)																	
Alkalinity	47 / 49	96%	1 : 1	1 - 1133	GW-15												
Chloramine	6 / 6	100%		0.01 - 0.12	BUTTERS ROW PLANT RAW		4		4	MRDL			3.7	n			
Chlorine, Free	2 / 6	33%		0.01 - 0.04	TOWN PARK		4						3.7	n			
Chlorine, Total	5 / 6	83%		0.01 - 0.06	BUTTERS ROW PLANT RAW		4						3.7	n			
Dissolved Oxygen	336 / 336	100%		0.1 - 15.2	PZ-16RR												
Eh **(mv)**	27 / 27	100%		5 - 436	GW-76S												
Hardness as CaCO3	7 / 7	100%		43 - 92	ALTRON B3												
Nitrogen, Ammonia	450 / 467	96%	0.1 : 1	0.05 - 1200	GW-55D			NA									
Oxidation Reduction Potential **(mv)**	273 / 273	100%		-200 - 243	GW-39												
pH **(pH units)**	939 / 939	100%		3.4 - 13.31	BR-1							6.5					
Specific Conductance **(umhos/cm)**	448 / 448	100%		1 - 27000	GW-55D												
Specific Gravity **(g/mL)**	38 / 38	100%		0.99 - 1.03	MP-2 #11 MP-3 #10												
Temperature **(°C)**	228 / 228	100%		5 - 21	GW-16												
Total Dissolved Solids (TDS)	58 / 60	97%	58 : 120	38 - 8560	GW-7							500					
Viscosity **(cpoise)**	17 / 17	100%		1.22 - 3.5	GW-80D												
TPH (mg/L)																	
Fuel Oil #2 (C9-C25)	6 / 62	10%	0.1 : 0.5	6.2 - 14	GW-16												
Fuel Oil #6 (C9-C36)	3 / 62	5%	0.1 : 10	0.27 - 0.38	GW-101												
Motor Oil (C14-C36)	1 / 9	11%	0.1 : 0.1	1.2 - 1.2	B-03												
Motor Oil (C9-C36)	4 / 53	8%	0.1 : 10	4 - 10	B-03												
NAPHTHA	1 / 4	25%	0.13 : 0.16	0.14 - 0.14	GW-87D												
Unmatched	14 / 26	54%	0.1 : 2.5	0.14 - 29	GW-16												
EPH (mg/L)																	
2-Methylnaphthalene	1 / 98	1%	0.0005 : 10	13 - 13	GW-16								0.15	n	0.01	2	20
Acenaphthylene	3 / 98	3%	0.0005 : 10	0.012 - 0.048	B-10								1.1	n	0.03	10	0.04
Benzo(a)anthracene	1 / 98	1%	0.0005 : 10	0.14 - 0.14	B-10			NA					0.000029	c	0.001		1
Benzo(g,h,i)perylene	1 / 98	1%	0.0005 : 10	0.018 - 0.018	B-10			NA					1.1	n	0.05		0.02
Fluorene	2 / 98	2%	0.0005 : 10	0.013 - 0.016	B-10			NA					1.5	n	0.03		0.04
Naphthalene	1 / 98	1%	0.0005 : 10	0.01 - 0.01	B-10			NA			0.14		0.00014	c*	0.14	1	20
C11-C22 Aromatics (FID)	37 / 98	38%	0.01 : 100	0.059 - 220	GW-16						0.2				0.2	50	5
C19-C36 Aliphatics (PID)	4 / 98	4%	0.01 : 100	0.12 - 0.29	GW-16						14				14		50
C9-C18 Aliphatics (FID)	9 / 98	9%	0.01 : 100	0.05 - 7	B-10						0.7				0.7	5	50
EPH Concentration (Total)	38 / 84	45%	0.01 : 100	0.05 - 220	GW-16												
VPH (mg/L)																	
Benzene	2 / 135	1%	0.0005 : 0.125	0.0018 - 0.0021	GW-10D		0.005		0.005				0.00041	c	0.005	2	10
Ethylbenzene	15 / 140	11%	0.002 : 0.125	0.0065 - 1.2	B-10		0.7		0.7				0.0015	c	0.7	20	5
Methyl-t-butyl ether (MTBE)	2 / 134	1%	0.002 : 0.125	0.0079 - 0.03	MP-5 #08						0.07	0.02	0.012	c	0.07	50	50
o-Xylene	3 / 40	8%	0.002 : 0.005	0.0063 - 0.012	IW-6		10		10				1.4	n	10	9	5
Toluene	17 / 135	13%	0.002 : 0.125	0.0069 - 3.3	B-10 GW-16		1		1				2.3	n	1	50	40
Xylenes, Total	7 / 123	6%	0.005 : 0.125	0.005 - 0.17	B-10		10		10				0.2	n	10	9	5
C5-C8 Aliphatics (FID)	64 / 146	44%	0.01 : 0.085	0.019 - 16	B-10						0.3				0.3	3	50
C9-C10 Aromatics (PID)	9 / 146	6%	0.01 : 1.25	0.03 - 1.7	IW-6						0.2				0.2	7	50
C9-C12 Aliphatics (FID)	29 / 146	20%	0.01 : 1.25	0.011 - 1	B-10						0.7				0.7	5	50
VPH Concentration (Total)	63 / 132	48%	0.01 : 0.085	0.011 - 17	B-10												

Table 6.2-2
Summary of Analytical Data for Groundwater - OU3

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Parameter Name	Frequency of Detection	Percent Detected	Range of SQL Limits	Range of Detected Concentrations	Location of Maximum Detection	Industriplex Background (mg/L)	Federal MCL (mg/L)	Massachusetts MCL (mg/L)	Massachusetts Drinking Water Guidelines (mg/L)	Massachusetts Secondary MCL (mg/L)	Regional Screening Levels (mg/L)	GW-1 MCP (mg/L)	GW-2 MCP (mg/L)	GW-3 MCP (mg/L)

umhos/cm = microOhms per centimeter
°C = degrees Celsius
°F = degrees Fahrenheit
EPH = Extractable Petroleum Hydrocarbon
FID = Flame Ionization Detector
g/mL = grams per milliliter

MCL = Maximum Contaminant Limit
MCP = Massachusetts Contingency Plan
mg/L = milligrams per Liter
mv = millivolts
NTU = Nephelometric Turbidity Unit
pCi/L = picocurie per Liter

PCB = Polychlorinated Biphenyl
PID = Photoionization Detector
SQL = Sample Quantitation Limit
TPH = Total Petroleum Hydrocarbon
VPH = Volatile Petroleum Hydrocarbon

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Revised by / Date: KJC 10/10/08
Checked by / Date: SB 10/14/08

Roux Associates, Inc.; Environmental Science and Engineering, Inc.; PTI Environmental Services. 1991. Ground-water/Surface Water Investigation Plan Phase I Remedial Investigation Final Report. Prepared for: Industri-Plex Site Remedial Trust. June 7.
USEPA, Office of Water. 2006. 2006 Edition of the Drinking Water Standards and Health Advisories. EPA 822-R-06-013. August.
NA = Not Available
SDWR = Secondary Drinking Water Regulation
TT = Treatment Technique
TT** = at tap, Copper action level 1.3 mg/L; lead action level 0.015 mg/L.
MADEP, Office of Research and Standards. 2008. Standards and Guidelines for Contaminants in Massachusetts Drinking Waters. Spring.
MRDL = Maximum Residual Disinfectant Level
TT = Treatment Technique
USEPA. 2008. USEPA Regional Screening Levels Table. September 12.
n = Noncancer PRG
c = Cancer PRG
c* = Cancer PRG where Noncancer PRG < 100 x Cancer PRG
c** = Cancer PRG where Noncancer PRG < 10 x Cancer PRG

Table 6.2-3
Most Recent Specific Conductance Data for Groundwater

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Sample Date	Conductivity (µhmos/cm)	Type	Ground Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
GW-22D	1/19/2000	702000	DAPL	85.2	55.6	50.6
GW-36	1/27/2000	668000	DAPL	84.3	57.3	47.3
GW-37	1/27/2000	465000	DAPL	81.8	62.5	52.5
GW-44D	7/21/1999	510000	DAPL	83.5	28.5	18.5
GW-45D	7/21/1999	440000	DAPL	89.8	37.3	27.3
GW-83D	11/8/2005	53800	DAPL	79.9	-30.77	-40.77
MP-1 #01	3/25/2003	122000	DAPL	84.9	47.4	46.4
MP-1 #03	3/25/2003	81800	DAPL	84.9	52.4	51.4
MP-2 #01	7/31/2003	198000	DAPL	83.58	46.64	45.64
MP-2 #02	3/27/2003	148000	DAPL	83.58	49.14	48.14
MP-2 #03	3/27/2003	79200	DAPL	83.58	51.64	50.64
MP-2 #04	3/27/2003	56800	DAPL	83.58	54.14	53.14
MP-2 #06	3/27/2003	22400	DAPL	83.58	57.14	56.14
MP-2 #09	7/31/2003	36900	DAPL	83.58	61.64	60.64
MP-3 #02	3/26/2003	79000	DAPL	90.02	30.5	29.5
MP-3 #04	3/26/2003	31200	DAPL	90.02	39.5	38.5
MP-4 #05	3/28/2003	46500	DAPL	96.5	-14	-15
MP-4 #08	6/29/2000	292000	DAPL	96.5	22	21
MP-4 #09	6/29/2000	255000	DAPL	96.5	32	31
GW-10D	1/28/2000	3890	Diffuse	83.5	66.3	56.3
GW-201S	11/14/2005	3830	Diffuse	81.1	79.4	69.4
GW-202D	11/22/2005	4000	Diffuse	84.5	74.4	64.4
GW-27D	1/19/2000	11000	Diffuse	88.4	67.5	57.5
GW-40D	4/23/1998	3080	Diffuse	86.4	51.4	41.4
GW-55S	11/17/2005	6020	Diffuse	79.8	74.8	69.8
GW-62BR	11/14/2005	8050	Diffuse	81.9	1.6	-23.4
GW-62BRD	11/24/2003	16400	Diffuse	82	-23	-63
GW-69D	7/21/1999	15000	Diffuse	91.1	55.1	45.1
GW-7	1/24/2000	8390	Diffuse	82.7	74.2	69.2
GW-79S	11/22/2005	3580	Diffuse	79.3	79.3	69.3
GW-86D	5/17/2006	4200	Diffuse	77.9	-2.1	-12.1
GW-87D	5/17/2006	6000	Diffuse	78.3	-18.7	-28.7
MP-1 #04	3/25/2003	19200	Diffuse	84.9	54.9	53.9
MP-1 #05	3/25/2003	9410	Diffuse	84.9	57.4	56.4
MP-1 #06	3/25/2003	6110	Diffuse	84.9	58.9	57.9
MP-2 #07	3/27/2003	4980	Diffuse	83.58	58.64	57.64
MP-2 #08	3/27/2003	3760	Diffuse	83.58	60.14	59.14
MP-3 #06	3/26/2003	11700	Diffuse	90.02	45.5	44.5
MP-3 #07	3/26/2003	10600	Diffuse	90.02	47	46
MP-4 #01	3/28/2003	15200	Diffuse	96.5	-70	-71
MP-4 #02	3/28/2003	15000	Diffuse	96.5	-59	-60
MP-4 #03	3/28/2003	14200	Diffuse	96.5	-47	-48
MP-4 #11	3/27/2003	3190	Diffuse	96.5	41	40
MP-5 #03	10/12/2005	11600	Diffuse	79.48	-19	-21
MP-5 #05	10/12/2005	9310	Diffuse	79.48	-13	-15
MP-5 #06	10/11/2005	9060	Diffuse	79.48	-7	-9

Table 6.2-3
Most Recent Specific Conductance Data for Groundwater

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Sample Date	Conductivity (µhmos/cm)	Type	Ground Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
MG-02-A	4/24/1998	2990	Overlying		47.5	44.5
ALTRON B1	10/21/2004	670	Overlying			
ALTRON B3	7/21/2004	545	Overlying			
AN-1	4/24/1998	446	Overlying	83.8		
AN-2	4/24/1998	152	Overlying	84.48		
B-03	8/10/2000	306	Overlying			74.6
BUTTERS ROW 1	4/16/2003	616	Overlying	85	43.5	33.5
BUTTERS ROW 2	4/16/2003	473	Overlying	81	45	35
CHESTNUT ST 1	4/16/2003	723	Overlying	100	60	45
CHESTNUT ST 1A/2	4/16/2003	535	Overlying	100	55	45
E-10	1/21/2000	793	Overlying			
GT-9D	1/19/2000	665	Overlying	87.62	69.62	54.62
GW-101	8/10/2000	302	Overlying	87.4	80.15	68.65
GW-103BR	5/22/2006	430	Overlying	81.2	-0.8	-25.1
GW-103D	5/22/2006	450	Overlying	81.6	31.6	21.6
GW-10S	11/16/2005	228	Overlying	87.1	82.3	77.3
GW-11	11/7/2000	1030	Overlying	85.6	76.6	71.6
GW-12	1/25/2000	262	Overlying	82	77.2	72.2
GW-13	8/10/2000	48	Overlying	88.6	75.5	70.5
GW-14	10/1/1997	1090	Overlying	86.8	79.9	74.9
GW-15	1/18/2000	2170	Overlying	88.4	74.2	69.2
GW-16	8/10/2000	210	Overlying	90	80.1	75.1
GW-17D	1/20/2000	1950	Overlying	79.4	72.6	67.6
GW-17S	1/28/2000	2010	Overlying	79.4	76.7	71.7
GW-18D	1/20/2000	614	Overlying	86.8	72.2	67.2
GW-19D	1/20/2000	2000	Overlying	87.9	73.1	68.1
GW-19S	8/9/2000	2300	Overlying	87.9	83.2	78.2
GW-20	1/24/2000	204	Overlying	83.5	73.7	68.7
GW-202S	11/22/2005	2440	Overlying	85.2	82.4	74.4
GW-21D	1/20/2000	247	Overlying	83.9	74.6	69.6
GW-21S	1/20/2000	288	Overlying	89.6	80.2	70.2
GW-22S	1/19/2000	994	Overlying	85.2	75.6	70.6
GW-24	11/16/2005	570	Overlying	82.7		
GW-25	11/16/2005	1720	Overlying	83.1		
GW-26	11/16/2005	1660	Overlying	84.9		
GW-27S	1/19/2000	1450	Overlying	88.1	78.1	68.1
GW-28D	1/27/2000	96.6	Overlying	83.6	79.2	69.2
GW-28S	1/27/2000	97.6	Overlying	83.6	81.9	71.9
GW-29D	1/25/2000	1310	Overlying	83.8	64.8	54.8
GW-29S	1/25/2000	352	Overlying	83.3	79.9	69.9
GW-31S	1/20/2000	272	Overlying	90.1	84.1	74.1
GW-32D	8/11/2005	357	Overlying	87.6	65.7	55.7
GW-32S	8/11/2005	87.6	Overlying	87.6	82.6	72.6
GW-33D	1/19/2000	240	Overlying	88.1	72.1	62.1
GW-33S	1/19/2000	114	Overlying	88.2	77.4	67.4
GW-34D	11/15/2005	175	Overlying	88.3	65.3	55.3
GW-34S	1/19/2000	118	Overlying	88.1	77.7	67.7

Table 6.2-3
Most Recent Specific Conductance Data for Groundwater

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Sample Date	Conductivity (µhmos/cm)	Type	Ground Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
GW-34SR	11/15/2005	93.2	Overlying	87.4	82.9	72.9
GW-35S	11/16/2005	676	Overlying	85.2	77.1	67.1
GW-39	11/15/2005	525	Overlying	81.7	78.6	68.6
GW-3D	1/20/2000	797	Overlying	84.1	71.2	61.2
GW-3S	1/20/2000	90.6	Overlying	85.4	75.4	70.4
GW-42S	11/21/2005	363	Overlying	84.5	76	66
GW-43S	7/25/2005	655	Overlying	85.6	77.6	67.6
GW-44S	7/21/1999	170	Overlying	84	74	64
GW-45S	7/21/1999	500	Overlying	89.9	77.9	67.9
GW-46D	4/22/1998	241	Overlying	84.2	76.2	66.2
GW-4D	1/20/2000	2330	Overlying	77.5	68.5	58.5
GW-51D	1/20/2000	1360	Overlying	82.8	73.8	63.8
GW-51S	1/20/2000	220	Overlying	82.9	79.9	74.9
GW-52D	1/18/2000	1280	Overlying	85.8	74.8	64.8
GW-52S	1/18/2000	334	Overlying	85.6	80.6	75.6
GW-53D	1/18/2000	276	Overlying	89.3	77.8	67.8
GW-53S	1/18/2000	46.7	Overlying	89	84	79
GW-54D	1/18/2000	160	Overlying	86.6	76.6	66.6
GW-54S	1/18/2000	172	Overlying	86.4	81.4	76.4
GW-57D	5/23/2006	380	Overlying	95.3	74.3	64.3
GW-59S	7/22/1997	312	Overlying	85.3	75.3	65.3
GW-61BR	5/23/2006	970	Overlying	81.6	9.6	-10.4
GW-61D	5/23/2006	650	Overlying	81.5	40.7	30.7
GW-61S	8/10/2005	306	Overlying	81.7	71.7	61.7
GW-62D	11/14/2005	559	Overlying	82.4	21.4	11.4
GW-62M	5/23/2006	700	Overlying	82.4	52.4	42.4
GW-62S	5/23/2006	350	Overlying	82.3	77.3	67.3
GW-63D	5/22/2006	390	Overlying	81.1	57.1	47.1
GW-63S	5/22/2006	310	Overlying	81.1	73.1	63.1
GW-64D	5/22/2006	680	Overlying	84.1	28.1	18.1
GW-64S	5/4/1999	260	Overlying	84.6	74.1	64.1
GW-65BR	11/11/2005	2490	Overlying	82.8	-27.2	-57.2
GW-65D	5/22/2006	660	Overlying	82.4	-0.9	-15.9
GW-65S	5/22/2006	600	Overlying	82.4	74.4	64.4
GW-66D	8/4/1998	299	Overlying	88.3	55.3	45.3
GW-66S	7/22/1997	260	Overlying	88.4	79.4	69.4
GW-67D	8/9/2005	1650	Overlying	98.2	25.7	10.7
GW-67S	8/9/2005	122	Overlying	98.4	80.9	70.9
GW-68BR	12/10/1998	140	Overlying	90.2	59.2	14.2
GW-69S	7/21/1999	230	Overlying	90.9	77.9	67.9
GW-6D	1/19/2000	312	Overlying	88.4	70.5	60.5
GW-6S	1/19/2000	2070	Overlying	88.7	79	74
GW-71D	8/4/1998	352	Overlying	94.4	54.5	44.5
GW-72D	12/10/1998	900	Overlying	86	74	64
GW-73D	5/23/2006	330	Overlying	83.8	29.3	19.3
GW-73S	12/9/1998	180	Overlying	83.4	68.4	58.4
GW-74D	11/21/2003	562	Overlying	77.7	57.7	47.7

Table 6.2-3
Most Recent Specific Conductance Data for Groundwater

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Sample Date	Conductivity (µhmos/cm)	Type	Ground Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
GW-74S	11/21/2003	542	Overlying	77.7	69.7	57.7
GW-75D	4/22/1998	1090	Overlying	81.4	45.4	35.4
GW-76S	2/4/2003	631	Overlying	86.1	82.9	72.9
GW-77S	2/4/2003	392	Overlying	84	83	73
GW-78S	11/22/2005	1150	Overlying	82.5	82.5	73.5
GW-8	1/24/2000	2900	Overlying	83.19	74.6	69.6
GW-80BR	11/21/2003	889	Overlying	79.3	49.3	9.3
GW-80D	11/21/2003	755	Overlying	79.4	69.4	59.4
GW-80S	11/21/2003	645	Overlying	79.6	75.6	70.6
GW-81BR	12/10/1998	310	Overlying	86.2	65.2	36.2
GW-81D	7/16/1998	285	Overlying	86.1	81	71
GW-83M	11/8/2005	1090	Overlying	79.9	15.9	-4.1
GW-83S	11/8/2005	637	Overlying	79.9	40.9	30.9
GW-84D	10/13/2005	1320	Overlying	79.4	-10.6	-25.6
GW-84M	10/13/2005	625	Overlying	79.4	19.4	4.4
GW-84S	10/12/2005	422	Overlying	79.4	44.4	34.4
GW-85D	10/13/2005	707	Overlying	79.1	-0.9	-10.9
GW-85M	10/13/2005	1440	Overlying	79.1	35.1	15.1
GW-86M	5/17/2006	480	Overlying	77.9	30.9	15.9
GW-86S	5/17/2006	710	Overlying	77.9	63.4	53.4
GW-88D	5/17/2006	750	Overlying			
GW-88M	5/17/2006	710	Overlying			
GW-88S	5/17/2006	680	Overlying			
GW-CA1	11/16/2005	716	Overlying	85.4	83.69	78.69
GW-CA2	2/26/2002	1140	Overlying	85.3	83.52	78.77
IW-10	8/10/2000	455	Overlying			
IW-6	8/10/2000	258	Overlying			
M-2/L-7E	8/30/2002	353	Overlying			
M-24/L-116	11/28/2001	592	Overlying			
M-24/L-117	3/10/2004	430	Overlying			
M-24/L-63	1/29/2004	603	Overlying			
M-24/L-64	1/29/2004	577	Overlying			
M-24/L-65	1/29/2004	505	Overlying			
M-24/L-72A	1/29/2004	350	Overlying			
M-24/L-87A	1/29/2004	628	Overlying			
M-24/L-94	9/14/1999	544	Overlying			
M-25/L-04	10/20/1999	380	Overlying			
M-25/L-05	5/27/2004	205	Overlying	85.6		
MG-02-C	4/24/1998	824	Overlying	80.76	69.5	64.5
MP-1 #07	3/25/2003	1750	Overlying	84.9	60.4	59.4
MP-1 #08	5/13/2001	913	Overlying	84.9	61.9	60.9
MP-1 #16	1/28/2000	2250	Overlying	84.9	74.9	73.9
MP-1 #17	3/25/2003	2960	Overlying	84.9	77.4	76.4
MP-2 #10	3/27/2003	1090	Overlying	83.58	64.14	63.14
MP-2 #11	3/27/2003	185	Overlying	83.58	66.64	65.64
MP-2 #12	3/27/2003	358	Overlying	83.58	69.14	68.14
MP-2 #13	3/27/2003	403	Overlying	83.58	70.64	69.64

Table 6.2-3
Most Recent Specific Conductance Data for Groundwater

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, MA

Location	Sample Date	Conductivity (µhmos/cm)	Type	Ground Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
MP-2 #14	3/27/2003	472	Overlying	83.58	72.14	71.14
MP-2 #15	3/27/2003	438	Overlying	83.58	73.64	72.64
MP-2 #16	3/27/2003	288	Overlying	83.58	76.14	75.14
MP-2 #17	7/31/2003	437	Overlying	83.58	78.64	77.64
MP-3 #08	3/26/2003	1210	Overlying	90.02	48.5	47.5
MP-3 #09	3/26/2003	933	Overlying	90.02	50	49
MP-3 #11	3/26/2003	730	Overlying	90.02	53	52
MP-3 #19	3/26/2003	822	Overlying	90.02	74	73
MP-4 #12	3/27/2003	711	Overlying	96.5	46	45
MP-4 #13	3/27/2003	590	Overlying	96.5	57	56
MP-4 #14	3/27/2003	286	Overlying	96.5	72	71
MP-5 #08	10/11/2005	2010	Overlying	79.48	-1	-3
MP-5 #09	10/11/2005	1790	Overlying	79.48	5	3
MP-5 #11	10/12/2005	1350	Overlying	79.48	11	9
MP-5 #12	10/11/2005	942	Overlying	79.48	33	31
MP-5 #15	10/11/2005	999	Overlying	79.48	55	53
MW-3	4/29/1998	986	Overlying	88.92	85.9	71.4
MW-5	4/29/1998	162	Overlying	87.85	84.9	71.1
MW-8D	4/29/1998	866	Overlying	76.03	58.4	53.6
SL-1D	4/22/1998	273	Overlying		79.7	69.7
SL-2	4/22/1998	147	Overlying		78.5	68.5
SL-3	4/22/1998	775	Overlying		79.5	69.5
SL-5	4/22/1998	2490	Overlying		87.6	77.6
SL-6	4/22/1998	266	Overlying		79.1	69.1
TOWN PARK	4/16/2003	506	Overlying	81.69	52.69	42.69
W-10	1/21/2000	344	Overlying			

ft MSL = elevation in feet above Mean Sea Level
Shown specific conductance results are as reported by laboratory analysis.

Prepared by: BJR 6/21/2008
Checked by: PHT 8/27/2008

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
Number of Proposed Sample Points		182	182	183	183	183	4	10	85	83	85	85	85	85	85	85	85	
B-03	Plant C	X	X	X	X	X		X										Previously analyzed for VOC, SVOC, Metals, Inorganics, hydrocarbons; detected SVOCs low concentrations; Location near transformer, sampling objective to determine presence or absence of PCBs, and current SVOCs concentrations, additional Site-specific analytes proposed in nearby wells GW-101, GW-52S/D
B-07-A	Plant C	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOCS, with no detections; sampling objective to assess nature of impacts near former formaldehyde storage tank
B-10	Plant B	X	X	X	X	X	X											Previously analyzed for VOC, SVOC, inorganics, hydrocarbons; detected TMPs; Sampling objective to assess current VOC, SVOC, NDMA, Metals and inorganics, and EPH/VPH concentrations in vicinity of former EPH/VPH area
ECS-6	Plant D							X										Previously analyzed for SVOCs, NDMA, pest/PCB, metals, inorganics, VPH/EPH; detected low pest/PCB, metals; Sampling objective is to evaluate presence or absence of PCBs. Other down gradient wells are proposed to monitor area near and down gradient of Plant D (GW-307 and GW-3S/D).
GW-1	Pilot Plant/Lab	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, and Inorganics; detected low level VOCs, NDMA, BEHP. Sulfate; Sampling objectives is to determine nature of groundwater impacts near facility boundary. Other nearby wells (GW-32S/D) proposed for additional Site-specific analytes.
GW-101	Plant B Tank Farm	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Metals, Inorganics, VPH/EPH; detected TMPs, BTEX, NDMA, BEHP; Sampling objective is to assess presence or absence of other additional Site-specific analytes in vicinity of Plant B between extraction wells and East Ditch.
GW-103BR	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, and Inorganics; detected VOCs, BTEX, NDMA, Sulfate; Sampling objective is to evalaute current contaminant concentrations of standard comprehensive analytes and additional Site-specific analytes.
GW-103D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, and Inorganics; detected very low DCE, NDMA, metals, inorganics; ampling objective is to evalaute current contaminant concentrations of standard comprehensive analytes and additional Site-specific analytes.
GW-10D	Containment Area	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH/EPH; Diffuse groundwater with numerous VOC, SVOC, metals, inorganics and one PCB compound detections; Sampling objective is to assess standard comprehensive analytes and additional Site-specific analytes in the deep groundwater which would appear to be in the migration pathway from fomer Lake Poly to the Upper DAPL pool.
GW-10S	Containment Area	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH/EPH; Diffuse groundwater with detections of NDPA, NDMA, TMP, toluene; Sampling objective is to assess standard comprehensive analytes and additional Site-specific analytes to determine the distribution of these compounds vertically from dee to shallow groundwater.
GW-13	Plant B	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, Inorganics, VPH/EPH, NDMA; low detections of BEHP, TMPs, NDPA; Sampling objective to assess concentrations of these constituent on North Side of plant B. Additional Site-specific analytes will be evaluated in nearby wells GW-101, and GW-303.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-14	Plant C	X	X	X	X	X	X	X										Previously analyzed for VOC, SVOC, Metals, Inorganics, TPH, VPH/EPH; detected TMPs, BEHP, NDPA, chromium; Sampling objective to assess current groundwater impacts down gradient of boiler house USTs; Additional Site-specific analytes are proposed in nearby wells GW-101, GW-52S/D
GW-15	Plant C	X	X	X	X	X	X											Previously analyzed for VOC, SVOC, Metals, Inorganics, VPH/EPH; detected TMPs, chromium, ammonia, sulfate ; Sampling objective to assess current groundwater impacts down gradient of boiler house USTs; Additional Site-specific analytes are proposed in nearby wells GW-101, GW-52S/D
GW-16R	Plant B			X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, TPH, VPH/EPH; detected TMPs, BTEX, NDMA, NDPA, BEHP, phenol. Analyzed for VOCs/SVOCs under IRSWP; sampling objective is to compliment IRSWP list; Additional Site-specific analytes are proposed at nearby well GW-303.
GW-17D	Containment Area	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, Kempore, Opex; detected BEHP, nitrophenols, TCA, PCE, chromium, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, metals, and inorganic concentrations. Additional Site-specific analytes are proposed in GW-51S/D and GW-4S/D.
GW-17S	Containment Area	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics, Kempore, Opex; detected NDMA, BEHP, chromium, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, metals, and inorganic concentrations. Additional Site-specific analytes are proposed in GW-51S/D and GW-4S/D; VOCs for potential vapor intrusion
GW-18D	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest/PCB, Metals, NDMA; detected NDMA, BEHP, chromium, ammonia, sulfate, No VOCs; Sampling objective is to assess current concentrations of site-related contaminants near southern lateral plume boundary.
GW-202D	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOCs, SVOC (EPA), NDMA, metals, Inorganics; detected NDMA, other VOCs/SVOCs chromium, ammonia, sulfate; Sampling objective is to assess current VOCs, SVOCs, Metals, Inorganics, NDMA, and presence or absence additional Site-specific analytes in vicinity of discharge area to S. Ditch.
GW-202S	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for SVOC, Metals, Inorganics, NDMA; detected NDMA, chromium, ammonia, sulfate; Sampling objective is to assess current VOCs, SVOCs, Metals, Inorganics, NDMA, and presence or absence of additional Site-specific analytes.
GW-21D	Finished Product	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected benzene, BEHP, NDMA, chromium, ammonia, sulfate; Sampling objective to assess current contaminant concentrations and presence or absence of additional Site-specific analytes in NW border of property.
GW-21S	Finished Product	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics; detected toluene, BEHP, diethylephthalate, ammonia, sulfate; Sampling objective to assess current contaminant concentrations and presence or absence of additional Site-specific analytes in NW border of property.
GW-24	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, Inorganics, NDMA; detected TMPs, BEHP, NDMA, NDPA; to assess current conditions
GW-25	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, NDMA; detected TMPs, BEHP, NDMA, NDPA, Chromium, Ammonia, Sulfate; to assess current conditions

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-28D	Lake Poly	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH, EPH, NDMA, hydrazine, Opex / Kempore, formaldehyde ; detected TMPs, NDMA, chromium, ND for hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde; Sampling objective is to assess presence or absence of additional Site-specific analytes near property boundary and current concentrations of VOCs, SVOCs, NDMA, inorganics, metals
GW-28S	Lake Poly	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH, EPH, NDMA, hydrazine, Opex / Kempore, formaldehyde ; detected TMPs, NDMA, chromium, ND for hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde; Sampling objective is to assess presence or absence of additional Site-specific analytes near property boundary and current concentrations of VOCs, SVOCs, NDMA, inorganics, metals
GW-29D	Lake Poly	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde; detected TMPs, NDMA, NDPA, chromium, ammonia, sulfate etc; ND for hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde. Sampling objective is to assess current groundwater concentrations. Additional Site-specific analytes are being analyzed in nearby wells GW-28S/D, and GW-10S/D
GW-29S	Lake Poly	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics, hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde; detected NDMA, chromium, ammonia; ND for hydrazine, Opex/Kempore, Acetaldehyde/formaldehyde. Sampling objective is to assess current groundwater concentrations. Additional Site-specific analytes are being analyzed in nearby wells GW-28S/D, and GW-10S/D
GW-301	Pilot Plant/Lab	X	X	X	X	X		X										Previously analyzed for VOC, NDMA, hydrazine, formaldehyde; non-detect; to assess vertical boundary conditions; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in overburden groundwater in vicinity of former laboratory.
GW-302	Pilot Plant/Lab	X	X	X	X	X												Previously analyzed for VOC, NDMA, hydrazine, formaldehyde; detected NDMA; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in overburden groundwater in vicinity of former pilot laboratory and product storage buildings, and assess potential vapor intrusion
GW-303	Plant A	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, NDMA, VPH, hydrazine, formaldehyde, VPH; detected TMPs, NDMA; Sampling objective to assess presence /absence of standard comprehensive analytes and additional Site-specific analytes in vicinity of Plant A
GW-304	Plant C	X	X	X	X	X												Previously analyzed for VOC, NDMA, Hydrazine, formaldehyde; detected NDMA; Sampling objective is to assess current concentrations of VOCs,SVOCs, NDMA, Metals and Inorganics, and potential vapor intrusion
GW-305	Warehouse	X	X	X	X	X												Previously analyzed for NDMA, hydrazine, formaldehyde; only detected NDMA; Sampling objective is to characterize VOCs, SVOCs, Metals, and Inorganics, and current NDMA concentrations. Other wells down gradient of E. Warehouse/ former E. Pit (GW-6S/D) will be analyzed for additional Site-specific analytes.

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-306	Plant D	X	X	X	X	X												Previously analyzed for VOC, NDMA, hydrazine, formaldehyde; non-detect for all compounds; Sampling objective is to assess potential presence of VOCs, and SVOCs, NDMA, and current concentrations of Metals and Inorganics. Additional Site-specific analytes are being analyzed in down gradient areas GW-307 and GW-52S/D.
GW-307	Plant D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for NDMA, hydrazine, formaldehyde; detected NDMA, and hydrazine; Sampling objective is to assess standard comprehensive analytes and additional Site-specific analytes down gradient of Plant D and Plant D Tank Farm
GW-308	Plant D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for SVOC, PCB, Metals, Inorganics, VPH/EPH, NDMA; detected hydrazine, NDMA, chromium, phthalates; is to assess standard comprehensive analytes and additional Site-specific analytes down gradient of Plant D and Plant D Tank Farm
GW-31D	Pilot Plant/Lab	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, Pest/PCBs, Inorganics; detected TMPs, benzene, BEHP, NDPA , chromium; NDMA, not detected; Sampling objective is to assess current concentrations of VOCs, SVOCs, metals and inorganics and NDMA near northern boundary of property. Additional Site-specific analytes are being analyzed in nearby well GW-32S/D.
GW-31S	Pilot Plant/Lab	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected TMPs, chlorinated benzene compounds, BEHP, NDPA, ammonia, sulfate; Sampling objective is to assess current concentrations of VOCs, SVOCs, metals and inorganics and NDMA near northern boundary of property. Additional Site-specific analytes are being analyzed in nearby well GW-32S/D.
GW-32D	Pilot Plant/Lab	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics; detected TMPs, benzene, chlorinated benzene compounds, BEHP, NDPA, NDMA, nitrophenol, benzoic acid, ammonia, sulfate; Sampling objective is to assess current concentrations of standard comprehensive analytes and additional Site-specific analytes.
GW-32S	Pilot Plant/Lab	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics; detected TMPs, benzene, chlorinated benzene compounds, BEHP, NDMA, nitrophenol, ammonia, sulfate; Sampling objective is to assess current concentrations of standard comprehensive analytes and additional Site-specific analytes in this portion of the property.
GW-33D	Warehouse	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, NDMA; detected TMPs, chlorinated benzenes, chromium, NDPA, PAHs, benzoic acid, ; to assess current conditions
GW-33S	Warehouse	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected VOCs, chromium, NDPA, 4-chlorophenyl ether, phenol; Sampling objective is to assess evaluate standard comprehensive analytes and additional Site-specific analytes, and potential vapor intrusion.
GW-34D	Warehouse	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Opex/Kempore, Inorganics; Opex Kempore not detected; detected chromium, TMPs, dichlorobenzenes, other VOCs, nitro phenols, benzoic acid, benzyl alcohol, NDPA, BEHP, other SVOCs, ammonia, sulfate; etc. to Sampling objective is assess current VOC and SVOC impacts, and additional Site-specific analytes except Opex/Kempore which was non-detect.
GW-34S/SR	Warehouse	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Opex/Kempore, Inorganics; Opex Kempore not detected; similar compounds as deep well pair. Sampling objective is assess current VOC and SVOC impacts, and additional Site-specific analytes except Opex/Kempore which was non-detect.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-36	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics, Kempore, Opex; in DAPL; to assess current VOC and SVOC conditions
GW-37	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, Kempore, Opex; detected DCE, DCA, TCE, chlorinated and brominated methanes, napthalene, toluene, several pheols, benzoic Acid, BEHP, chromium, and inorganics. Sampling objective is to evalaute current concentrtaions of VOCs, SVOCs, NDMA, Metals and Inorganics.
GW-39	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected dichlorobenzene, bromoform, toluene, BEHP, chromium, ammonia; Sampling objective is to assess current concentrations of VOCs, SVOCs, NDMA, metals, inorganics upgradient of SD/Eph Drainage
GW-3D	Plant D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected NDMA, Chromium, Ammonia, Sulfate; to assess current lateral boundary conditions; VOCs not an issue
GW-3S	Plant D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detected NDMA; to assess current lateral boundary conditions, potential vapor intrusion
GW-4	Containment Area	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected TCE, NDMA, BEHP, chromium, ammonia, sulfate; Sampling objective to assess presence or absence of standard comprehensive analytes down gradient adjacent to east side of property.
GW-400BR	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-400D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-400M	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-400S	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-401D	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-401S	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor down gradient groundwater quality and assess nature and extent of potential impacts
GW-402D	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor groundwater quality and assess nature and extent of potential impacts on East Side of East Ditch
GW-402S	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor groundwater quality and assess nature and extent of potential impacts on East Side of East Ditch
GW-403D	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor groundwater quality and assess nature and extent of potential impacts on East Side of East Ditch
GW-403S	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor groundwater quality and assess nature and extent of potential impacts on East Side of East Ditch
GW-404D	MMB																	Contingency well location, analytical program to be evaluated based on results from GW-400 wells
GW-404M	MMB																	Contingency well location, analytical program to be evaluated based on results from GW-400 wells
GW-404S	MMB																	Contingency well location, analytical program to be evaluated based on results from GW-400 wells
GW-405BR	MSDP	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to monitor site-related contaminants in bedrock between DAPL pools and Cook Avenue
GW-406	Off-PWD	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to assess nature and extent of groundwater impacts on North side of Main Street/Upper DAPl pool and area west of former Lake Poly, and assess potential for vapor intrusion

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-406BR	Off-PWD	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to assess nature and extent of groundwater impacts on North side of Main Street/Upper DAPl pool and area west of former Lake Poly
GW-407BR	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New well proposed to assess nature and extent of additional Site-specific analytes in bedrock bordering western side of WBV in MMBA
GW-40D	CSL	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics; detected BTEX, ammonia, sulfate; Sampling objective is to evalaute VOCs, SVOCs, NDMA, Metals and Inorganics downgradient of the CSL
GW-40S	CSL	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; Sampling objective is to evalaute VOCs, SVOCs, NDMA, Metals and Inorganics downgradient of the CSL
GW-42S	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected NDMA and Chromium; to assess current conditions, potential vapor intrusion
GW-43S	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, hydrazine; detected low level VOCs, NDMA; Sampling objective is to evalaute current concentrtaions of VOCs, SVOCs, NDMA, Metals and Inorganics, and evaluate potential vapor intrusion
GW-44D	MSDP	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics, formaldehyde; detected TCE, DCE, dichlorobenzene, BTEX, TMPs and other VOCs, several phenols, benzoic acid, benzyl alcohol, chromium, ammonium, sulfate, formaldehyde; Sampling objective is to assess current concentrations and presence/absence of additional Site-specific analytes.
GW-44S	MSDP	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected chlorobenzene, chromium, ammonia; Sampling objective is to assess current concentrations of standard comprehensive analytes and additional Site-specific analytes.
GW-45D	MSDP	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE, dichlorobenzene, naphthalene, toluene, other VOCs, several phenols, benzoic acid, benzyl alcohol, NDMA, chromium, ammonia, and other constituents; Sampling objective is to assess current concentrations of standard comprehensive analytes. Additional Site-specific analytes are being analyzed in nearby wells.
GW-45S	MSDP	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected NDMA, chromium, ammonia; Sampling objective is to assess current concentrations of standard comprehensive analytes, potential for vapor intrusion. Additional Site-specific analytes are being analyzed in nearby wells.
GW-46D	MSDP	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; non-detect for SVOCs, VOCs, NDMA; detected chromium at low concentration; Sampling objective is to evaluate current VOC, SVOC, Metal, Inorganic, NDMA concentrations for overburden plume delineation.
GW-47	Finished Product	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected chromium at low concentration; Sampling objective to assess presence or absence of standard comprehensive analytes down gradient adjacent to NW corner of property.
GW-48D	Pepsi	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, inorganics; detected TCE; Sampling objective to assess current groundwater quality East of Olin property (lateral groundwater boundary)
GW-48S	Pepsi	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics, VPH/EPH; no detections above action levels; Sampling objective to assess current groundwater quality East of Olin property (lateral groundwater boundary)

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-4D	Containment Area	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected TCA, NDMA, ammonia, sulfate; Sampling objective to assess presence or absence of standard comprehensive analytes adjacent to east side of property.
GW-50D	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics; detections of chlorinated ethenes and ethanes, NDMA, chlorinated benzenes, benzene, TMPs, BEHP, ammonia, sulfate; Sampling objective to assess standard comprehensive and additional Site-specific analyte concentrations, near facility boundary under S. Ditch
GW-50S	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected dichlorobenzenes, NDMA, ammonia, sulfate; sampling objective to assess standard comprehensive and additional Site-specific analyte concentrations in S.Ditch discharge area.
GW-51D	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detections of nitrophenols, phenol, dichlorobenzene, ammonia, sulfate; Sampling objective is to assess current concentrations of standard comprehensive and addition Site-specific analytes w/ exception of OPEX/Kempore, which would not have a potential source in this eastern boundary of the property.
GW-51S	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected bromoform, PCE, dibenzofuran and chromium; Sampling objective is to assess current concentrations of standard comprehensive and addition Site-specific analytes w/ exception of OPEX/Kempore, which would not have a potential source in this eastern boundary of the property.
GW-52D	Plant C-3	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected sulfate, ammonia, etc. Sampling objective to assess presence/ absence of standard comprehensive and addition Site-specific analytes at property boundary down gradient of Plant C-2/C-3
GW-52S	Plant C-3	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH/EPH; no detections above action criteria; Sampling objective to assess presence /absence of standard comprehensive and addition Site-specific analytes at property boundary down gradient of Plant C-2/ C-3
GW-53D	Plant C-1	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected TMPs, NDMA, chromium; Sampling objective is to assess current groundwater quality in vicinity of Hydrazine tank #13, near Building C-1/C-2 and assess presence or absence of additional Site-specific analytes.
GW-53S	Plant C-1	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics, VPH/EPH; no detections above action levels; Sampling objective is to assess current groundwater quality in vicinity of Hydrazine tank #13, near Building C-1/C-2 and assess presence or absence additional Site-specific analytes.
GW-54D	Plant A	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected TMPs, NDMA, NDPA, 4-nitroanaline, diethyl phthalate, and phenol, metals and inorganics; Sampling objective to assess current concentrations and assess presence or absence additional Site-specific analytes between Plant A and Finished Product Storage Buildings
GW-54S	Plant A	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics; detected NDMA, PCBs, chromium, ammonia, metals, inorganics etc; Sampling objective to assess current concentrations and assess presence or absence additional Site-specific analytes between Plant A and Finished Product Storage Buildings

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-55D	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics; detected BTEX, TMPs, chlorinated ethenes and ethanes, chromium, DCA, phenols, NDPA, chromium ammonia, sulfate; Sampling objective is to assess current concentrations of VOCs, SVOCs, metals, inorganics. Additional Site-specific analytes proposed in up gradient and down gradient locations (GW-202S/D./GW-50D).
GW-55S	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected chromium, phenols, ammonia, sulfate; Sampling objective is to assess current concentrations of VOCs, SVOCs, metals, inorganics. Additional Site-specific analytes proposed in up gradient and down gradient locations (GW-202S/D./GW-50D).
GW-56D	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected several VOCs, NDMA, sulfate, ammonia; Sampling objective is to assess current VOC, SVOC, metals, inorganics and NDMA concentrations. Additional Site-specific analytes are being evaluated in upgradient and down gradient locations.
GW-56S	SD/Eph D	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected dichlorobenzene, NDMA, BEHP, sulfate, ammonia; Sampling objective is to assess current VOC, SVOC, metals, inorganics and NDMA concentrations. Additional Site-specific analytes are being evaluated in upgradient and down gradient locations.
GW-57D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, and Inorganics; detected TMP, dichlorobenzene, BEHP, chromium; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater.
GW-58D	MMB	X	X	X	X	X												Previously analyzed for VOCs, SVOCs, Pest, metals, inorganics; detected DCE, TCE, vinyl chloride, trichlorobenzene, toluene, several phenols, BEHP; trichlorobenzene, sulfate, ammonia, chromium; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater.
GW-58S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, and Inorganics; detected NDMA; trichlorobenzene, sulfate, ammonia; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallow overburden groundwater.
GW-60D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected toluene, dichlorobenzene, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater on southern side of the MMBA.
GW-60S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected chromium, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallow overburden groundwater on southern side of the MMBA, evaluate potential vapor intrusion
GW-61BR	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE, TCE, NDMA, ammonia; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in bedrock groundwater on southeastern side of the MMBA and determine presence or absence of additional Site-specific analytes.
GW-61D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected TCA, TCE and NDMA; Sampling objective is to assess current standard comprehensive and additional Site-specific analytes in deep overburden groundwater on southeastern side of the MMBA

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-61S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; VOCs, SVOCs, NDMA not detected; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in shallow overburden groundwater on southeastern side of the MMBA
GW-62BR	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detections of TMPs, DCE, DCA , TCE, benzene, toluene, chloroform, chlorobenzene, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in bedrock in southern portion of the MMBA.
GW-62BRD	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detections of BTEX, DCA, TCE, DCE, BEHP, ammonia, sulfate; Sampling objective is to assess standard comprehensive and additional Site-specific analyte concentrations in bedrock in southern portion of the MMBA.
GW-62D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE, DCA, TCE, TMP, benzene, toluene, chlorobenzene, NDMA, Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in deep overburden groundwater in southern portion of the MMBA
GW-62M	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected dichlorobenzene, toluene, NDMA, low BTEX; Sampling objective is to assess standard comprehensive and additional Site-specific analyte concentrations in moderate depth overburden groundwater in southern portion of the MMBA
GW-62S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; no VOC, SVOC detections; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in shallow overburden groundwater in southern portion of the MMBA and potential vapor intrusion
GW-63D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE, NDMA, phenol, ammonia and sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in deep overburden groundwater on western side of the MMBA.
GW-63S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected BEHP; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic, concentrations in shallow overburden groundwater on western side of the MMBA.
GW-64D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; to assess vertical clean boundary
GW-64S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; to assess vertical clean boundary, potential vapor intrusion
GW-65BR	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected xylenes, ammonia, Sampling objective to assess current contaminant concentrations. Low concentrations limited detection of VOCs, inorganics and metals, do not warrant assessment of additional Site-specific analytes, which will be analyzed in deeper bedrock well.
GW-65BRD	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	New bedrock well proposed to assess potential nature and extent and presence or absence of standard comprehensive and additional Site-specific analytes in deeper bedrock groundwater in WBV below down gradient portion of MMBA.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-65D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE, NDMA, BEHP, sulfate; Sampling objective is to assess current concentration of standard comprehensive and additional Site-specific analytes in deep overburden groundwater in down gradient portion of MMBA.
GW-65S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected DCE and dichlorobenzene; Sampling objective is to assess current concentration of site-related constituents in shallow overburden groundwater in down gradient portion of MMBA.
GW-66D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; low level metal detections; Sampling objective is to assess presence or absence of standard comprehensive analytes in deep overburden groundwater along southern portion of MMBA.
GW-66S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected di-n-butylphthalate, ammonia, sulfate; Sampling objective is to assess presence or absence of standard comprehensive analytes in shallow overburden groundwater along southern side of MMBA.
GW-67D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected TCE and NDMA at low concentrations; Sampling objective is to assess presence or absence of standard comprehensive analytes in deep overburden groundwater along northern side of MMBA.
GW-67S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected sulfate; Sampling objective is to assess presence or absence of standard comprehensive analytes in deep overburden groundwater along northern side of MMBA.
GW-68BR	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detections of BEHP, chromium, sulfate; Sampling objective is to assess current concentrations of standard comprehensive and additional Site-specific analytes in bedrock groundwater
GW-68D	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detections of low level TMPs, dichlorobenzene, ammonia, sulfate; Sampling objective is to assess current concentrations of standard comprehensive and additional Site-specific analytes in deep overburden groundwater.
GW-69D	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics, Formaldehyde; detections of VOCs, NDMA, chromium, ammonia, sulfate; to assess current contaminant conditions
GW-69S	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detections of NDMA and sulfates; to assess current contaminant conditions, and assess potential vapor intrusion
GW-6D	Containment Area	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics, hydrazine, formaldehyde; detected hydrazine, NDMA, BEHP, ammonia; Sampling objective to assess current concentrations of standard comprehensive and additional Site-specific analyte gradient of E. Pit, Plant D area.
GW-6S	Containment Area	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics, hydrazine, formaldehyde; detected hydrazine, NDMA, BEHP, ammonia. Sampling objective to assess current concentrations of VOCs, SVOCs, NDMA, metals, and inorganics down gradient of E. Pit, Plant D area. Additional Site-specific analytes are being sampled in other down gradient wells.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-70D	MSDP	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics, Hydrazine; in DAPL detected dichlorobenzene, BTE(X), naphthalene several phenols and NDMA; sampling objective is to evaluate current concentrations of VOC, SVOCs, metals, inorganics and NDMA for comparison to results from corresponding well in overlying groundwater.
GW-70S	MSDP	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics, Hydrazine; detected NDMA, sulfate; Sampling objective is to assess current concentrations of standard comprehensive analytes in groundwater above the Main Street DAPL pool at its down gradient side.
GW-71D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; site-related contaminants not detected, Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater on southern side of MMBA.
GW-71S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; site-related contaminants not detected, Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallow overburden groundwater on southern side of MMBA.
GW-72D	Woburn Landfill	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected ammonia, but not site-related; No site related VOCs detected, no SVOCs detected, Sampling objective is to assess ammonia and other water quality indicator parameters potentially affected by Woburn landfill and potential for contribution to impacts in Landfill Brook
GW-73D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; site-related contaminants not detected, Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater on northeastern side of MMBA.
GW-73S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; site-related contaminants not detected, Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallow overburden groundwater on northeastern side of MMBA.
GW-74D	North Pond	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected low level DCE, DCA, TCE; Sampling objective is to assess current VOCs, metals, inorganics
GW-74S	North Pond	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected low levels DCE, DCA, TCE, BEHP; Sampling objective is to assess current VOCs, metals, inorganics
GW-75D	Woburn Landfill	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected ammonia, but not site-related; No site related VOCs detected, no SVOCs detected, Sampling objective is to assess ammonia and other water quality indicator parameters potentially affected by Woburn landfill and potential for contribution to surface waters contributing to Landfill Brook
GW-75S	Woburn Landfill	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected ammonia, but not site-related; No site related VOCs detected, no SVOCs detected, Sampling objective is to assess ammonia and other water quality indicator parameters potentially affected by Woburn landfill and potentially affected by Woburn landfill and potential for contribution to surface waters contributing to Landfill Brook
GW-76S	Off-PWD	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected NDMA; to test for potential vapor intrusion

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-77S	West Ditch	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; low level phthalate detections; Sampling objective is to test for potential vapor intrusion
GW-79S	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected NDMA NDPA, BEHP, other phthalates, TMPs, TCA, DCA, chromium; Sampling objective to characterize standard comprehensive and additional Site-specific analytes down gradient of Containment area in S.Ditch discharge area.
GW-80BR	SD/Eph D	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected xylenes, NDMA, and phthalates; Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations, and additional Site-specific analytes.
GW-80D	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected, chlorinated benzenes, DCE, BTEX and NDMA, phenols; Sampling objective is to assess current concentrations of standard comprehensive and additional Site-specific analytes.
GW-80S	East of E Ditch	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest, Metals, Inorganics; detected, chlorinated benzenes, chlorinated ethenes and ethanes, BTEX and NDPA, phenols, phthalates; Sampling objective is to assess current concentrations of standard comprehensive and additional Site-specific analytes.
GW-81BR	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected BTEX and sulfate; assess current conditions
GW-81D	CSL	X	X	X	X	X												Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; low level SVOCs; Sampling objective is to evalaute VOCs, SVOCs, NDMA Metals and Inorganics downgradient of the CSL and to evalaute potential vapor intrusion
GW-82D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, Inorganics; detected TCE, BEHP, and sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater on southern side of MMBA.
GW-82S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, Metals, Inorganics; detected BEHP; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallow overburden groundwater on southern side of MMBA.
GW-83D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; detected formaldehyde, hydrazine, BETX, TCE,PCE, VDCE,DCA, dichlorobenzene, NDMA, several phenols, and phthalates; chromium, ammonia, sulfate. Sampling objective is to assess current concentrations/ presence or absence of standard comprehensive and additional Site-specific analytes.
GW-83M	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; detected phthalates, hydrazine NDMA; Sampling objective is to assess current concentrations/ presence or absence of standard comprehensive and additional Site-specific analytes vertically in moderate depth overburden groundwater in MMBA.
GW-83S	MMB	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; Sampling objective is to assess current VOC, SVOC, NDMA, hydrazine, Metal and Inorganic concentrations in shallower depth overburden groundwater in MMBA.
GW-84D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Formaldehyde; detected PCE, TCE, DCE, benzene, TMP, phthalates, NDMA; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in deep overburden groundwater within MMBA.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
GW-84M	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Formaldehyde; detected TCE, Di-n-butylphthalate, ammonia; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in moderate depth overburden groundwater within MMBA.
GW-84S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Formaldehyde; detected TCE, Di-n-butylphthalate, Diethylphthalate, ammonia; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallower depth overburden groundwater within MMBA
GW-86S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Formaldehyde; detected BEHP, Di-n-butylphthalate; Sampling objective is to assess current VOC, SVOC, NDMA, Metal and Inorganic concentrations in shallower depth overburden groundwater on north western side of MMBA
GW-87D	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Pest/PCB, Metals, Inorganics, Opex/Kempore, PAHs, TPH, VPH/EPH; detected NDMA, Kempore, chlorinated ethenes, ethanes, chlorobenzene, BTEX, MBTE, other VOCs, Di-n-butylphthalate, acenaphthylene, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations and evaluate presence or absence of additional Site-specific analytes.
GW-88D	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, Formaldehyde, VPH/EPH, PAHs, TPH; detected dichlorobenzene, chlorotoluene, chlorobenzene, chromium, ammonia, sulfate; Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations in deep overburden groundwater on western side of MMBA.
GW-88M	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, Formaldehyde, VPH/EPH; detected dichlorobenzene, chlorobenzene, diethyl ether, ammonia. Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations in moderate depth overburden groundwater on western side of MMBA.
GW-88S	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, Formaldehyde, VPH/EPH; detected chlorobenzene; Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations in shallower depth overburden groundwater on western side of MMBA.
GW-98	Plant C	X	X	X	X	X		X										Previously analyzed for Metals and, Inorganics; detected chromium, sulfate, elevated ammonia; Sampling objective is characterize groundwater in vicinity of PCB transformer #3. Additional Site-specific analytes are being analyzed in nearby wells GW-52S/D
GW-CA1	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for NDMA, Metals, Inorganics; detected NDMA, sulfate; Sampling objective is to evaluate if additional Site-specific analytes are present (VOCs, SVOCs) in vicinity of equalization window.
MP-1 #01	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest/PCB, Metals, Inorganics, VPH/EPH, Hydrazine, Opex/Kempore, Formaldehyde, PAHs; detected numerous VOCs, SVOCs, DAPL constituents; Sampling objective is to evaluate if other additional Site-specific analytes are present in DAPL
MP-1 #06	Containment Area	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; detected diffuse DAPL constituents, NDMA; Sampling objective is to evaluate if additional Site-Specific analytes are present in diffuse groundwater.

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
MP-2 #07	Off-PWD	X	X	X	X	X			X		X	X	X	X	X	X	X	Previously analyzed for VOCs, SVOCs, NDMA, Metals, Inorganics, Formaldehyde, TPH; Sampling objective is to assess standard comprehensive and additional Site-specific analytes to determine the distribution of these compound.
MP-2 #17	Off-PWD	X	X	X	X	X			X		X	X	X	X	X	X	X	Previously analyzed for NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; Sampling objective is to assess standard comprehensive and additional Site-specific analytes to determine the vertical distribution of these compounds.
MP-3 #01	MSDP	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for NDMA, Metals, Inorganics; Sampling Objective is assess presence/absence of standard comprehensive and additional Site-specific analytes and current vertical profile of constituents in DAPL, Diffuse and Overlying Groundwater by comparing data from ports 1, 7, 21
MP-3 #07	MSDP	X	X	X	X	X												Previously analyzed for Metals, Inorganics; Sampling objective is assess current vertical profile of constituents in DAPL, Diffuse and Overlying Groundwater by comparing data from ports 1, 7, 21
MP-3 #21	MSDP	X	X	X	X	X												Previously analyzed for Metals, Inorganics; Sampling objective is assess current vertical profile of constituents in DAPL, Diffuse and Overlying Groundwater by comparing data from ports 1, 7, 21
MP-4 #1	MSDP	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for Metals, Inorganics; Sampling objective is assess current vertical profile of constituents in DAPL, and Overlying Groundwater by comparing data from ports 1, and 12. Evaluate presence of standard comprehensive and additional Site-specific analytes in deepest port in bedrock.
MP-4 #12	MSDP	X	X	X	X	X												Previously analyzed for VOC, NDMA, Metals, Inorganics, Hydrazine, Formaldehyde; detected NDMA, low level metals; Sampling objective is assess current vertical profile of constituents in DAPL, and Overlying Groundwater by comparing data from ports 1, and 12.
MP-5 #03	MMB	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, formaldehyde, VPH/EPH; detected DCE, PCE, TCE, DCA, MTBE, vinyl chloride, benzene, NDMA, BEHP, Kempore; Sampling objective is to assess current VOC, SVOC, NDMA, metal and inorganic concentrations and evaluate presence or absence of additional Site-specific analytes.
MP-5 #08	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, formaldehyde, VPH/EPH; detected DCA, DCE, Butane, MTBE, benzoic acid, BEHP, NDMA; Sampling objective is assess current VOC, SVOC, Metal, inorganic and NDMA concentrations. Additional Site-specific analyted are assessed in Port #3
MP-5 #15	MMB	X	X	X	X	X												Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Opex/Kempore, formaldehyde, VPH/EPH; detected ethylbenzene and xylenes, benzoic acid, methylphenol, ammonia, sulfate and metals; Sampling objective is to assess current VOC, SVOC, metal, inorganic and NDMA concentrations. Additional Site-specific analytes are assessed in Port #3
MW-203BR	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
MW-204BR	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
MW-204D	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
MW-204M	MMB	X	X	X	X	X												Previously analyzed for NDMA; non-detected; to assess current lateral boundary conditions

Table 6.2-4
Proposed Sampling and Analysis Program - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Location	VOCs	SVOCs	NDMA	Metals	Inorganics *	VPH/EPH	PCBs	Hexavalent Chromium	Opex /Kempore	Hydrazine	Acetaldehyde/Formaldahyde	Nonylphenol	Phthalic Anhydride	Diphenylamine	N,N-dimethylformamide	Perchlorate	Rational/ Comments
MW-204S	MMB	X	X	X	X	X												Previously analyzed for NDMA; non-detected; to assess current lateral boundary conditions
MW-206BR	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
MW-206D	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
MW-206S	MMB	X	X	X	X	X												Well not owned by Olin. Previously sampled for NDMA, which was not detected. Sampling objective is to evaluate presence or absence of standard comprehensive analytes.
SL-1S	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.
SL-1D	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.
SL-2	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, NDMA, Metals, Inorganics, Hydrazine, Formaldehyde, TPH; detected BEHP and chromium; assess current conditions
SL-3	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Metals, Inorganics; detected sulfate; assess current conditions
SL-4	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.
SL-5	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.
SL-6	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Previously analyzed for VOC, SVOC, Pest, Metals, Inorganics; detected ammonia and sulfate; assess current conditions
SL-7	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.
SL-8	CSL	X	X	X	X	X			X	X	X	X	X	X	X	X	X	Assess current conditions of CSL area groundwater.

Prepared by TL 4/20/2009
Checked by PHT 4/24/2009

CSL = Calcium Sulfate Landfill
DAPL = Dense Aqueous Phase Liquid
E Ditch = East Ditch
EPH = Extractable Petroleum Hydrocarbon
MMB = Maple Meadow Brook
MSDP = Main Street DAPL Pool
NDMA = N-nitrosodimethylamine
Off-PWD = Off-Property West Ditch
PCB = Polychlorinated Biphenyl
SD/Eph D = South Ditch/ Ephemeral Drainage
SVOC = Semi-Volatile Organic Compound
UST = Underground Storage Tank
VOC = Volatile Organic Compound
VPH = Volatile Petroleum Hydrocarbon
* = ammonia, bromide, nitrite/nitrate, sulfate, chloride

Table 6.3-1
Proposed Synoptic Water Level Measurements - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Proposed For Water Level Measurements	Aquifer Depth Designation	Located In Vicinity Of	Rationale
Locations	**156**			
GW-10D	X	Deep	Containment Area	Shallow and deep pair; vertical gradient determination
GW-10S	X	Shallow	Containment Area	Adjacent to Containment Area
GW-17D	X	Deep	Containment Area	Shallow and deep pair; vertical gradient determination
GW-17S	X	Shallow	Containment Area	Within Containment Area
GW-22D	X	Deep	Containment Area	Shallow and deep pair; vertical gradient determination
GW-22S	X	Shallow	Containment Area	Within Containment Area
GW-4	X	Shallow	Containment Area	Shallow and deep pair; vertical gradient determination
GW-4D	X	Deep	Containment Area	Along east boundary
GW-6D	X	Deep	Containment Area	Shallow and deep pair; vertical gradient determination
GW-6S	X	Shallow	Containment Area	Adjacent to Containment Area
PZ-24	X	Shallow	Containment Area	With PZ-25; Shallow GW elevations on both sides of
PZ-25	X	Shallow	Containment Area	Slurry Wall
GW-40D	X	Deep	CSL	Shallow and deep pair; vertical gradient determination
GW-40S	X	Shallow	CSL	down gradient of CSL
GW-81BR	X	BR	CSL	With GW-81D; vertical gradient across rock interface
GW-81D	X	Deep	CSL	west of CSL
SL-1D	X	Deep	CSL	Shallow and deep pair; vertical gradient determination
SL-1S	X	Shallow	CSL	at CSL
SL-2	X	Shallow	CSL	Shallow GW CSL
SL-3	X	Shallow	CSL	Shallow GW CSL
SL-4	X	Shallow	CSL	Shallow GW CSL
SL-5	X	Shallow	CSL	Shallow GW CSL
SL-6	X	Shallow	CSL	Shallow GW CSL
SL-7	X	Shallow	CSL	Shallow GW CSL
SL-8	X	Shallow	CSL	Shallow GW CSL
GW-401D	X	Deep	East of E Ditch	Shallow and deep pair; vertical gradient determination
GW-401S	X	Shallow	East of E Ditch	east of E. Ditch
GW-402D	X	Deep	East of E Ditch	Shallow and deep pair; vertical gradient determination
GW-402S	X	Shallow	East of E Ditch	east of E. Ditch
GW-403D	X	Deep	East of E Ditch	Shallow and deep pair; vertical gradient determination
GW-403S	X	Shallow	East of E Ditch	east of E. Ditch
GW-48D	X	Deep	East of E Ditch	Shallow and deep pair; vertical gradient determination
GW-48S	X	Shallow	East of E Ditch	at east boundary location
GW-21D	X	Deep	Finished Product	Shallow and deep pair; vertical gradient determination
GW-21S	X	Shallow	Finished Product	at Finished Product Area
GW-47	X	Shallow	Finished Product	Shallow water elevation at boundary location
GW-28D	X	Deep	Lake Poly	Shallow and deep pair; vertical gradient determination
GW-28S	X	Shallow	Lake Poly	at Lake Poly
GW-29D	X	Deep	Lake Poly	Shallow and deep pair; vertical gradient determination
GW-29S	X	Shallow	Lake Poly	near Lake Poly
GW-400BR	X	BR	MMB	New well; downgradient horizontal/ vertical profile
GW-400D	X	Deep	MMB	New well; downgradient horizontal/ vertical profile
GW-400M	X	Deep	MMB	New well; downgradient horizontal/ vertical profile
GW-400S	X	Shallow	MMB	New well; downgradient horizontal/ vertical profile
GW-404D	X	Deep	MMB	New well; downgradient horizontal/ vertical profile
GW-404M	X	Deep	MMB	New well; downgradient horizontal/ vertical profile
GW-404S	X	Shallow	MMB	New well; downgradient horizontal/ vertical profile
GW-405BR	X	BR	MSDP/Off-PWD	New well; horizontal gradient
GW-406	X	Shallow	MSDP/Off-PWD	New well pair; vertical /horizontal gradient
GW-406BR	X	BR	MSDP/Off-PWD	vertical gradient bedrock/ overburden
GW-407BR	X	BR	MMB	New well; horizontal gradient adjacent to MMB
GW-103BR	X	BR	MMB	Gradient across rock interface MMB
GW-103D	X	Deep	MMB	Gradient across rock interface MMB / overburden horiz gradient
GW-57D	X	Deep	MMB	Deep GW elevation MMBA
GW-58D	X	Deep	MMB	Deep GW elevation MMBA

Table 6.3-1
Proposed Synoptic Water Level Measurements - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Proposed For Water Level Measurements	Aquifer Depth Designation	Located In Vicinity Of	Rationale
GW-58S	X	Shallow	MMB	Shallow and deep pair; vertical gradient determination
GW-59D	X	Deep	MMB	Shallow and deep pair; vertical gradient determination
GW-59S	X	Shallow	MMB	within MMBA
GW-61BR	X	BR	MMB	Shallow and deep overburden pair with bedrock well; to
GW-61D	X	Deep	MMB	assess vertical gradients throughout profile D to S
GW-61S	X	Shallow	MMB	groundwater, use in horizontal gradient determination
GW-62BR	X	BR	MMB	Shallow and deep bedrock pair with overburden wells; to
GW-62BRD	X	BR	MMB	assess vertical gradients throughout profile
GW-62D	X	Deep	MMB	within MMBA
GW-62M	X	Deep	MMB	
GW-62S	X	Shallow	MMB	
GW-63D	X	Deep	MMB	Shallow and deep pair; vertical / horizontal gradient determination
GW-63S	X	Shallow	MMB	within MMBA
GW-64D	X	Deep	MMB	Shallow and deep pair; vertical / horizontal gradient determination
GW-64S	X	Shallow	MMB	within MMBA
GW-65BR	X	BR	MMB	new deep bedrock well with deep and shallow
GW-65BRD	X	BR	MMB	overburden wells; to determine vertical gradient profile
GW-65D	X	Deep	MMB	at downgradient location within WBV in
GW-65S	X	Shallow	MMB	the MMBA
GW-68BR	X	BR	Off-PWD	Bedrock potentiometric surface
GW-70D	X	Deep	MSDP	Shallow and deep pair; vertical / horizontal gradient determination
GW-70S	X	Shallow	MSDP	within MSDP Area
GW-83D	X	Deep	MMB	Deep, medium, shallow overburden wells to determine
GW-83M	X	Deep	MMB	vertical / horizontal gradient profile within MMBA
GW-83S	X	Deep	MMB	
GW-84D	X	Deep	MMB	Deep, medium, shallow overburden wells to determine
GW-84M	X	Deep	MMB	vertical / horizontal gradient profile within MMBA
GW-84S	X	Deep	MMB	
GW-86D	X	Deep	MMB	Deep, medium, shallow overburden wells to determine
GW-86M	X	Deep	MMB	vertical / horizontal gradient profile within MMBA
GW-86S	X	Shallow	MMB	
GW-88D	X	Deep	MMB	Deep, medium, shallow overburden wells to determine
GW-88M	X	Deep	MMB	vertical / horizontal gradient profile within MMBA
GW-88S	X	Shallow	MMB	
MW-202S	X	Shallow	MMB	Shallow overburden at clean western area
MW-203BR	X	BR	MMB	Bedrock with deep and shallow overburden wells; to
MW-203D	X	Deep	MMB	determine vertical / horizontal gradient profile MMBA
MW-203S	X	Shallow	MMB	
MW-204BR	X	BR	MMB	Bedrock with deep, medium, shallow overburden wells; to
MW-204D	X	Deep	MMB	determine vertical / horizontal gradient profile MMBA
MW-204M	X	Deep	MMB	
MW-204S	X	Shallow	MMB	
MW-206BR	X	BR	MMB	Bedrock with deep and shallow overburden wells; to
MW-206D	X	Deep	MMB	determine vertical / horizontal gradient profile MMBA
MW-206S	X	Shallow	MMB	
GW-44D	X	Deep	MSDP	Shallow and deep pair; vertical / horizontal gradient determination
GW-44S	X	Shallow	MSDP	within DAPL Pool
GW-45D	X	Deep	MSDP	Shallow and deep pair; vertical / horizontal gradient determination
GW-45S	X	Shallow	MSDP	within DAPL Pool
GW-46D	X	Deep	MSDP	
GW-24	X	Shallow	Off-PWD	shallow groundwater gradient near Upper DAPL pool
GW-25	X	Shallow	Off-PWD	shallow groundwater gradient near Upper DAPL pool
GW-26	X	Shallow	Off-PWD	shallow groundwater gradient near Upper DAPL pool
GW-36	X	Deep	Off-PWD	shallow groundwater gradient near Upper DAPL pool
GW-37	X	Deep	Off-PWD	shallow groundwater gradient near Upper DAPL pool
GW-42D	X	Deep	Off-PWD	shallow and deep pair; vertical gradient determination

Table 6.3-1
Proposed Synoptic Water Level Measurements - OU3

Field Sampling Program
Olin Chemical Superfund Site
Wilmington, MA

Well ID	Proposed For Water Level Measurements	Aquifer Depth Designation	Located In Vicinity Of	Rationale
GW-42S	X	Shallow	Off-PWD	within Upper DAPL Pool
GW-69D	X	Deep	MSDP	Shallow and deep pair; vertical / horizontal gradient determination
GW-69S	X	Shallow	MSDP	within MSDP
GW-76S	X	Shallow	Off-PWD	Shallow water elevation within Upper DAPL Pool
GW-1	X	Deep	Pilot Plant/Lab	Shallow water elevation on-Property
GW-31D	X	Deep	Pilot Plant/Lab	Shallow and deep pair; vertical gradient determination
GW-31S	X	Shallow	Pilot Plant/Lab	on-Property
GW-32D	X	Deep	Pilot Plant/Lab	Shallow and deep pair; vertical / horizontal gradient determination
GW-32S	X	Shallow	Pilot Plant/Lab	on-Property
GW-53D	X	Deep	Plant A	Deep groundwater elevation on-Property
GW-54D	X	Deep	Plant A	Shallow and deep pair; vertical gradient determination in
GW-54S	X	Shallow	Plant A	on-Property
GW-13	X	Shallow	Plant B	Shallow groundwater on-Property
GW-14	X	Shallow	Plant C	Shallow groundwater on-Property
GW-304	X	Shallow	Plant C	Shallow groundwater on-Property
GW-52S	X	Shallow	Plant C	Shallow groundwater on-Property
GW-307	X	Shallow	Plant D	Shallow groundwater on-Property
GW-308	X	Shallow	Plant D	Shallow groundwater on-Property
GW-3D	X	Deep	Plant D	Shallow and deep pair; vertical gradient determination
GW-3S	X	Shallow	Plant D	on-Property
GW-39	X	Shallow	SD/Eph D	Shallow water elevation at South Ditch area
GW-49D	X	Deep	SD/Eph D	combined with GW-80 wells
GW-5	X	Deep	SD/Eph D	on-Property
GW-50D	X	Deep	SD/Eph D	Shallow and deep pair; vertical gradient determination
GW-50S	X	Shallow	SD/Eph D	on-Property
GW-55S	X	Shallow	SD/Eph D	Shallow groundwater elevation in Ephemeral Drainage Area
GW-55D	X	Deep	SD/Eph D	Deep groundwater elevation in Ephemeral Drainage Area
GW-74D	X	Deep	SD/Eph D	Shallow and deep pair; vertical / horizontal gradient determination
GW-74S	X	Shallow	SD/Eph D	
GW-80BR	X	BR	E. of E. Ditch	Bedrock with deep and shallow overburden wells; to
GW-80D	X	Deep	E. of E. Ditch	determine vertical / horizontal gradient
GW-80S	X	Shallow	E. of E. Ditch	
PZ-16RR	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-17RR	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-18R	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-20	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-21	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-22	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
PZ-23	X	Shallow	SD/Eph D	Shallow groundwater, South Ditch
E-10	X	Shallow	Warehouse	Shallow groundwater at Warehouse Area
GW-33D	X	Deep	Warehouse	Shallow and deep pair; vertical / horizontal gradient determination
GW-33S	X	Shallow	Warehouse	at Warehouse Area
GW-34D	X	Deep	Warehouse	Shallow and deep pair; vertical / horizontal gradient determination
GW-34SR	X	Shallow	Warehouse	at Warehouse Area
LPB-44	X	Shallow	Warehouse	Shallow groundwater at Warehouse Area

Notes
CSL = Calcium Sulfate Landfill
SD/ Eph D = South Ditch Ephemeral Drainage Area
Off-PWD = Off-Property West Ditch Area
E Ditch = East Ditch
MMB = Maple Meadow Brook
MSDP = Maine Street DAPL Pool Area
BR = Bedrock

Prepared by / Date: PHT 8/26/2008
Checked by / Date: BJR 10/14/2008

Table 9.1-1
Summary of Analytical Methods, Sample Containers, Preservation, and Hold Times

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Medium/ Matrix	Analytical Parameter	Conc. Level	Analytical Method/ SOP	Sample Volume	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
SW/GW	VOCs	Low	SW-846 8260B / L-3	3 x 40 mL	3 x 40 mL VOA vials	pH < 2 w/ HCl: No headspace; Cool, 4ºC	14 days to analysis
SO/SD	VOCs	Low/High	SW-846 5035A/8260B / L-3	3 x 40 mL and (1) 2oz. jar for % solids	3 x 40 mL (2 with DI water, 1 with methanol)	Low-Conc: 5 mL DI water with stir bar, 4ºC. High-Conc: 10 mL methanol, 4ºC.	Low-Conc (DI water): 48 hours to freeze vials and 14 days to analysis. High-Conc (methanol): 14 days to analysis
SW/GW	SVOC	Low	SW-846 8270C / L-4	2 x 1 L	2 x 1 L Amber Glass	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
SO/SD	SVOCs	Low	SW-846 8270C / L-4	1 x 4 oz.	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
SW/GW	NDMA / NDPA	Low	EPA 521 / L-5	2 x 1 L	2 x 1 L Amber Glass	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
SO/SD	NDMA	Low	Modified 8270C – Low Level Method / L-6	1 x 4 oz.	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
SW/GW	PCBs	Low	SW-846 8082 / L-28	2 x 1 L	2 x 1 L Amber Glass	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
SO	PCBs	Low	SW-846 8082 / L-27	1 x 8 oz	1 x 8 oz. clear wide mouth glass	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
SW/GW	EPH	Low	MADEP EPH-2004 / L-7	2 x 1 L	2 x 1 L Amber Glass	Cool, 4ºC, pH < 2 w/ 1:1 HCL	14 days to extraction; 40 days from extraction to analysis
SO/SD	EPH	Low	MADEP EPH-2004 / L-7	1 x 4 oz	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
SW/GW	VPH	Low	MADEP VPH-2004 / L-8	3 x40 ml	3 x 40 mL VOA vials	pH < 2 w/ HCl: No headspace; Cool, 4ºC	14 days to analysis for preserved sample
SO/SD	VPH	Low	MADEP VPH-2004 / L-8	1 x 40 mL and (1) 2 oz. jar for % solids	1 x 10 g in 10 mL of methanol	10 g in 10 mL of methanol.	28 days to analysis for preserved sample
SW/GW	TAL Metals	Low	SW-846 6010B/6020A/7470A / L-1	1 x 500 mL	1 x 500 mL polyethylene and a separate container if collecting a dissolved fraction	pH < 2 w/ HNO_3; Cool, 4ºC	Hg: 28 days to analysis Other Metals: 180 days to analysis

Table 9.1-1
Summary of Analytical Methods, Sample Containers, Preservation, and Hold Times

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

SO/SD	TAL Metals	Low	SW-846 6010B/ 6020A/7471B / L-2	1 x 4 oz.	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	Hg: 28 days to analysis Other metals: 180 days to analysis
SW/GW	Hexavalent Chromium	Low	SW-846 7199 / L-38	1 x 250mL	1 x 250mL polyethylene	Cool, 4ºC No Headspace	**24-Hours to analysis**
SO/SD	Hexavalent Chromium	Low	SW-846 3060A / 7199 / L-38	1 x 4 oz.	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	30 days to digestion, 7 days to analyze digestate
SW/GW	OPEX and Kempore	Low	Lab Specific HPLC Method, and SW-846 8000B / L-11	2 x 40 mL	2 x 40 mL VOC vials	Cool, 4ºC	7-days to analysis
SW/GW	Hydrazine, MMH and UDMH	Low	Modified Method 8315 / L-24	2 x 40 mL	2 x 40 mL amber VOC vials	Zero headspace, Acetate buffer, Cool, 4 ºC	10-days to be derivatized / analyze extracts within 5 days of derivatization
SO/SD	Hydrazine, MMH and UDMH	Low	Modified Method 8315 / L-24	1 x 2 oz.	1 x 2 oz. amber glass	Cool, 4ºC	14-days to be extracted and derivatized / extracts must be analyzed within 72 hours of derivatization
SW/GW	Formaldehyde and Acetaldehyde	Low	SW-846 8315 / L-32	2 x 250 mL	2 x 250 mL Amber Glass	Cool, 4ºC	3 day hold time to extraction, then 3 days from extraction to analysis
SO/SD	Formaldehyde and Acetaldehyde	Low	SW-846 8315 / L-32	1 x 4oz	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	3 day hold time to extraction, then 3 days from extraction to analysis
SW/GW	N,N-dimethylformamide (DMF)	Low	Modified 8033 – GC/NPD / L-35	2 x 40 mL	2 x 40 mL VOC vials	Cool, 4ºC	14 days to analysis
SO/SD	N,N-dimethylformamide (DMF)	Low	Modified 8033 – GC/NPD / L-35	1 x 2oz	1 x 2 oz. clear wide mouth glass	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
SW/GW	Alkylphenols – Nonylphenol, Nonylphenol diethoxylate, 4-nonylphenyl, Nonylphenol isomers	Low	SW-846 8270C SIM / L-34	2 x 1L	2 x 1L Amber Glass	H_2SO_4 to pH<2 and Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
SW/GW	Phthalic Anhydride (acid)	Low	Lab Specific HPLC Method / L-36	3 x 40 mL	3 x 40 mL VOC vials	Cool, 4ºC out of direct sunlight	7 days to extraction; 40 days from extraction to analysis
SO/SD	Phthalic Anhydride (acid)	Low	Lab Specific HPLC Method / L-36	1 x 8 oz.	1 x 8 oz. clear wide mouth glass	Cool, 4ºC out of direct sunlight	14 days to extraction; 40 days from extraction to analysis
SW/GW	Sulfate[1]	Low	USEPA 300 / L-12	1 x 500 mL	1 x 500 mL polyethylene	Cool, 4ºC	28 days to analysis
SO/SD	Sulfate	Low	USEPA 300 / L-12	1 x 4 oz.	1 4 oz. clear wide mouth glass	Cool, 4ºC	28 days to analysis
SW/GW	Chloride[1]	Low	USEPA 300 / L-13	1 x 500 mL	1 x 500 mL polyethylene	Cool, 4ºC	28 days to analysis
SO/SD	Chloride	Low	USEPA 300 / L-13	1 4 oz.	1 x 4 oz. clear wide mouth glass	Cool, 4ºC	28 days to analysis

Table 9.1-1
Summary of Analytical Methods, Sample Containers, Preservation, and Hold Times

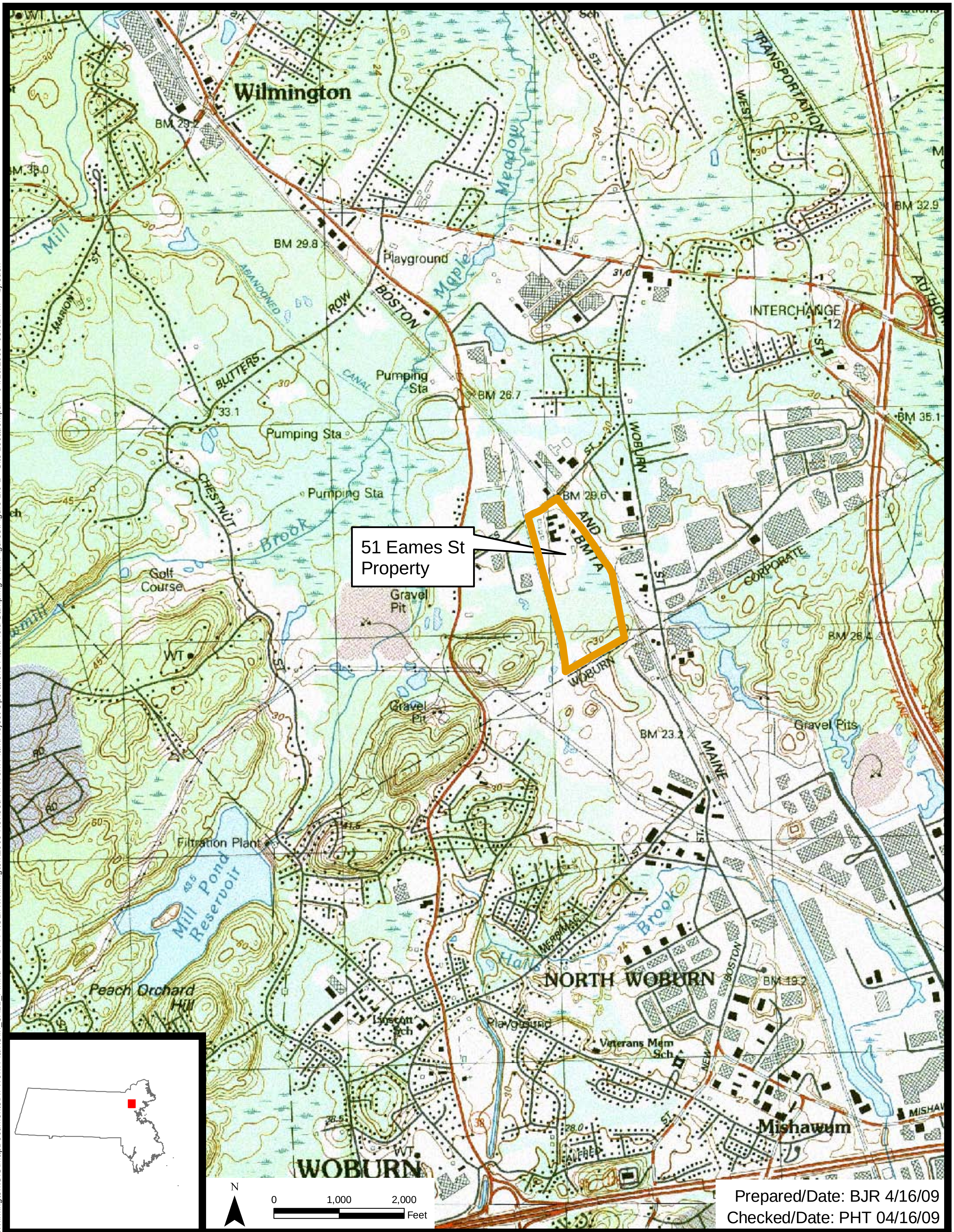
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

SW/GW	Alkalinity[1]	Low	SM 2320B / L-15	1 x 500 mL	1 x 500 mL polyethylene	Cool, 4ºC	14 days to analysis
SW/GW	Nitrate	Low	USEPA 300.0 / L-17	1 x 500mL	1 x 500 mL polyethylene (can be collected with nitrite)	Cool, 4ºC	48 hours to analysis
SW/GW	Nitrite	Low	USEPA 300.0 / L-18	1 x 500 mL	1 x 500 mL polyethylene (can be collected with nitrate)	Cool, 4ºC	48 hours to analysis
SW/GW	Bromide	Low	USEPA 300.0 / L-18	1 x 500 mL	1 x 500 polyethylene	Cool, 4ºC	28 days to analysis
SW/GW	Hardness	Low	SM 2340B / L-16	1 x 250 mL	1 x 250 mL polyethylene	pH < 2 w/ HNO_3	180 days to analysis
SW/GW	Total Dissolved Solids (TDS)	NA	SM 2540C / L-19	1 x 500 mL	1 x 500 mL polyethylene	none	7 days to analysis
SW/GW	Total Suspended Solids (TSS)	NA	SM 2540D / L-19	1 x 500 mL	1 x 500 mL polyethylene	none	7 days to analysis
SW/GW	Ammonia	Low	Quick Chem Method 10-107-06-1-A / L-20	1 x 250 mL	1 x 250 mL polyethylene	H_2SO_4 to pH<2, Cool, 4ºC	28 days to analysis
SO/SD	Ammonia	Low	Quick Chem Method 10-107-06-1-A / L-20	1x 4oz	1 x 4 oz. amber wide mouth glass	Cool, 4ºC	28 days to analysis
SW/GW	pH	Low	SM 4500 / L-15	1 x 250 mL	1 x 250 mL polyethylene	Cool, 4ºC	Immediately upon arrival at the lab
SW/GW	Specific Conductance	Low	SM 2510B / L-15	1 x 250 mL	1 x 250 mL polyethylene	Cool, 4ºC	28 days to analysis
SW/GW	Chemical Oxygen Demand (COD)	Low	USEPA 410.4 / L-21	1 x 250 mL	1 x 250 mL polyethylene	H_2SO_4 to pH<2, Cool, 4ºC	28 days to analysis
SW/GW	Total Organic Carbon (TOC)	Low	SM 5310B / L-22	3 x 40 mL	3 x 40 mL VOC vials	H_2SO_4 to pH<2 or HCL to pH<2 and Cool, 4ºC	28 days to analysis
SO/SD	Total Organic Carbon (TOC)	Low	Lloyd Kahn / L-39	1x 4oz	1 x 4 oz. amber wide mouth glass	Cool, 4ºC	28 days to analysis
GW	Perchlorate	Low	SW-846 6850 / L-37	2 x 40 mL	2 x 40 mL VOC vials	none	28 days to analysis

Prepared by / Date: TLC 10/07/2008
Checked by / Date: PHT 10/07/2008

mL = milliliter
L = Liter
g = gram
SW/GW = Surface water / Groundwater
SO/SD = Soil / Sediment
SOP = Standard Operating Procedure
[1] Sulfate, chloride, and alkalinity can be collected in a single 500 mL bottle.

FIGURES



Prepared/Date: BJR 4/16/09
Checked/Date: PHT 04/16/09

Olin Chemical Superfund Site
Wilmington, Massachusetts

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Figure 1.0-1
Site Location
Field Sampling Plan

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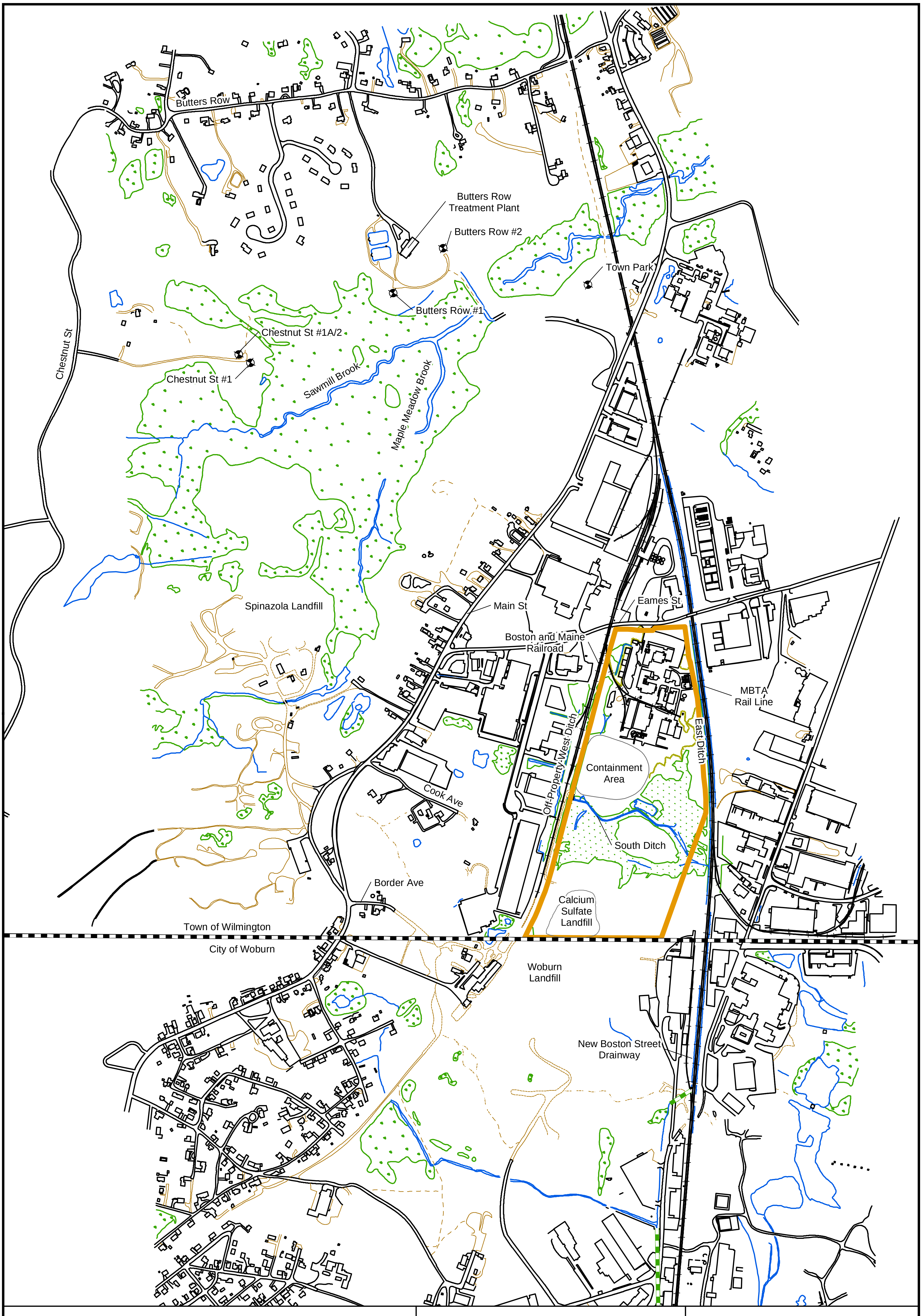

Legend

- Town Wells
- Town Line
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- 51 Eames St. Property Boundary
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

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107 Audubon Road Suite 301
Wakefield, MA 01880

N

0 340 680 1,360
Feet

Figure 1.0-2
Site Features

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/09	Checked/Date: MJM 04/16/09

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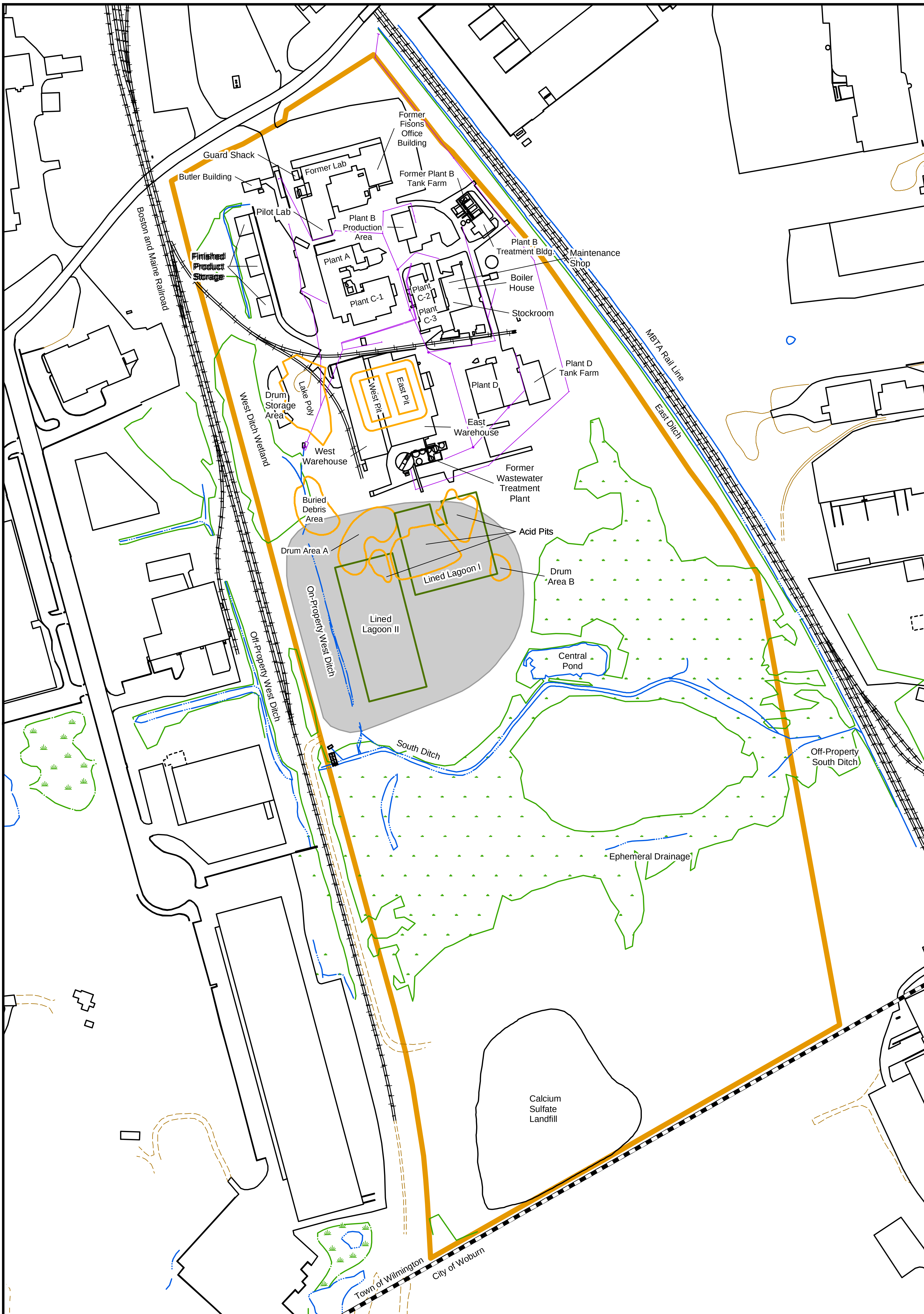

Legend

- Town Line
- Drain/Sewer Line
- Trail
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Surface Water
- Wetland Boundary
- 51 Eames St Property Boundary
- Containment Structure (current feature, not historical)

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N

0 100 200 400
Feet

Figure 2.1-1
Historical Facility Features

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/16/09 | Checked/Date: MJM 04/16/09

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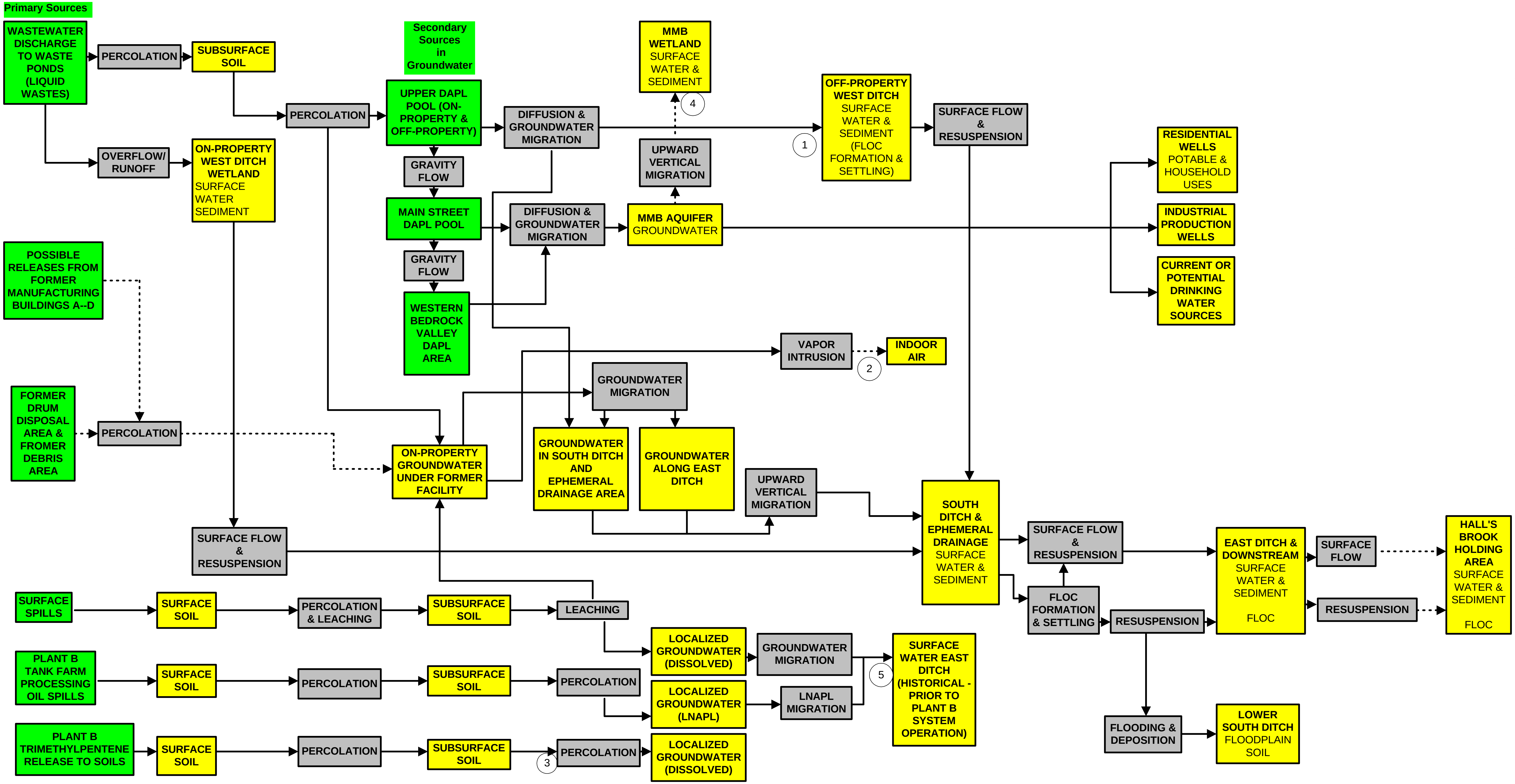

NOTES:

1. UPWARD MIGRATION ELIMINATED BY WEIR INSTALLATION
2. PREVIOUS AIR SAMPLING PLANT P (POSITIVE OUTCOME). COMPARISON TO MCP GW-2 STANDARDS
3. AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM REMEDIATED THIS RELEASE
4. AVAILABLE DATA INDICATE PATHWAY IS CURRENTLY INCOMPLETE
5. CURRENTLY CONTROLLED BY THE PLANT B GROUNDWATER RECOVERY/TREATMENT SYSTEM

———— COMPLETE PATHWAY

- - - - - POTENTIALLY COMPLETE PATHWAY (TO BE DETERMINED)

YELLOW SHADING — YELLOW SHADING INDICATES A MEDIA TYPE

GRAY SHADING — GRAY SHADING INDICATES A MECHANISM

GREEN SHADING — GREEN SHADING INDICATES A PRIMARY OR SECONDARY SOURCE

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Prepared/Date: SEH 04/22/09 | Checked/Date: MJM 04/29/09

Figure 2.2-1
Physical Conceptual Site Model
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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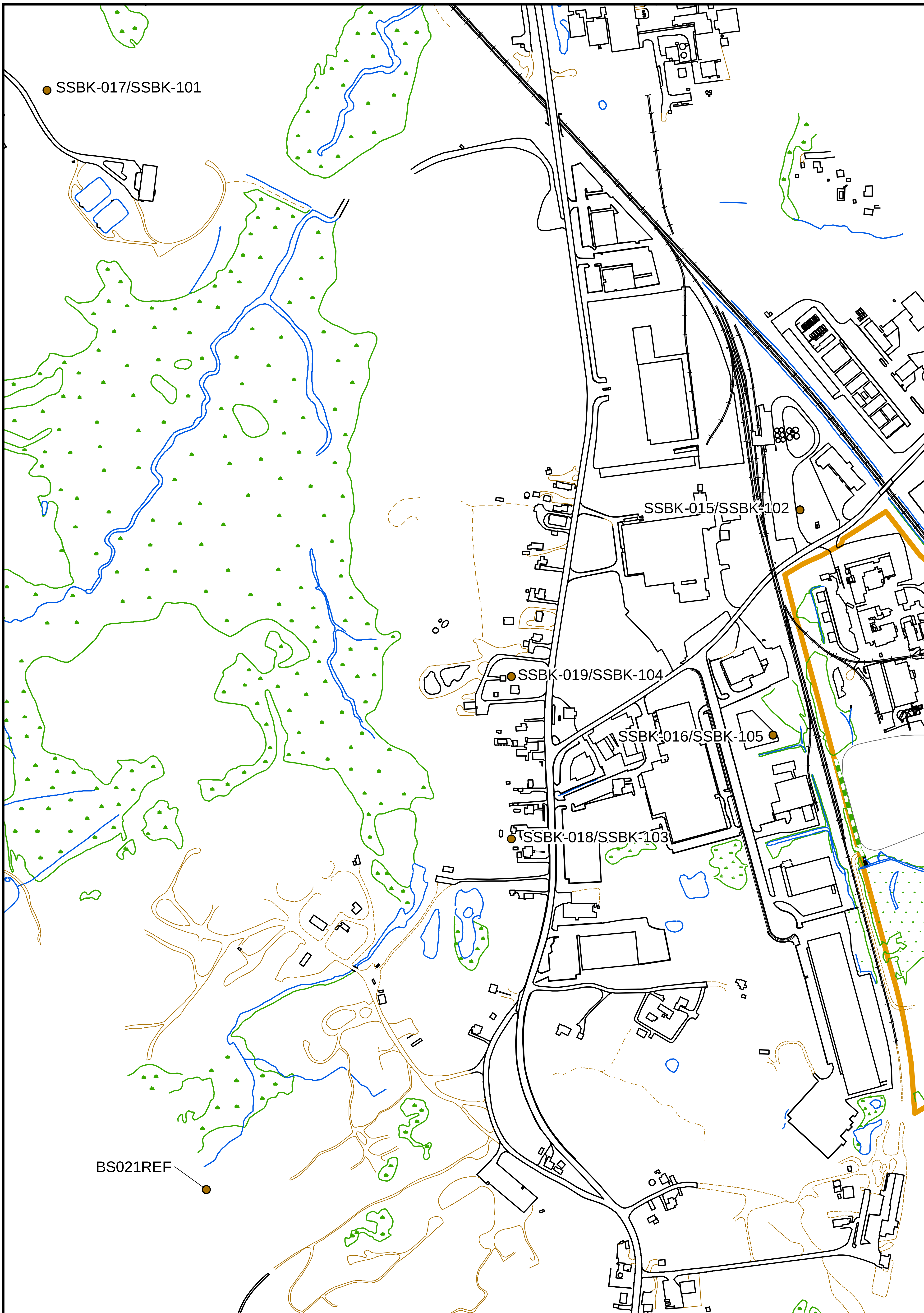

Legend

- Soil Background Location
- 51 Eames St. Property Boundary
- Railroad
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary

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N

0 200 400 800 Feet

Figure 3.2-1
Background Soil Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/06/09 | Checked/Date: MJM 08/07/09

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Legend

▽ Surface Water Background Location

51 Eames St. Property Boundary

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N

0 1,200 2,400 4,800
Feet

Figure 3.2-2
Background Surface Water Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/06/09	Checked/Date: MJM 08/07/09

Document: P:\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\Olin_11X17_P.mxd PDF: P:\OLIN\Wilmington\2009 Revised RI Work Plan\FINAL RI Work Plan\Field Sampling Plan\Figures\Figure 3.2-2 - Background Surface Water Locations.pdf 08/11/2009 4:58 PM bjroden

Legend

△ Sediment Background Location
51 Eames St. Property Boundary

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Wakefield, MA 01880

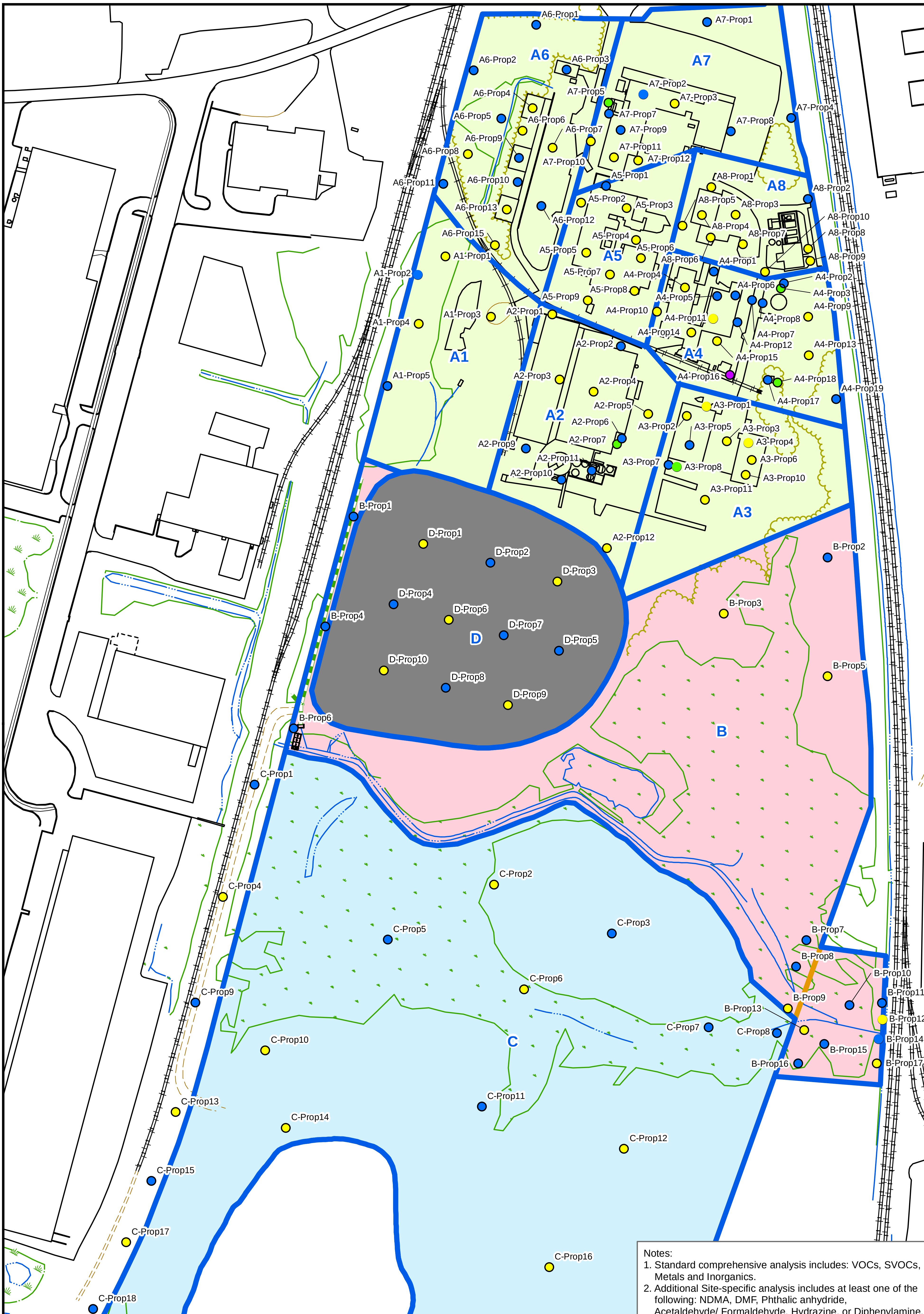
N

0 1,200 2,400 4,800 Feet

Figure 3.2-3
Background Sediment Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/06/09 | Checked/Date: MJM 08/07/09



Notes:

1. Standard comprehensive analysis includes: VOCs, SVOCs, Metals and Inorganics.
2. Additional Site-specific analysis includes at least one of the following: NDMA, DMF, Phthalic anhydride, Acetaldehyde/ Formaldehyde, Hydrazine, or Diphenylamine.

Legend

- Location with Standard Comprehensive Analysis Proposed
- Location with Additional Site-Specific Analysis Proposed
- Location with only PCB Analysis Proposed
- Location with only Inorganics Analysis Proposed
- Investigation Area
- 51 Eames St. Property Boundary
- Exposure Area A
- Exposure Area B
- Exposure Area C
- Exposure Area D
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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N

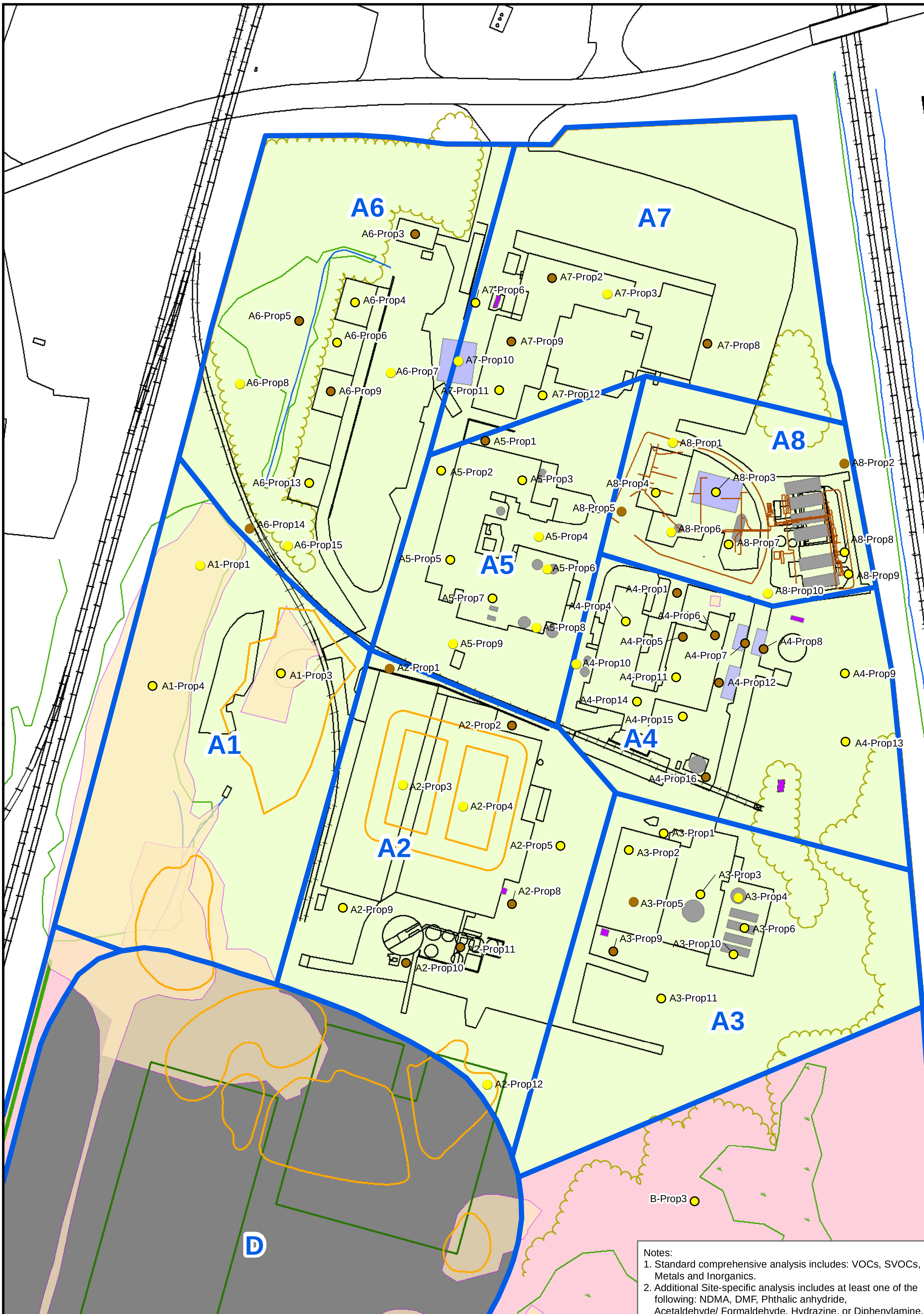
0 80 160 320 Feet

Figure 4.1-1
Proposed Surface Soil Sample Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/10/09 | Checked/Date: MJM 08/10/09

Document: P:\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\Olin_11X17_P_rotated.mxd PDF: P:\OLIN\Wilmington\2009 Revised RI Work Plan\FINAL RI Work Plan\Field Sampling Plan\Figures\Figure 4.1-1 - Proposed Surface Soil Sample Locations.pdf 08/10/2009 1:01 PM bjroden



Notes:
1. Standard comprehensive analysis includes: VOCs, SVOCs, Metals and Inorganics.
2. Additional Site-specific analysis includes at least one of the following: NDMA, DMF, Phthalic anhydride, Acetaldehyde/ Formaldehyde, Hydrazine, or Diphenylamine.

Legend

- Location with Standard Comprehensive Analysis Proposed
- Location with Additional Site-Specific Analysis Proposed
- Investigation Area
- 51 Eames St. Property Boundary
- Exposure Area A
- Exposure Area B
- Exposure Area C
- Exposure Area D
- Excavation Area
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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Figure 4.2-1
Proposed Subsurface Soil Sample Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/28/09	Checked/Date: MJM 04/28/09

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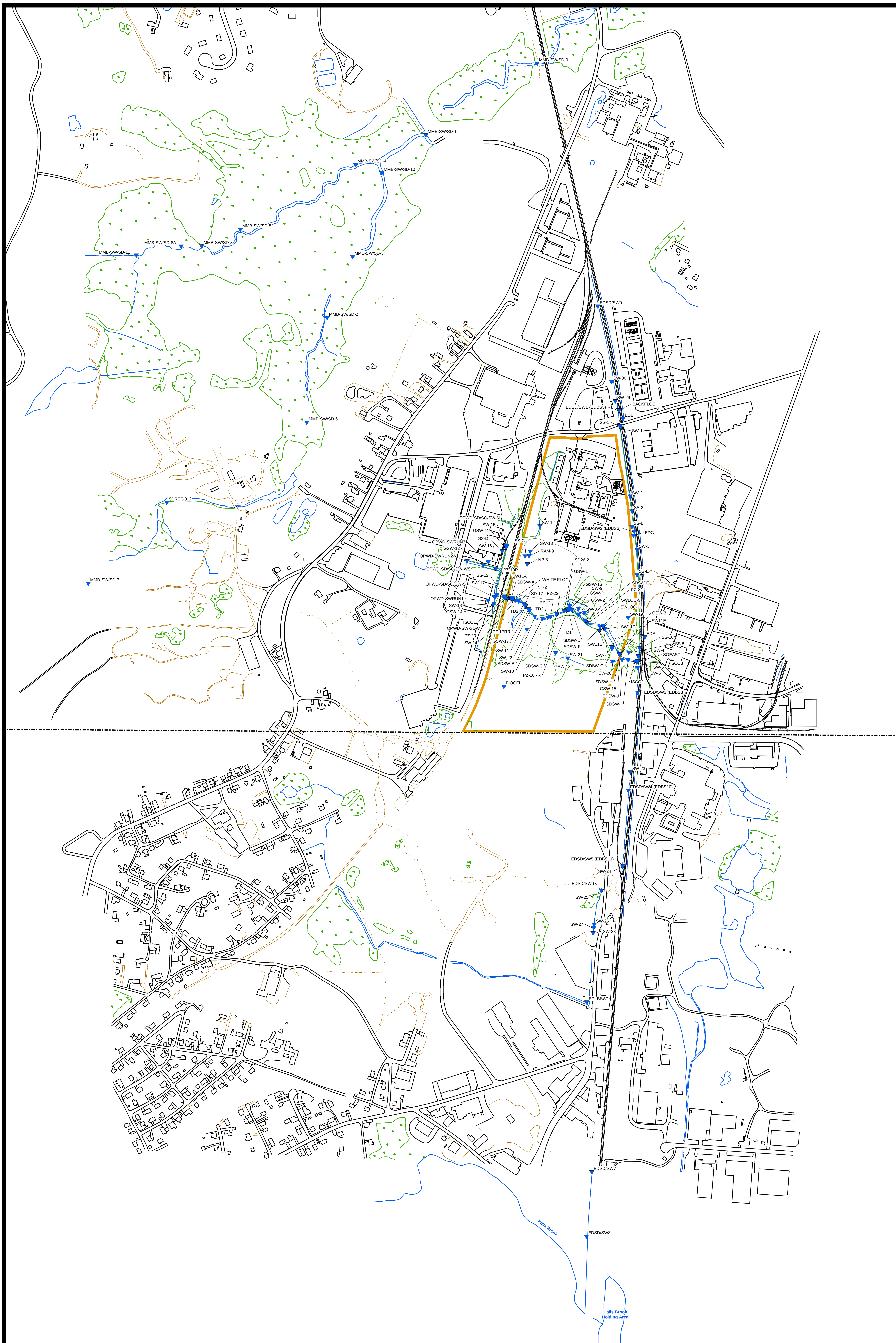

▼ Historical Surface Water Sample Location

Legend

- 51 Eames St. Property Boundary
- Trail
- Town Line
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Symbol
- Wetland Boundary

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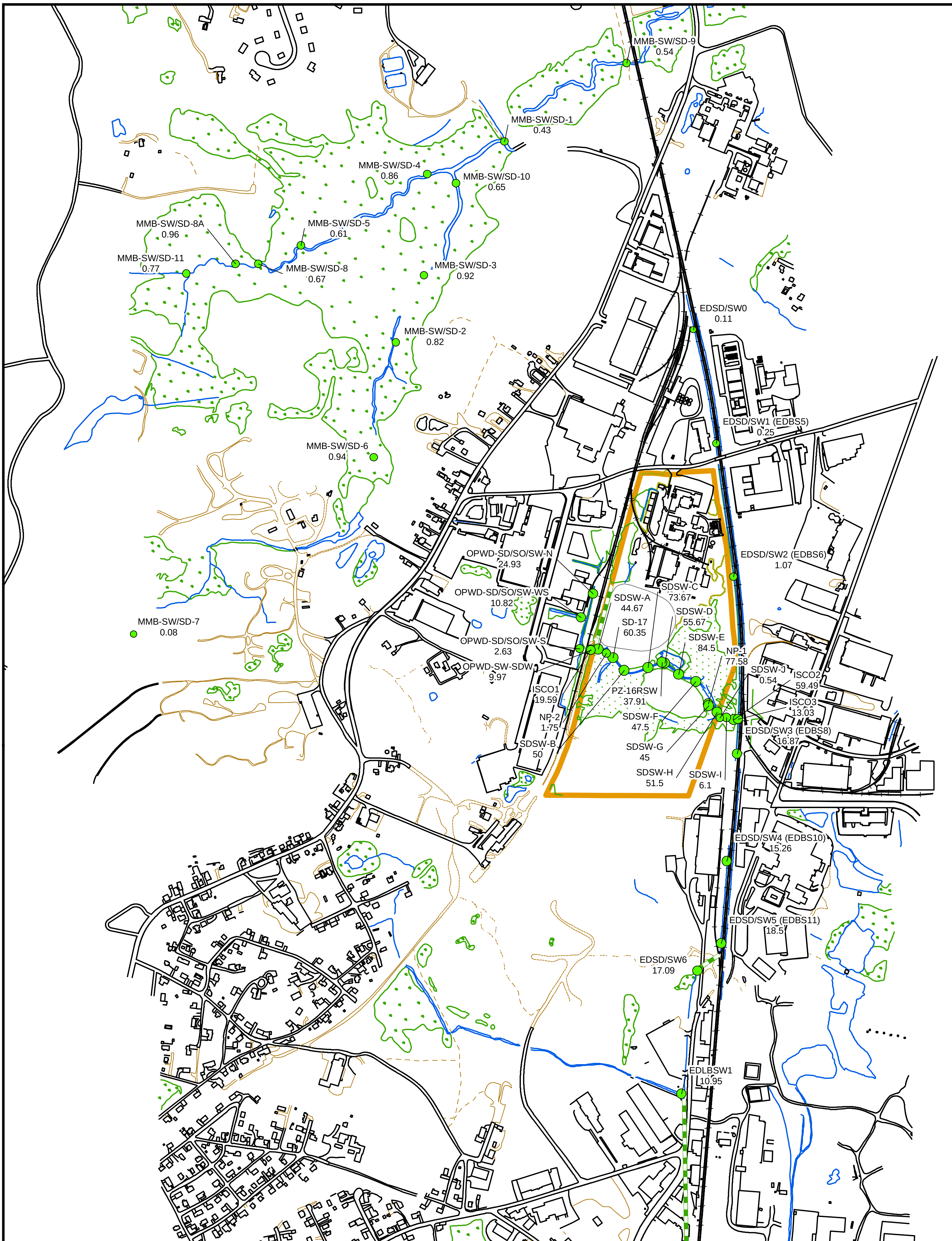
N

0 350 700
Feet

Figure 4.3-1
Locations of Historical Surface Water Samples
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/31/08 | Checked/Date: MJM 07/31/08

Document: P:\OLIN\Wilmington\GIS\MapDocuments\Focused RI\Olin_22X34_P.mxd PDF: P:\OLIN\Wilmington\2007 Remedial Investigation Work Plan\Field Sampling Plan\FSP Figures\Figure 4.3-1 - Locations of Historical Surface Water Samples.pdf 07/31/2008 9:11 AM bjroden



Notes:
Symbol size is proportional based on log normal chemical concentration.

Data used are from 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.

Legend

- *MMB-SW/SD-4* Location ID
- *0.05* Analyte Concentration (mg/L)
- Analyte Not Detected (ND)
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

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N

0 340 680 1,360
Feet

Figure 4.3-2
Distribution of Ammonia Concentrations in Surface Water Samples

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08 | Checked/Date: MJM 10/14/08

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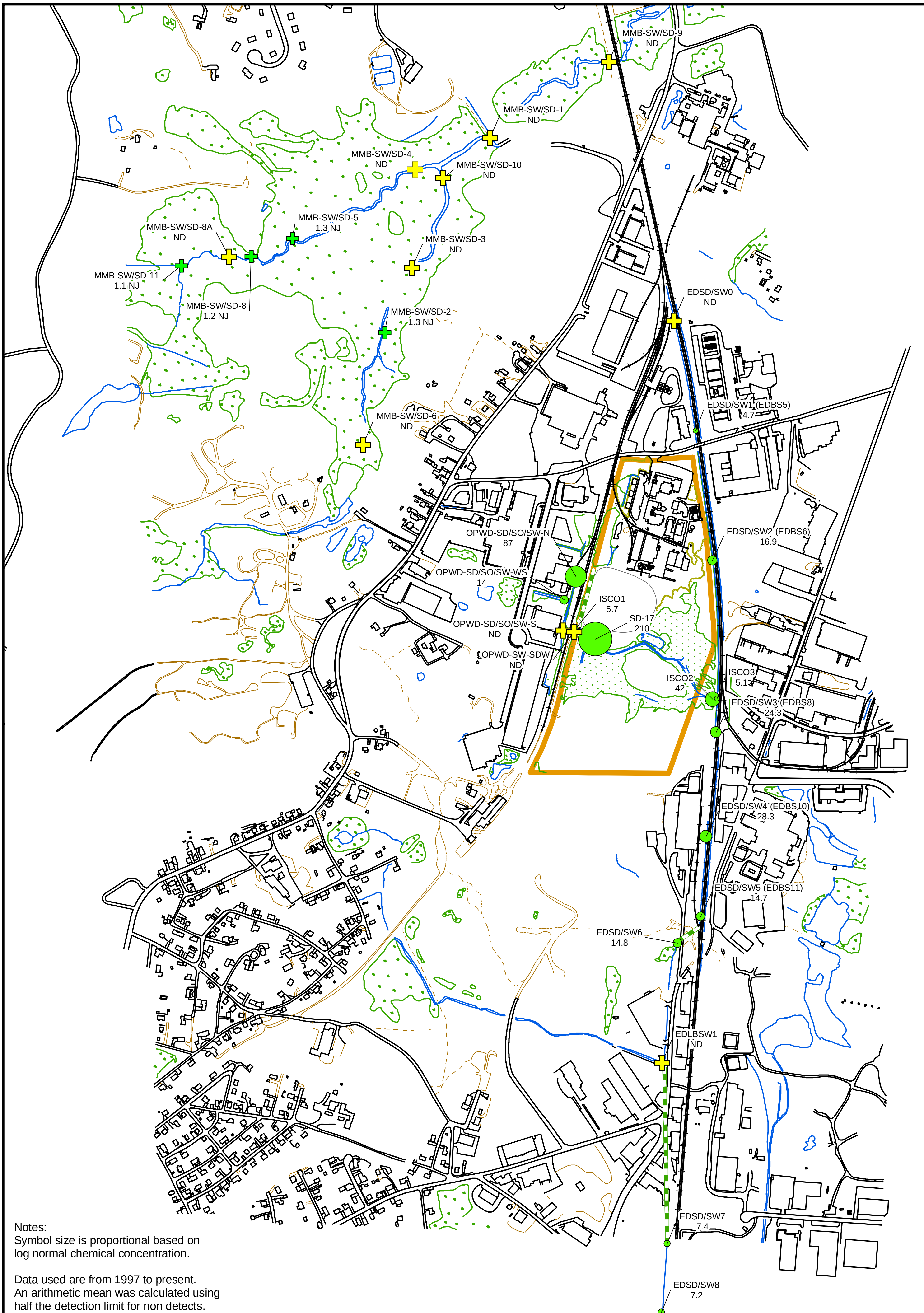

Notes:
Symbol size is proportional based on log normal chemical concentration.

Data used are from 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.

Legend

- *MMB-SW/SD-4* Location ID
- *0.05* Analyte Concentration (ng/L)
- Analyte Presumptively Present (NJ)
- Analyte Not Detected (ND)
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

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Figure 4.3-3
Distribution of N-Nitrosodimethylamine Concentrations in Surface Water Samples

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08 | Checked/Date: MJM 10/14/08

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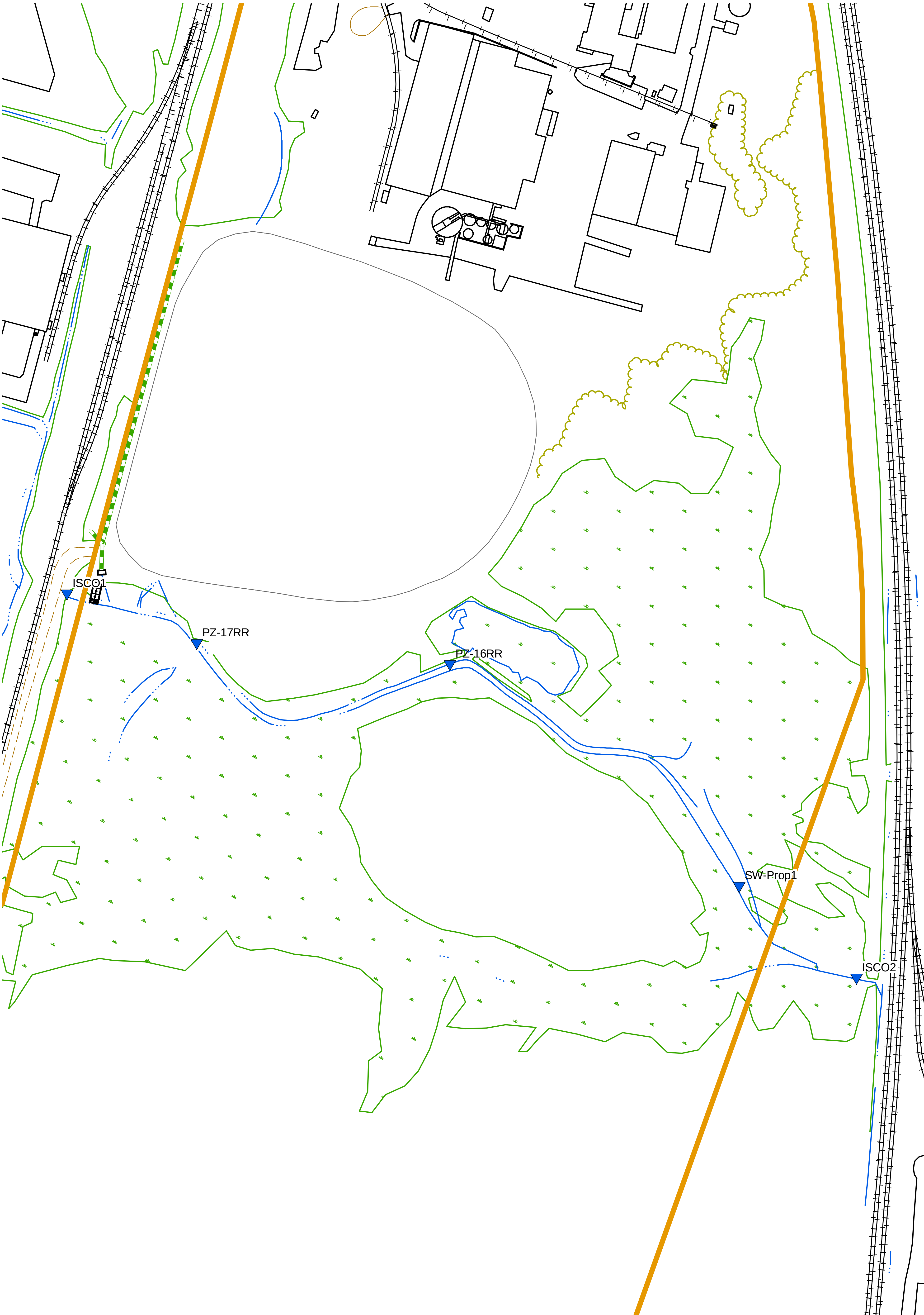

Legend

- ▼ Proposed Surface Water Sample Location
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- 51 Eames St. Property Boundary
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

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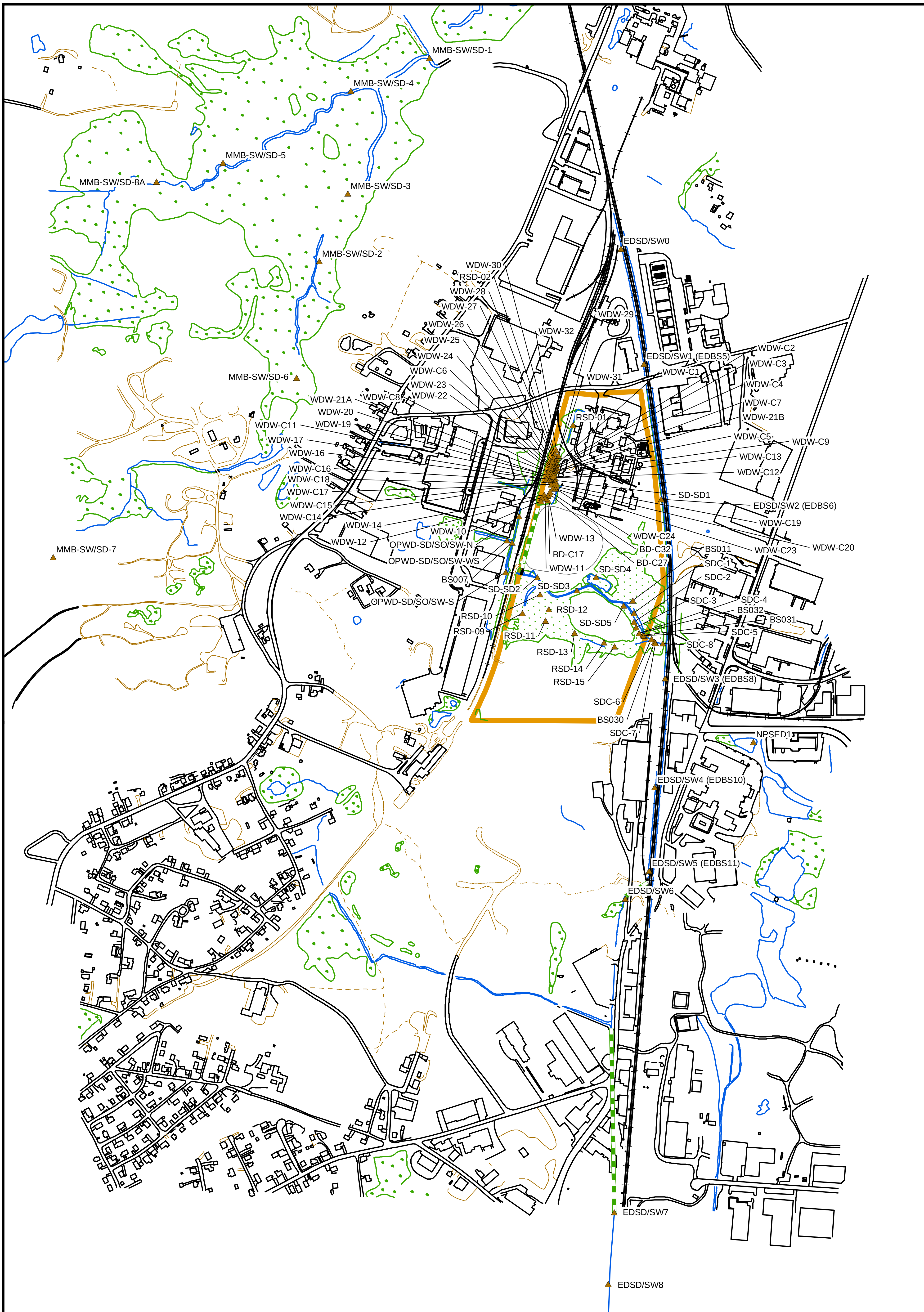
N

0 60 120 240
Feet

Figure 4.3-4
Proposed Surface Water Sample Locations - OU1

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/17/09	Checked/Date: MJM 04/17/09



Legend

- ▲ Historical Sediment Sample Location
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert

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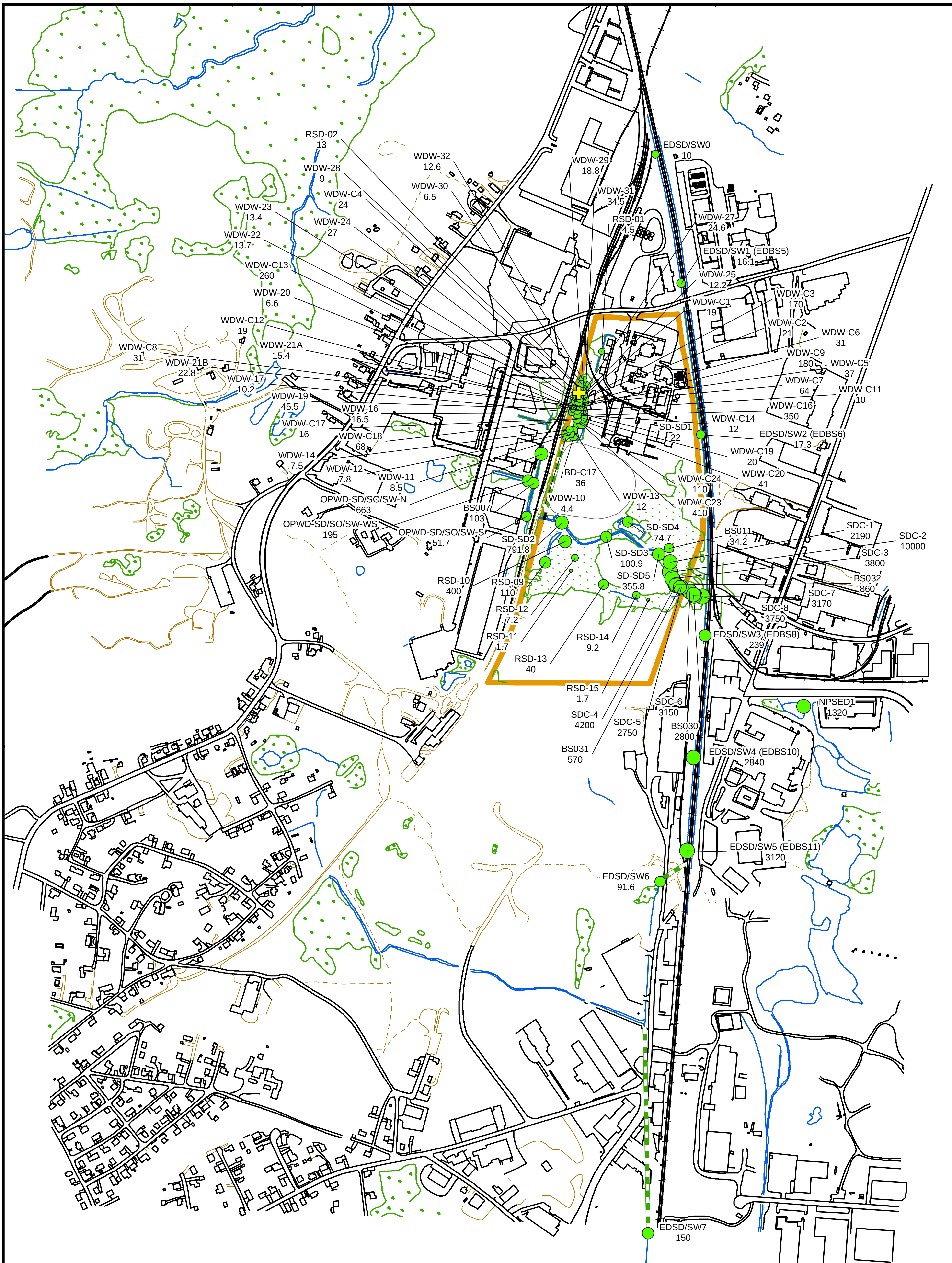
N

0 325 650 1,300
Feet

Figure 4.4-1
Location of Historical Sediment Samples

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/31/08	Checked/Date: MJM 07/31/08



Notes:
Symbol size is proportional based on log normalized chemical concentration.

Data used are from Jan. 1997, to present. For locations sampled multiple times an arithmetic mean was calculated using half the detection limit for non detects.

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert

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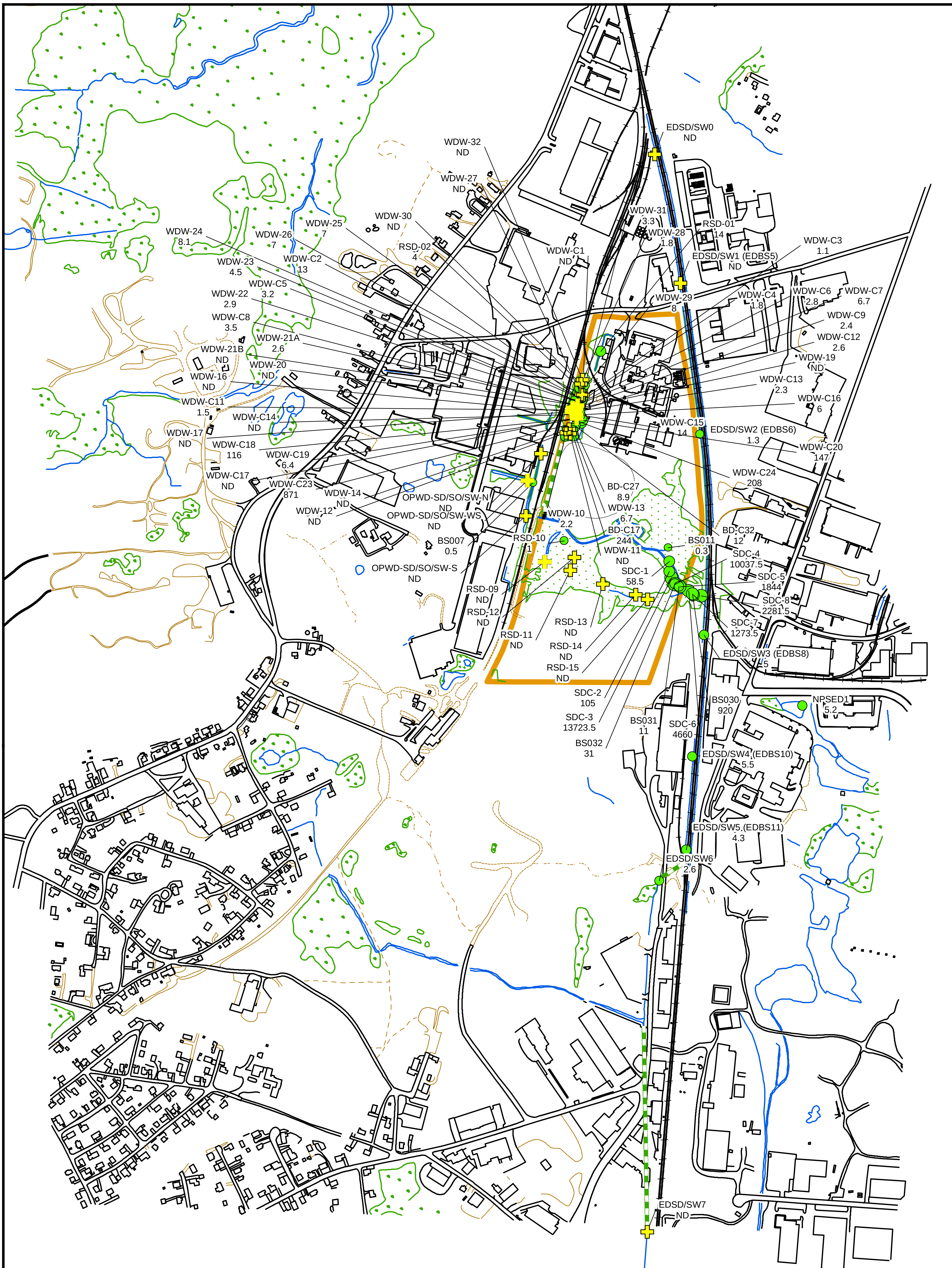
N
0 300 600 1,200
Feet

Figure 4.4-2
Distribution of Chromium Concentrations in Historical Sediment Samples

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/31/08 | Checked/Date: MJM 07/31/08

Document: P:\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\SedimentDistributions.mxd PDF: P:\OLIN\Wilmington\2009 Revised RI Work Plan\Project Operations Plan\Field Sampling Plan\Figures\Figure 4.4-2 - Distribution of Chromium Concentrations in Historical Sediment Samples.pdf 07/31/2008 11:05 AM bjroden



Notes:
Symbol size is proportional based on log normalized chemical concentration.

Data used are from Jan. 1997, to present. For locations sampled multiple times an arithmetic mean was calculated using half the detection limit for non detects.

Legend

- *SDC1* Location ID
- *10* Analyte Concentration (mg/kg)
- Analyte Not Detected (ND)
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Culvert

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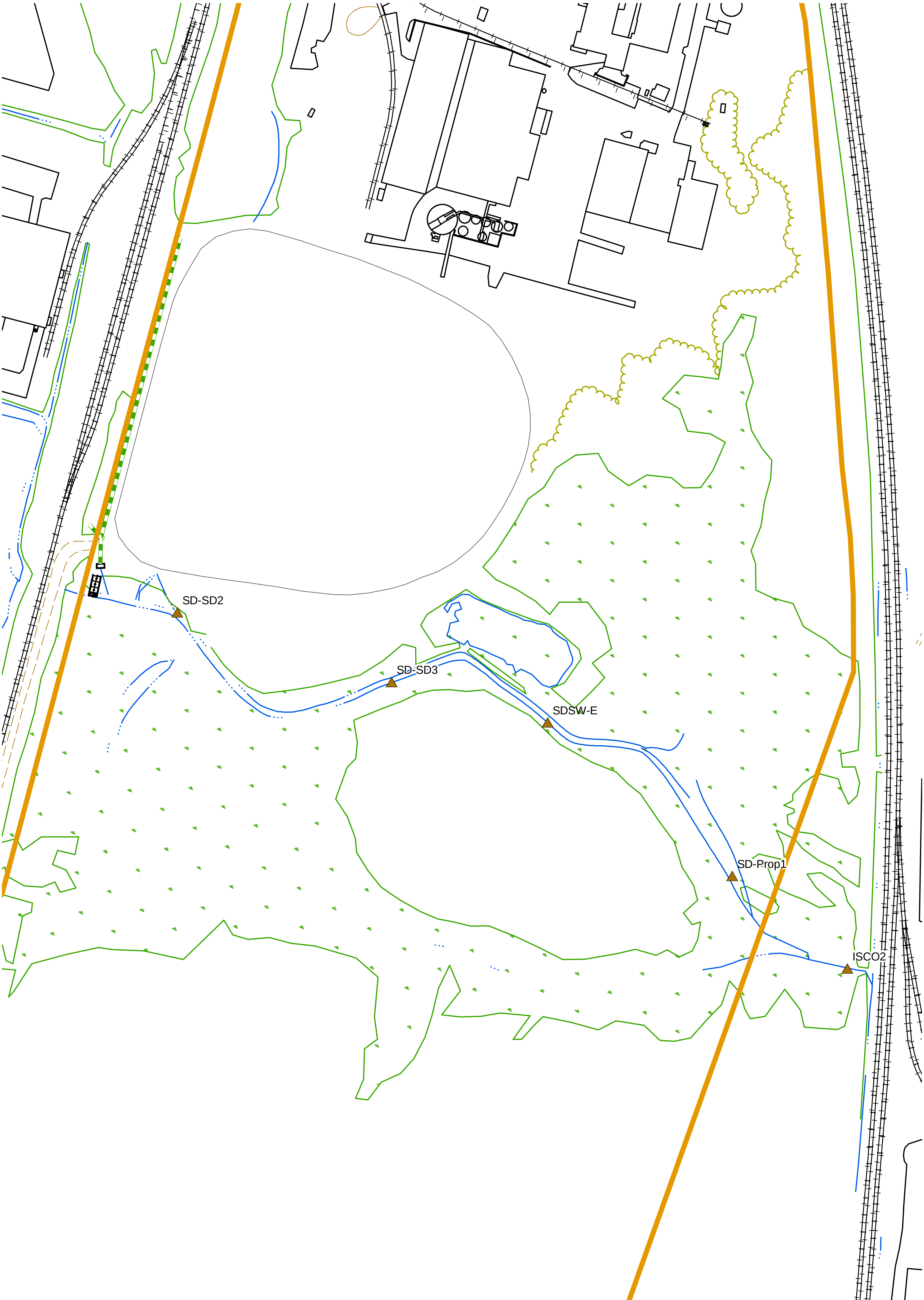
Figure 4.4-3
Distribution of bis-2-ethylhexylphthalate Concentrations in Historical Sediment Samples

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/31/08	Checked/Date: MJM 07/31/08



Legend

- ▲ Proposed Sediment Sample Location
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- 51 Eames St. Property Boundary
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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N

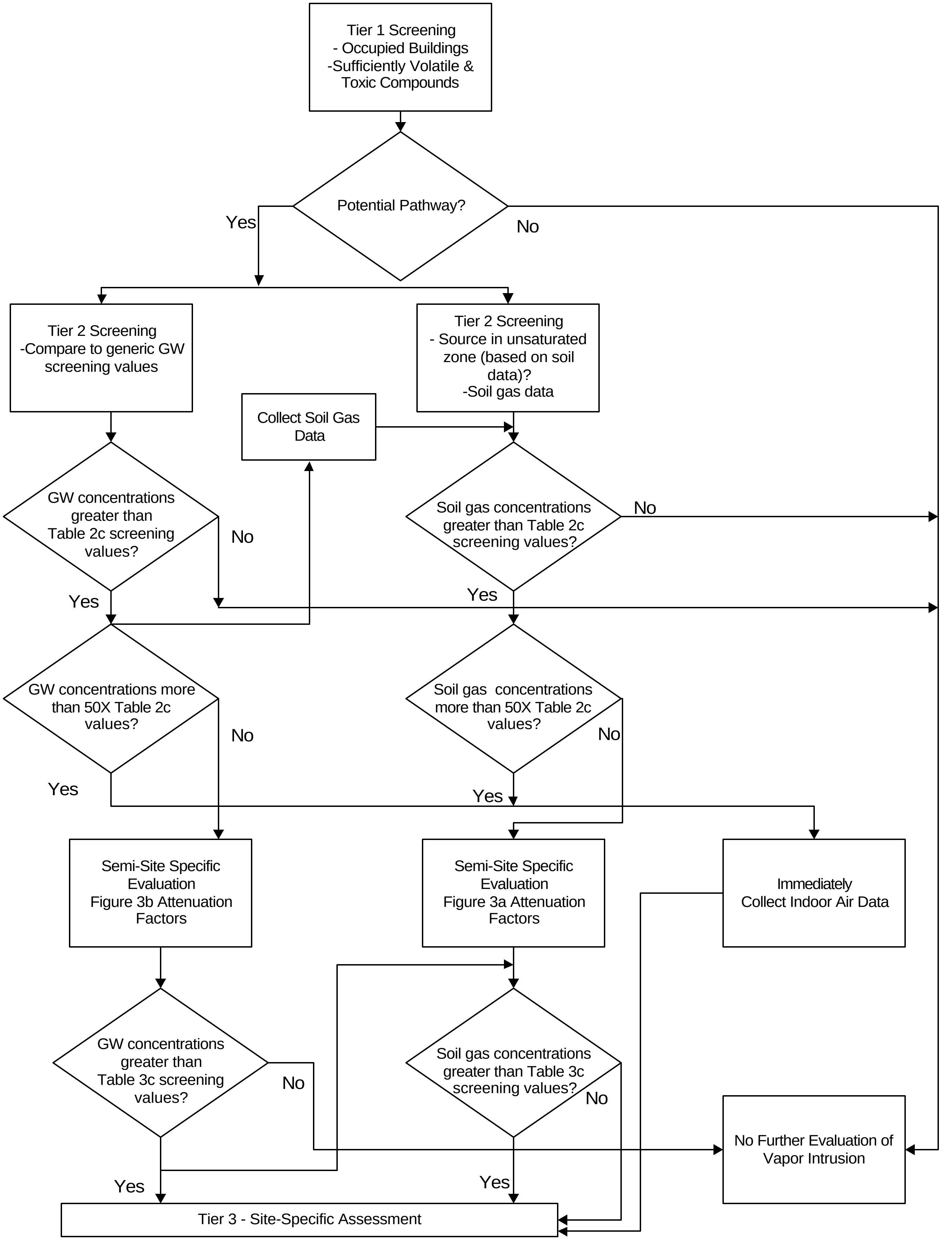
0 60 120 240 Feet

Figure 4.4-4
Proposed Sediment Sample Locations - OU1

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/20/09	Checked/Date: PHT 04/20/09

Document: P:\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\Olin_11X17_P_rotated.mxd PDF: P:\OLIN\Wilmington\2009 Revised RI Work Plan\Project Operations Plan\Field Sampling Plan\Figures\Figure 4.4-4 - Proposed Sediment Sample Locations - OU1.pdf 04/20/2009 10:45 AM bjroden



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Olin Chemical Superfund Site
Wilmington, Massachusetts

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Figure 4.5-1
Vapor Intrusion Evaluation Approach
Field Sampling Plan

Prepared/Date: BJR 04/29/09

Checked/Date: MJM 04/29/09

Legend

- Water Table Well with VOC and SVOC Analysis Proposed
- Groundwater Locations
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Existing Building
- Vacant Building
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 4.5-2
Location and Analytical Program for Shallow Groundwater Samples to Support Vapor Intrusion Evaluation
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/28/09	Checked/Date: MJM 04/28/09

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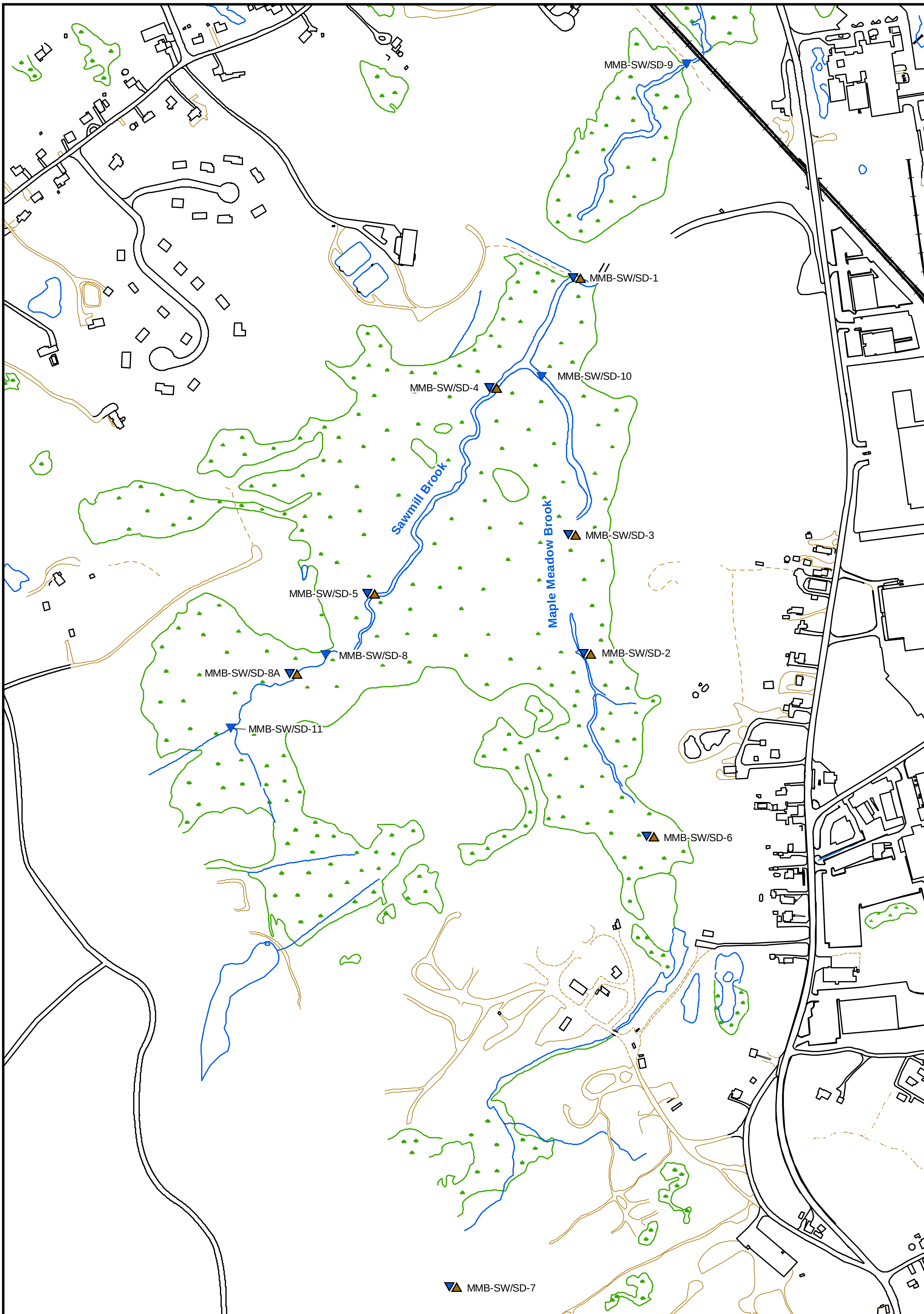

Legend

- Historical Surface Water and Sediment Location
- Historical Surface Water
- 51 Eames St. Property Boundary
- Railroad
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary

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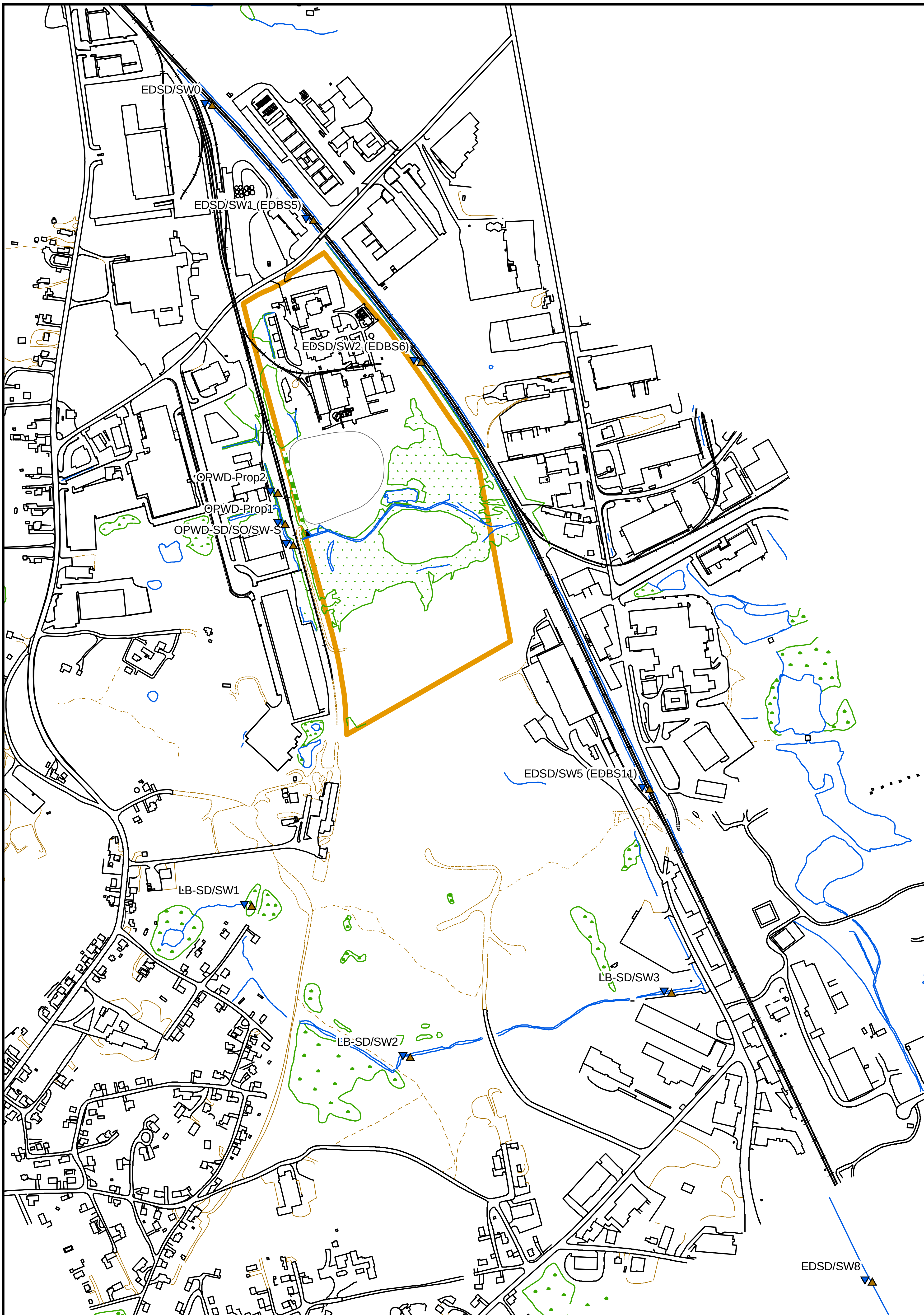
N

0 200 400 800
Feet

Figure 5.1-1
Location of Historical Surface Water and Sediment Samples - Maple Meadow Brook

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/29/09 | Checked/Date: MJM 04/29/09



Legend

- Proposed Sediment and Surface Water Location
- 51 Eames St. Property Boundary
- Railroad
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary

Locations LB-SD/SW1, LB-SD/SW2 and LB-SD/SW3 are considered approximate and will be field located based on access to the brook.

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N

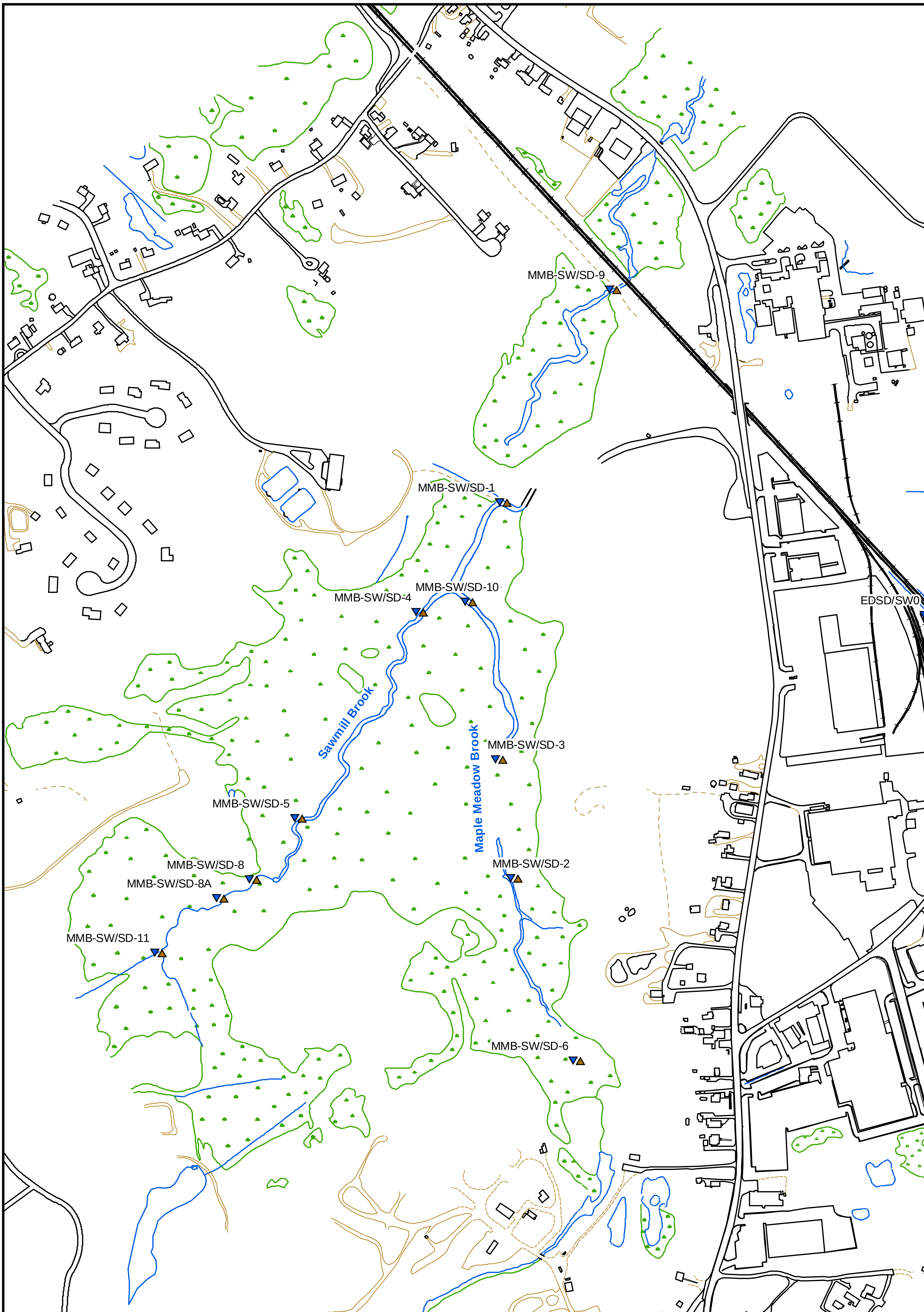
0 250 500 1,000 Feet

Figure 5.1-2
Proposed East Ditch and Off-Property West Ditch Surface Water and Sediment Sample Locations - OU2

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/06/09 | Checked/Date: PHT 08/07/09

Document: P:\OLIN\Wilmington\GIS\MapDocuments\RI Work Plan\Olin_11X17_P.mxd PDF: P:\OLIN\Wilmington\2009 Revised RI Work Plan\FINAL RI Work Plan\Field Sampling Plan\Figures\Figure 5.1-2 - Proposed ED and Off-PWD Surface Water and Sediment Sample Locations - OU2.pdf 08/11/2009 4:23 PM bjroden



Legend

- Proposed Sediment and Surface Water Location
- 51 Eames St. Property Boundary
- Railroad
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary

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N

0 200 400 800
Feet

Figure 5.1-3
Proposed Maple Meadow Brook Wetland Area
Surface Water and Sediment
Sample Locations - OU2

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/29/09 | Checked/Date: PHT 04/29/09

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Legend

- Groundwater Sample Location
- Extent of Groundwater Impact
- Inferred Extent of Groundwater Impact
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 275 550
Feet

Figure 6.1-1
Extent of Groundwater Impact

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/17/09	Checked/Date: PHT 04/17/09

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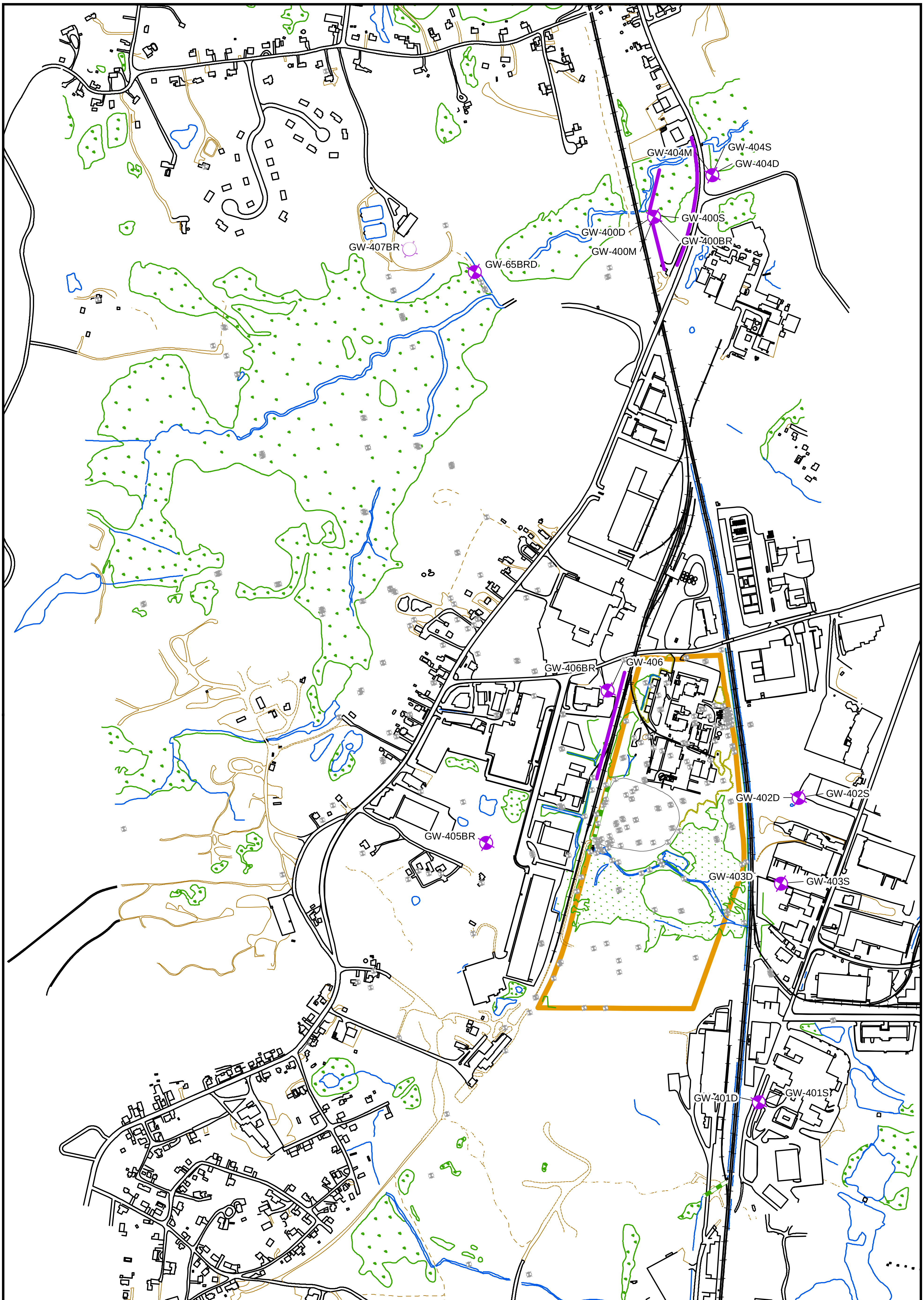

Legend

- Proposed Monitoring Well Location
- Historical Monitoring Well Location
- Proposed Seismic Line
- 51 Eames St. Property Boundary
- Paved Road
- Unpaved Road
- Railroad
- Sidewalks
- Structures
- Surface Water
- Trails
- Wetland Boundary
- Wooded Areas
- Culvert

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N

0 300 600 1,200
Feet

Figure 6.1-2
Proposed Monitoring Well Locations

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 08/06/09 | Checked/Date: PHT 08/06/09

Legend

Symbol		
Sample Analyzed for VOCs	Wilmington/Woburn Town Line	Water
Sample Not Analyzed for VOCs	51 Eames St. Property Boundary	Railroad
		Paved Road
		Unpaved Road
		Wetland Boundary

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N

0 300 600 Feet

Figure 6.2-1
Groundwater Samples Analyzed for Volatile Organic Compounds

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08 | Checked/Date: PHT 10/14/08

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Legend

- Sample Analyzed for SVOCs
- Sample Not Analyzed for SVOCs
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 6.2-2
Groundwater Samples Analyzed for Semi-volatile Organic Compounds

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08	Checked/Date: PHT 10/14/08

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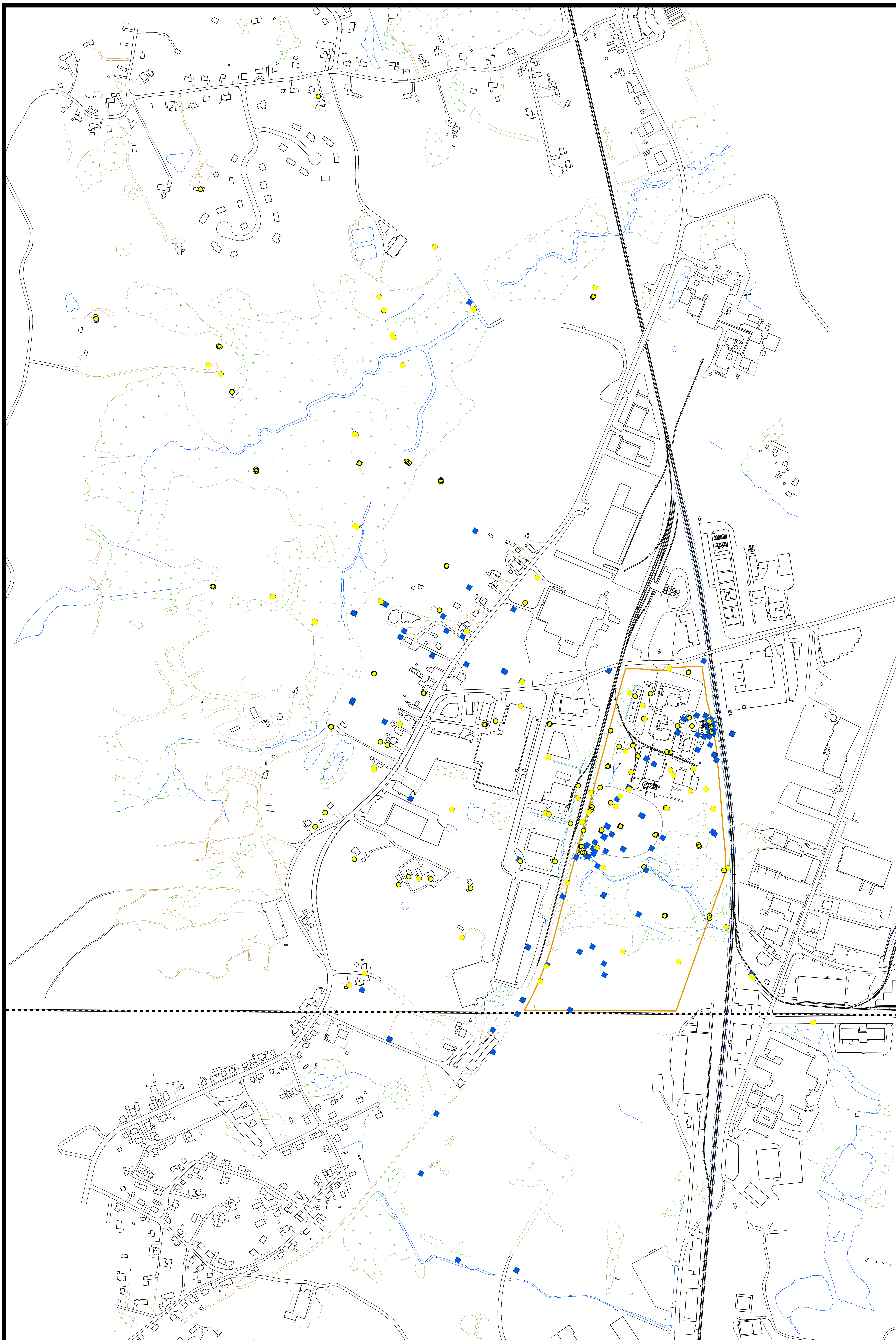

Legend

- Sample Analyzed for NDMA
- Sample Not Analyzed for NDMA
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 6.2-3
Groundwater Samples Analyzed for N-Nitrosodimethylamine

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08	Checked/Date: PHT 10/14/08

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Legend

- Sample Analyzed for Total Metals
- Sample Not Analyzed for Total Metals
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 6.2-4
Groundwater Samples Analyzed for Total Metals

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08	Checked/Date: PHT 10/14/08

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Legend

- Sample Analyzed for Filtered Metals
- Sample Not Analyzed for Filtered Metals
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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N

0 300 600
Feet

Figure 6.2-5
Groundwater Samples Analyzed for Filtered Metals

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/01/08	Checked/Date: PHT 10/01/08

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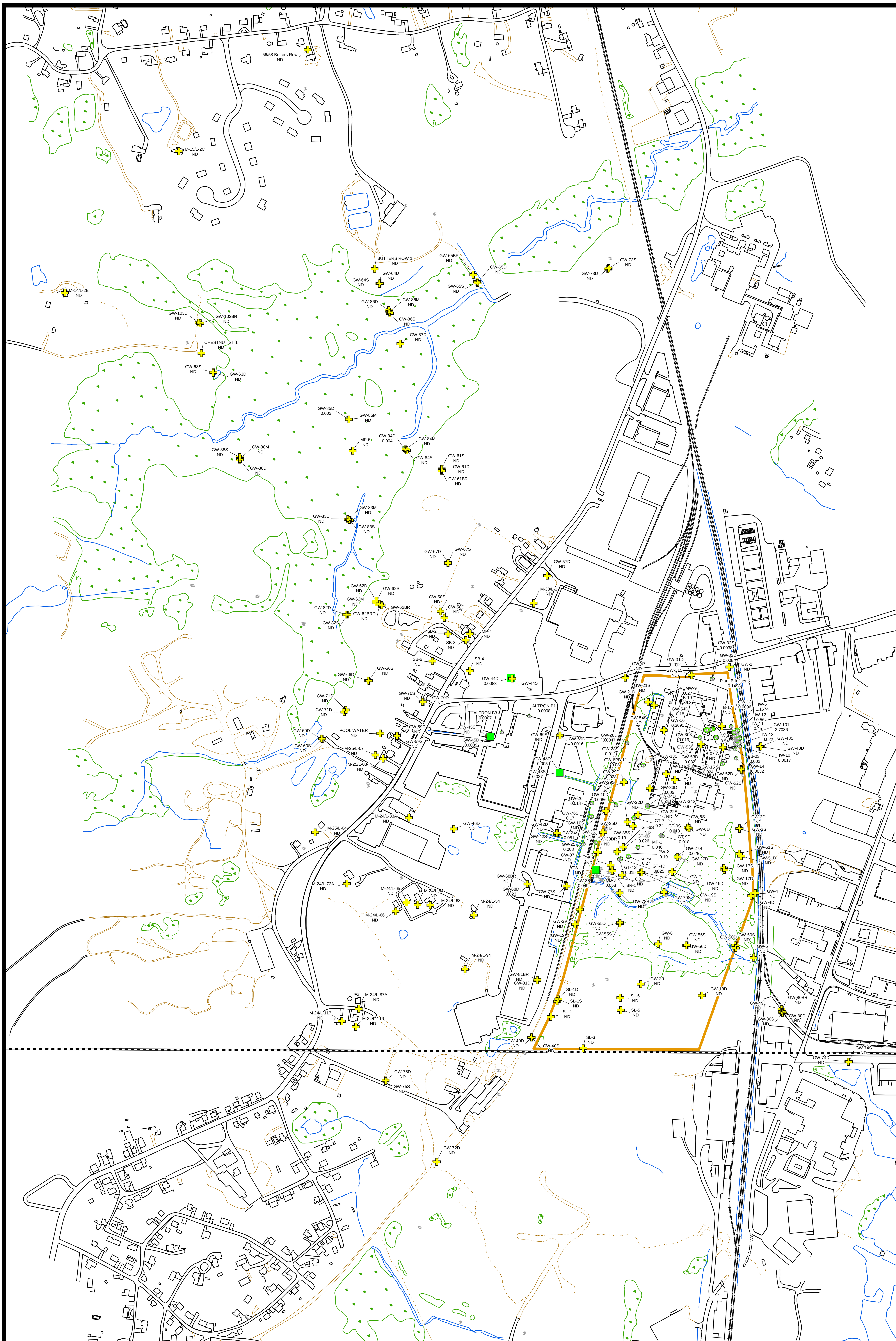

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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N

0 275 550
Feet

Figure 6.2-6
Distribution of 2,4,4-trimethyl-1-pentene Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/02/08 | Checked/Date: PHT 10/02/08

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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Figure 6.2-7
Distribution of 2,4,4-trimethyl-2-pentene Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/02/08	Checked/Date: PHT 10/02/08

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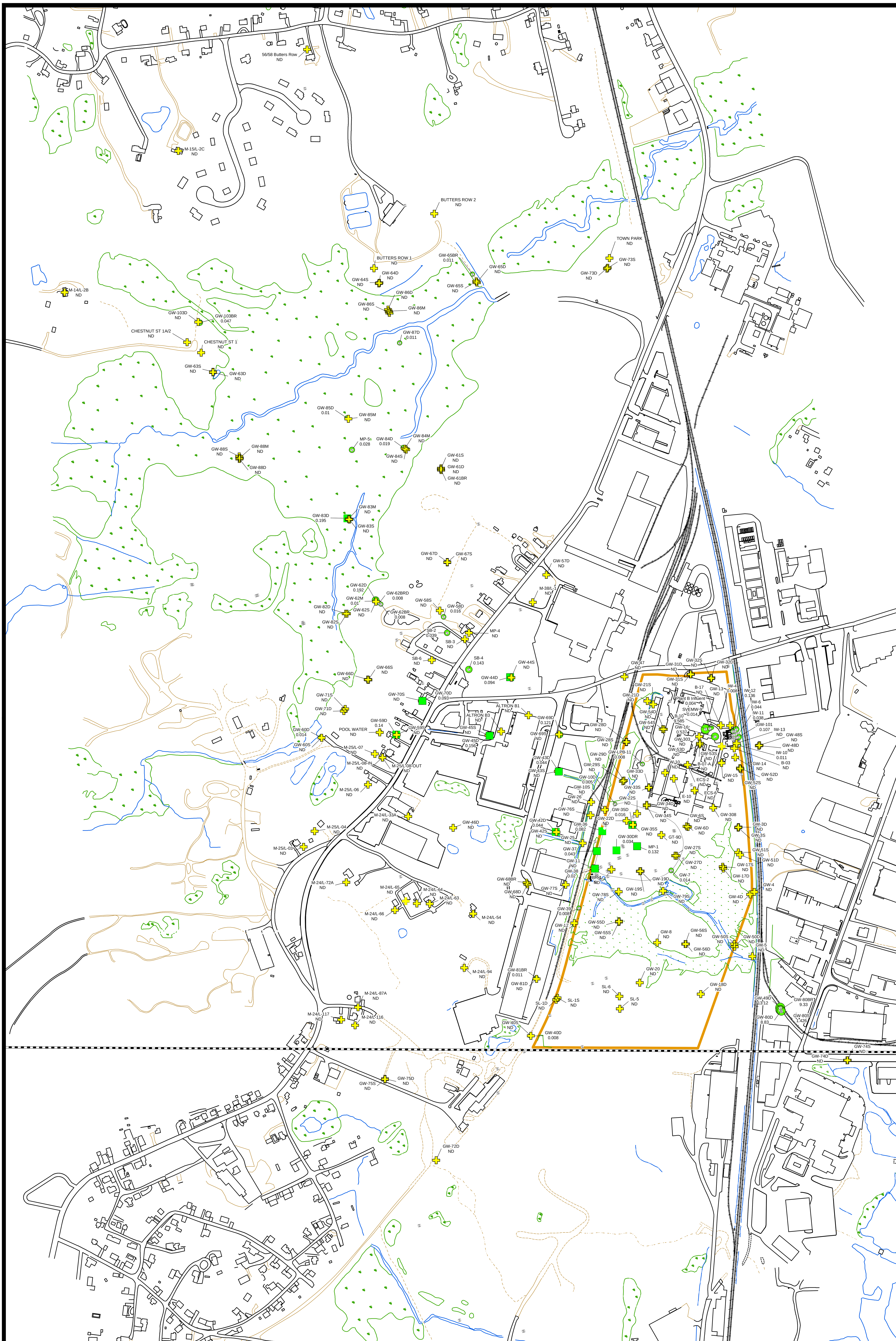

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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Figure 6.2-8
Distribution of BTEX (Benzene, Toluene, Ethylbenzene, Xylenes) Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- 111TCA, 11DCA or 12DCA Detected in Groundwater
- 111TCA, 11DCA, and 12DCA Not Detected in Groundwater
- ND Compound Not Detected
- Groundwater Location Not Analyzed for VOCs
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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Feet

Figure 6.2-9
Most Recent Chlorinated Solvents (1,1,1-TCA; 1,1-DCA; 1,2-DCA) Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/08/08 | Checked/Date: PHT 10/08/08

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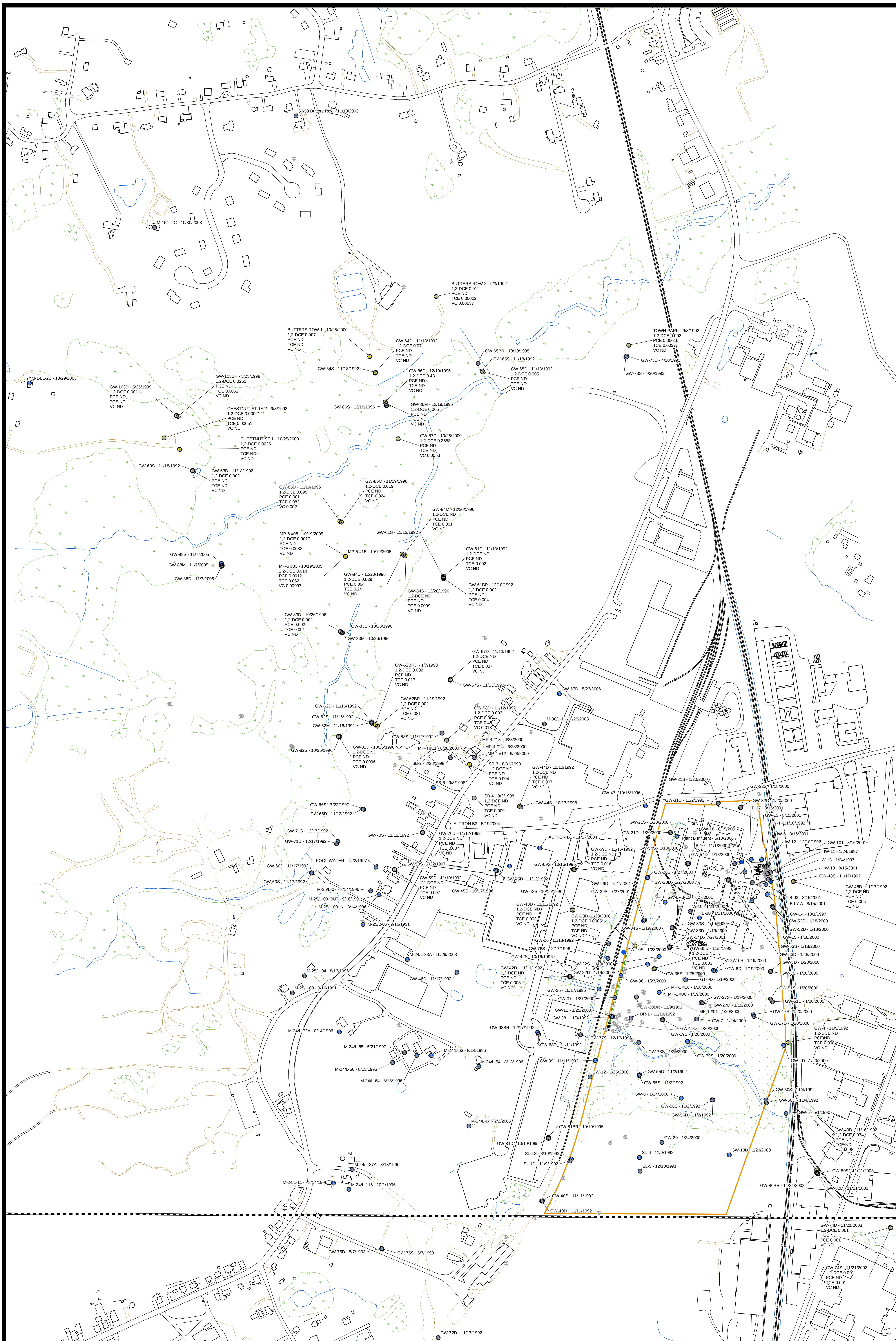

Legend

- DCE, PCE, TCE, and VC Not Detected in Groundwater
- DCE, PCE, TCE, or VC Detected in Groundwater
- Groundwater Location Not Analyzed for VOCs
- ND Compound Not Detected
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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Figure 6.2-10
Most Recent Chlorinated Solvents (1,2-DCE; PCE; TCE; VC) Detected in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/08/08 | Checked/Date: PHT 10/08/08

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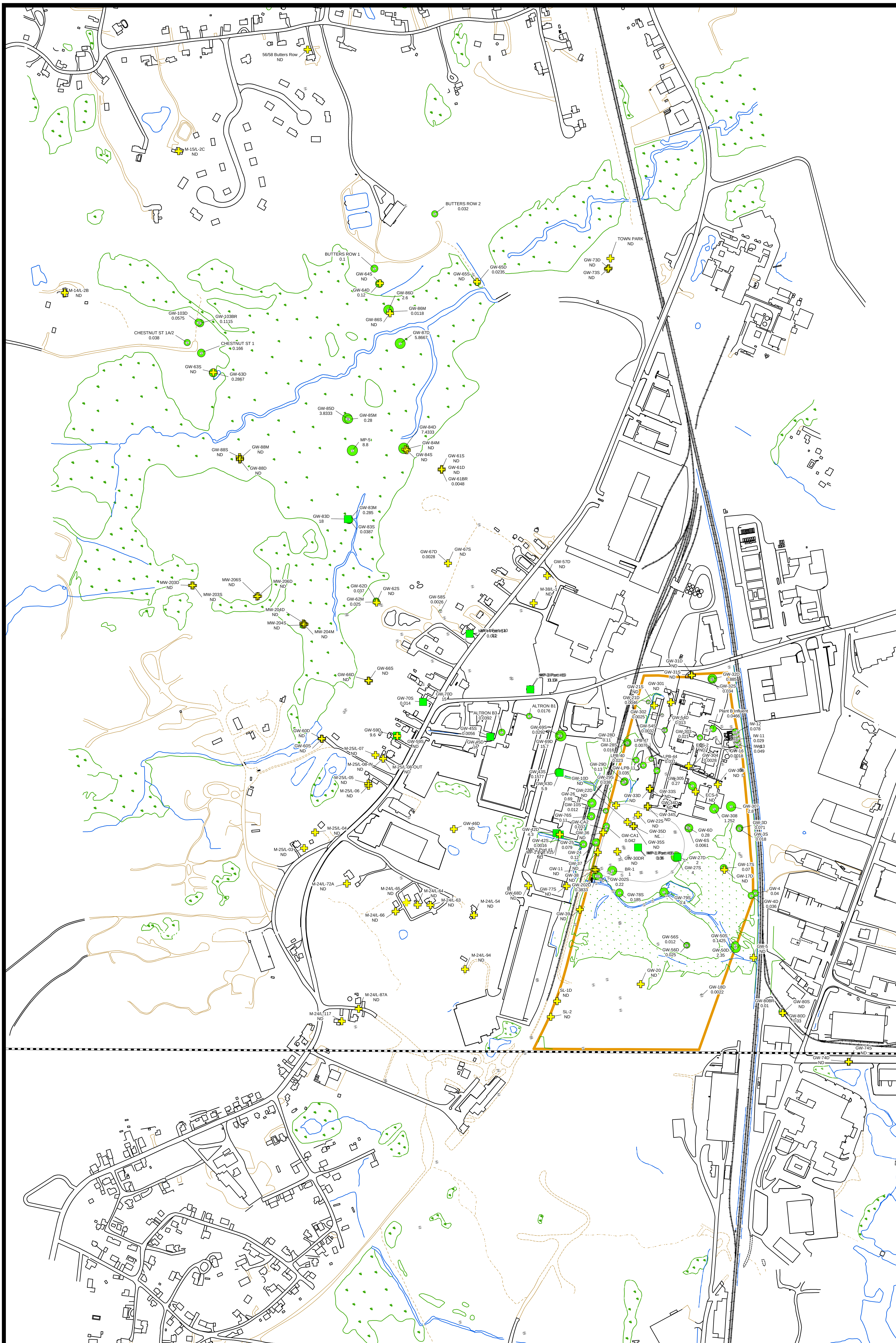

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (µg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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Figure 6.2-11
Distribution of N-Nitrosodimethylamine Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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Figure 6.2-12
Distribution of N-Nitrosodiphenylamine Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/03/08 | Checked/Date: PHT 10/03/08

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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Figure 6.2-13
Distribution of Bis-2-Ethylhexyl Phthalate Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

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0 275 550
Feet

Figure 6.2-14
Distribution of Phenol Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND) or is consistent with background
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

Filtered Chromium background = 0.0098 mg/L

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0 275 550 Feet

Figure 6.2-15
Distribution of Chromium Concentrations Filtered in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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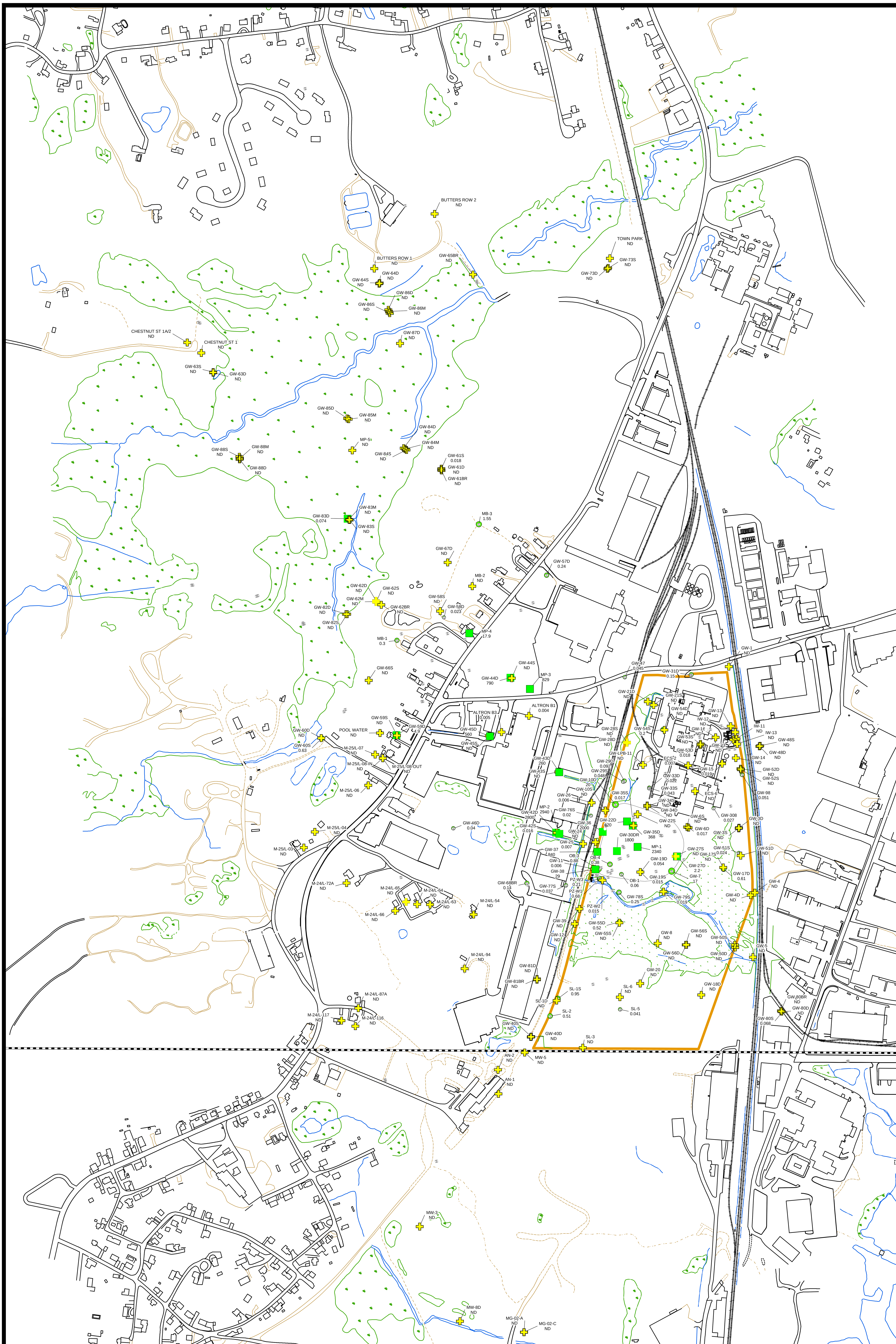

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND) or is consistent with background
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

Total Chromium background = 0.019 mg/L

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Feet

Figure 6.2-16
Distribution of Total Chromium Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/02/08 | Checked/Date: PHT 10/02/08

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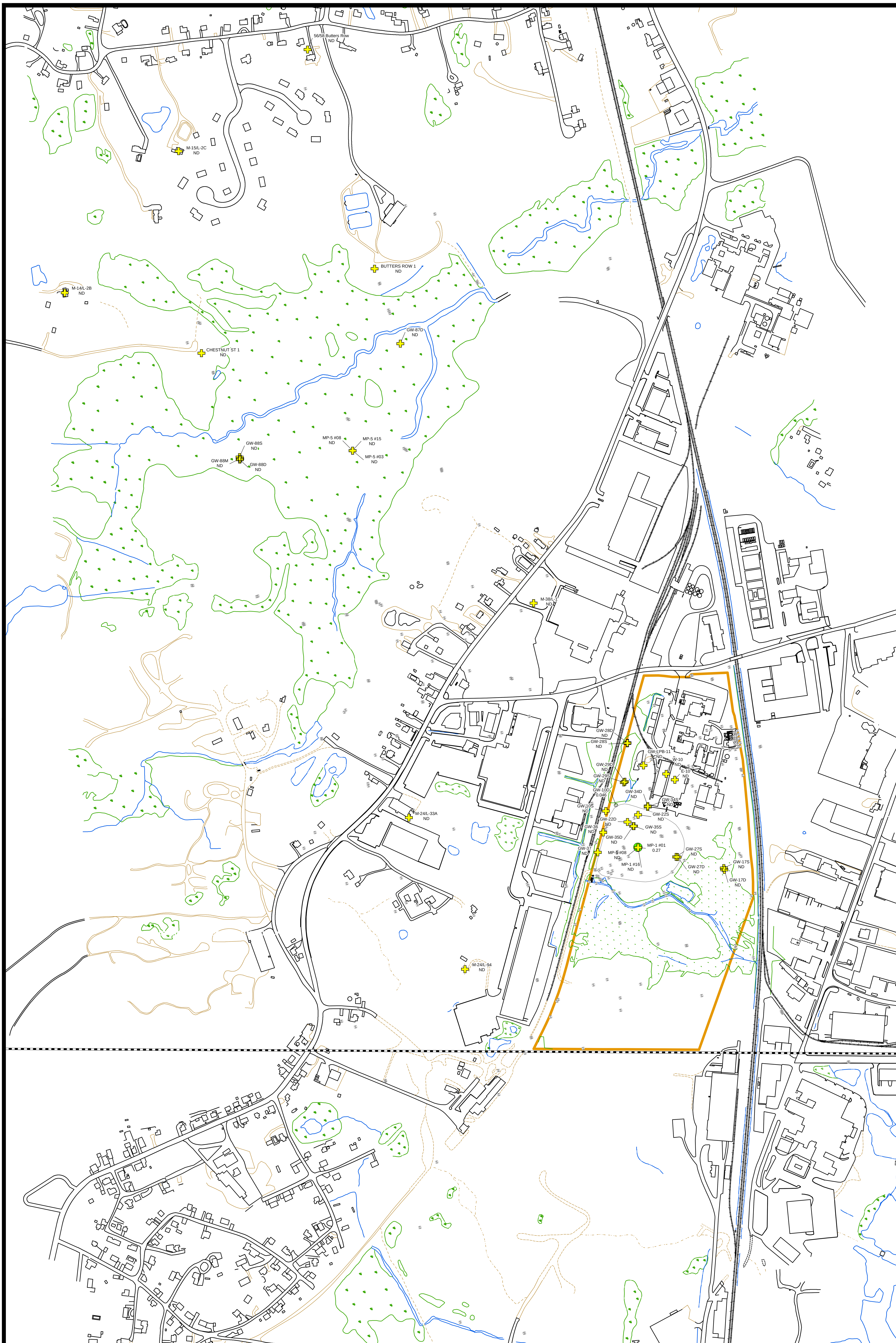

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells is proportional based on chemical concentration.

Data used are from Jan 1997 to present.
An arithmatic mean was calculated using half the detection limit for non detects
For those locations which have not been sampled after 1997, the latest sample result was used.

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0 275 550
Feet

Figure 6.2-17
Distribution of OPEX Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/03/08 | Checked/Date: PHT 10/03/08

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Legend

GW-201	Location ID
0.05	Analyte Concentration (mg/L)
	Analyte not detected (ND)
	Well is screened in DAPL
	GW Location Not Analyzed for Analyte

- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells is proportional based on chemical concentration.

Data used are from Jan 1997 to present. An arithmatic mean was calculated using half the detection limit for non detects For those locations which have not been sampled after 1997, the latest sample result was used.

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N
0 275 550 Feet

Figure 6.2-18
Distribution of Kempore Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/03/08 | Checked/Date: PHT 10/03/08

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- GW Location Not Analyzed for Analyte
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Trail

Notes:
Symbol size for wells is proportional based on chemical concentration.

Data used are from Jan 1997 to present. An arithmatic mean was calculated using half the detection limit for non detects For those locations which have not been sampled after 1997, the latest sample result was used.

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Feet

Figure 6.2-19
Distribution of Hydrazine Concentrations in Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/03/08 | Checked/Date: PHT 10/03/08

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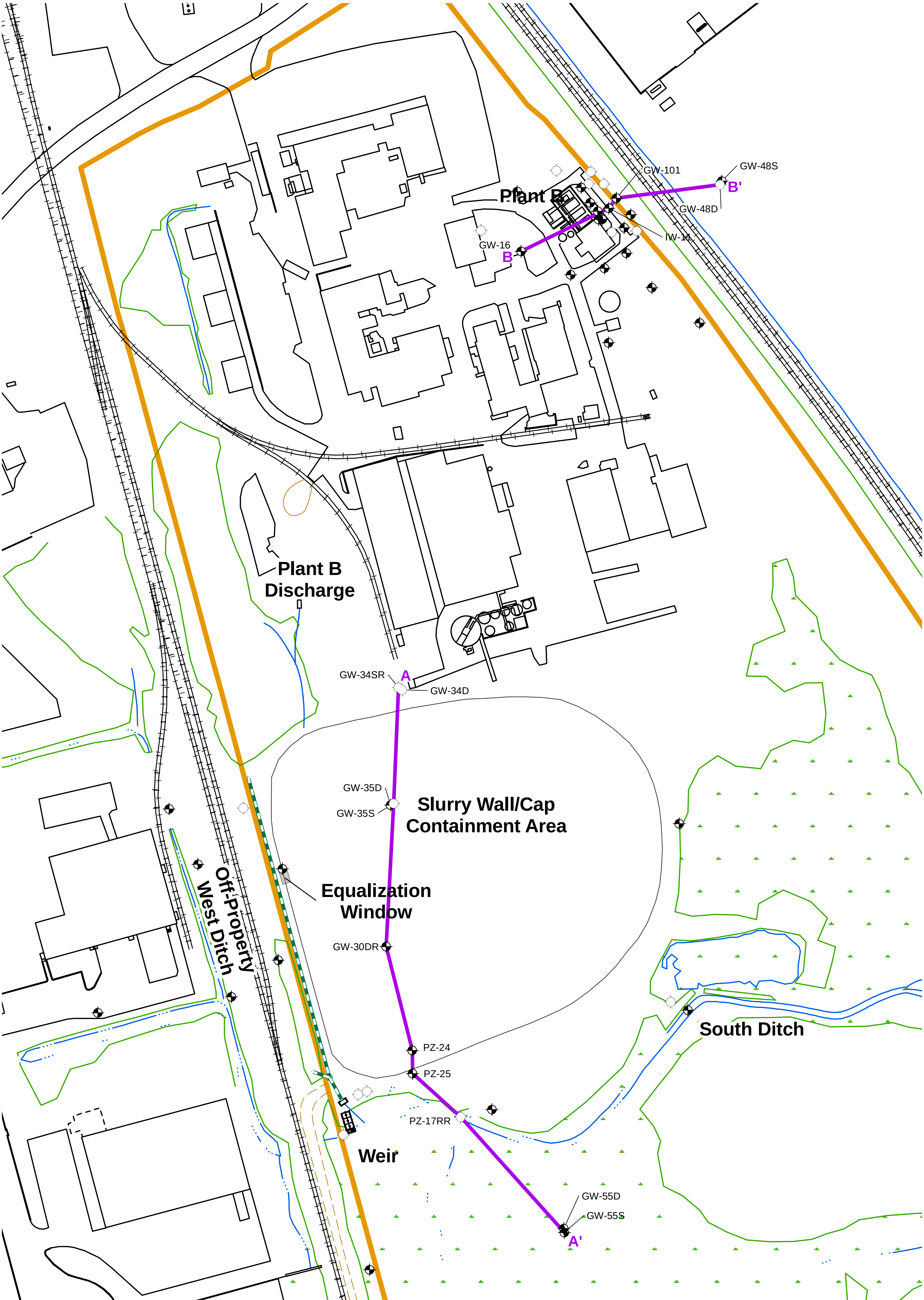

Legend

- Cross Section
- Monitoring Well
- Site Boundary
- Wetland Boundary
- Paved Road
- Unpaved Road
- Railroad
- Structure
- Water
- Culvert
- Trail

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N

0 60 120 240 Feet

Figure 6.2-20
Cross Section Locations Plant B / Slurry Wall
Temporary Cap Containment Area
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/08/08	Checked/Date: PHT 10/08/08

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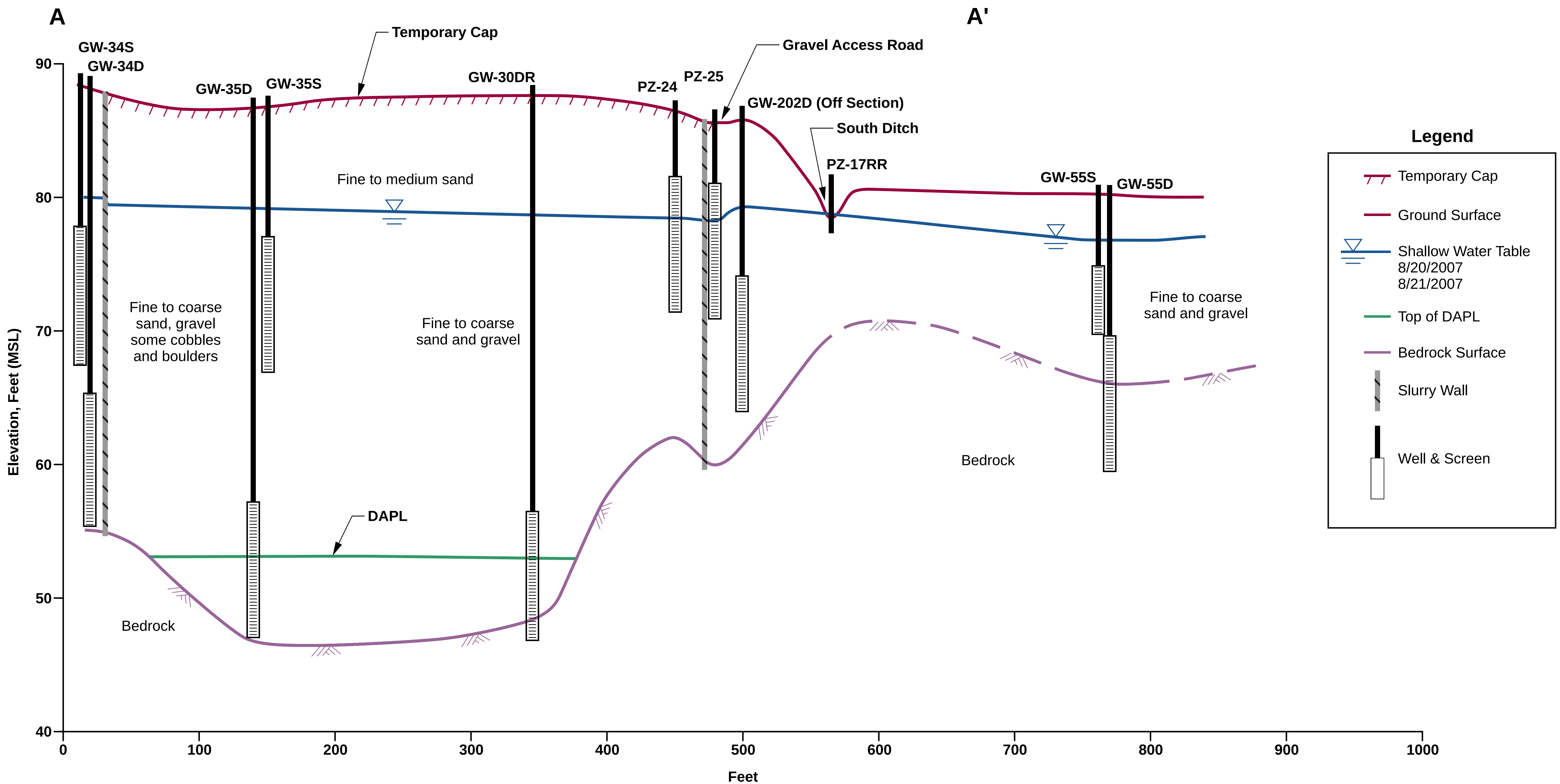

Prepared/Date: MRS 8/21/08
Checked/Date: PHT 8/21/08

October 2008 6100080016 Task 3	MACTEC	Cross Section Through Slurry Wall/Temporary Cap Containment Area Field Sampling Plan Olin Chemical Superfund Site Wilmington, Massachusetts Figure 6.2-21

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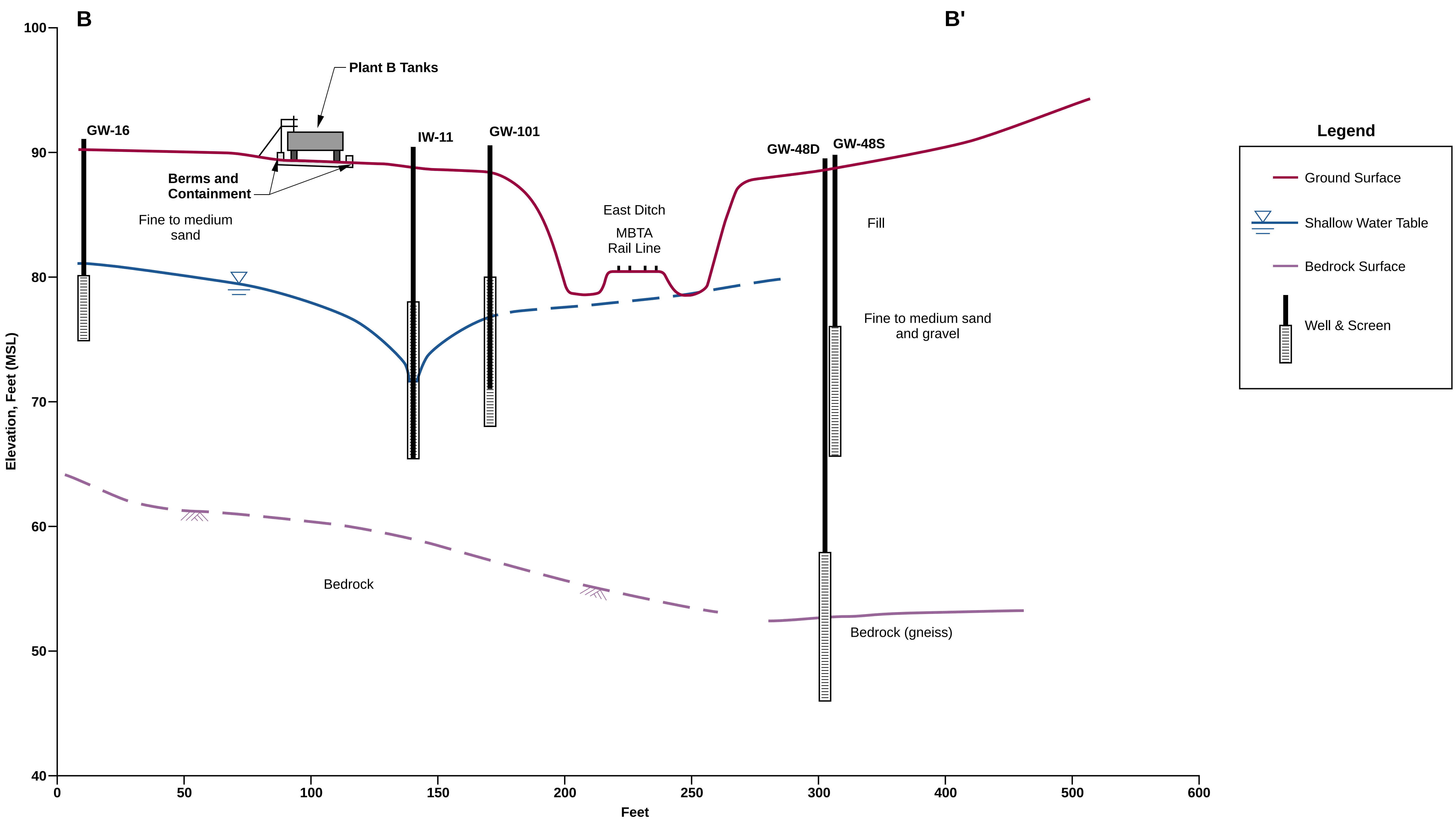

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6100080016 Task 3

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Cross Section Through Plant B Area
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Figure 6.2-22

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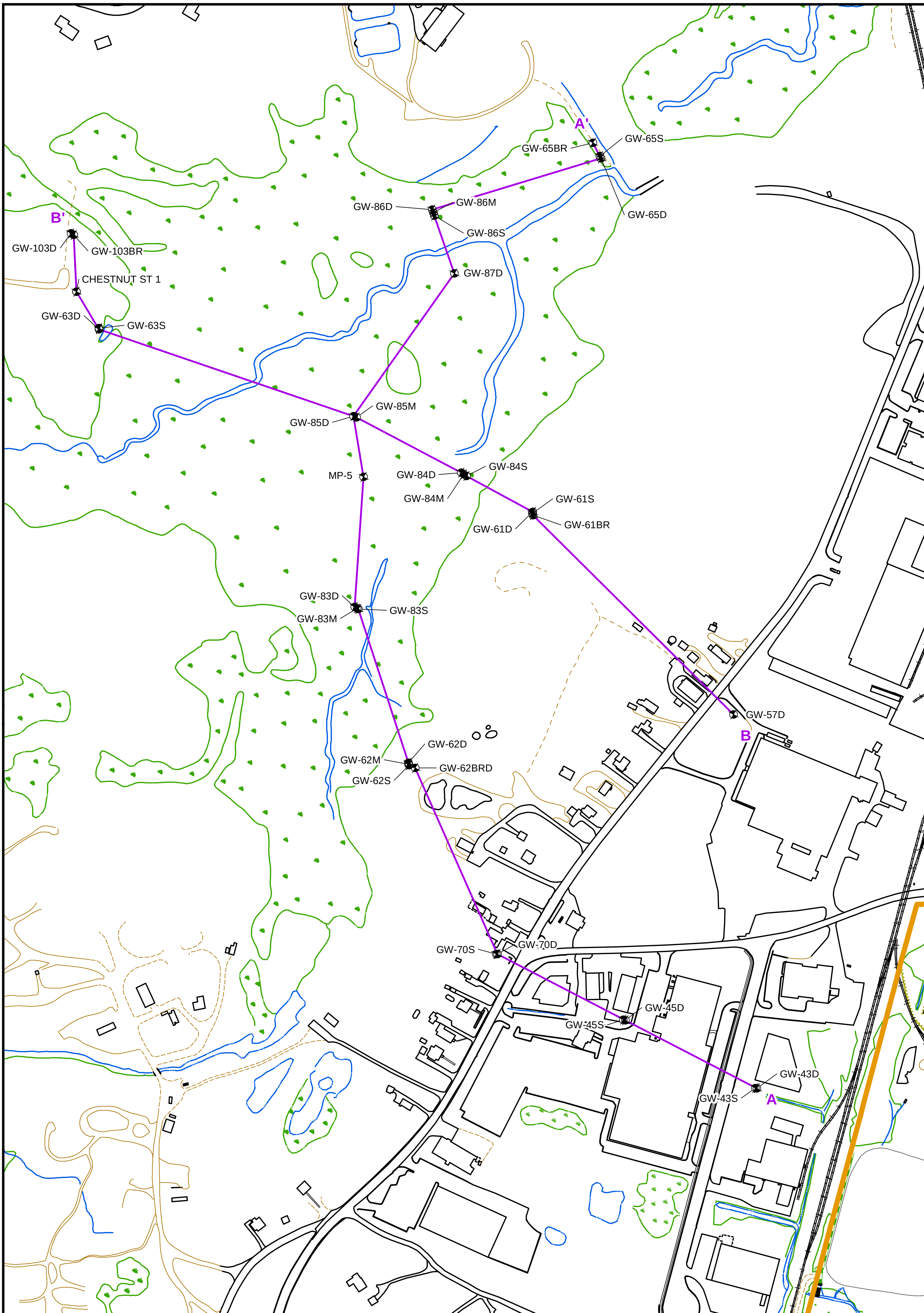

Legend

- Cross Section
- Monitoring Well
- Paved Road
- Unpaved Road
- Sidewalks
- Structures
- 51 Eames St. Property Boundary
- Surface Water
- Trails
- Wooded Areas
- Wetland Boundary
- Culvert

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N

0 150 300 600
Feet

Figure 6.2-23
Cross Section Locations
Maple Meadow Brook Area

Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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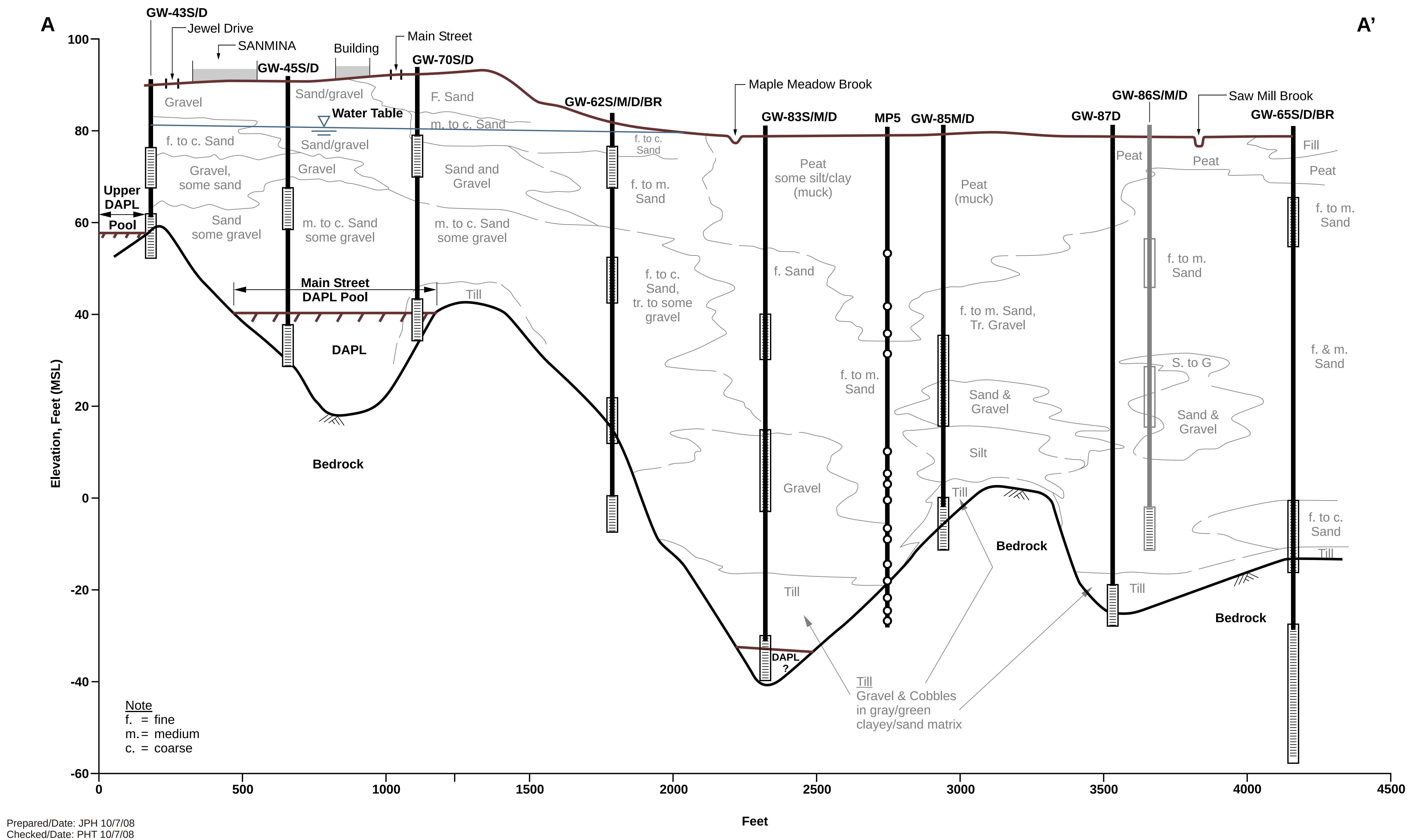

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6100080016 Task 3

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Surficial Geology Cross Section A - A'
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Figure 6.2-24

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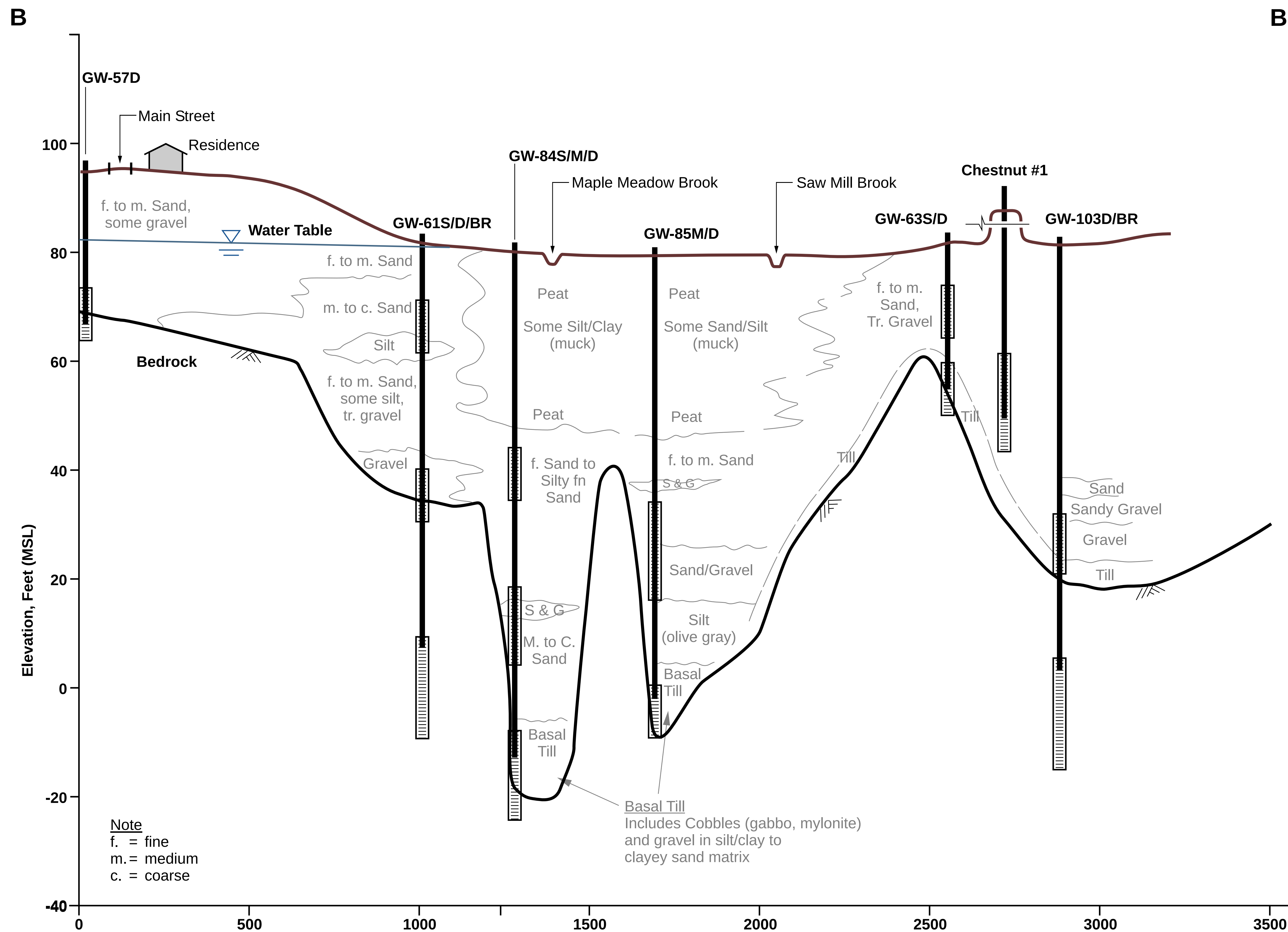

Prepared/Date: JPH 10/7/08
Checked/Date: PHT 10/7/08

October 2008 6100080016 Task 3	MACTEC	Surficial Geology Cross Section B - B' Field Sampling Plan Olin Chemical Superfund Site Wilmington, Massachusetts Figure 6.2-25

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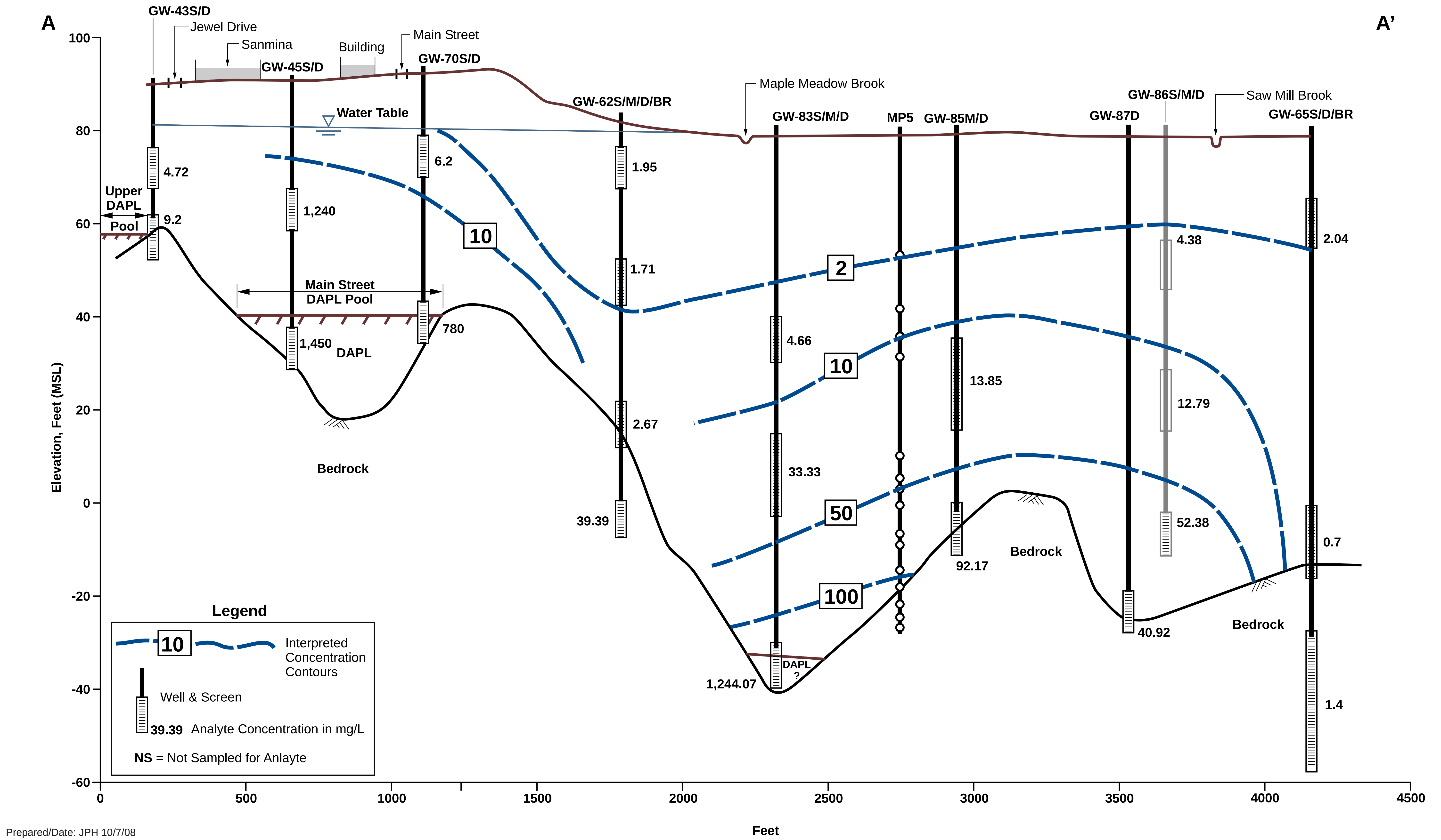

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October 2008 6100080016 Task 3	MACTEC	Ammonia Cross Section A - A’ Field Sampling Plan Olin Chemical Superfund Site Wilmington, Massachusetts Figure 6.2-26

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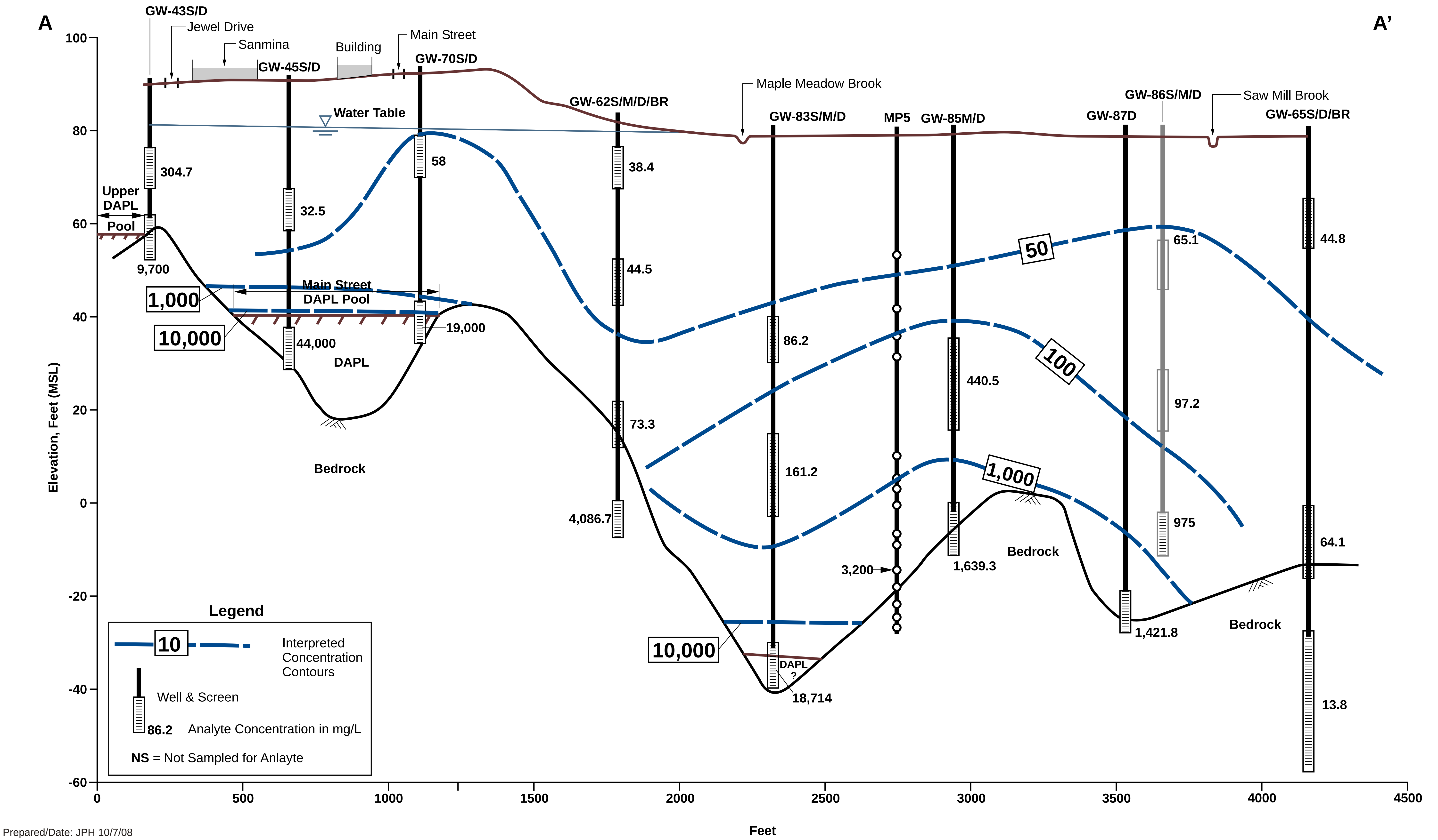

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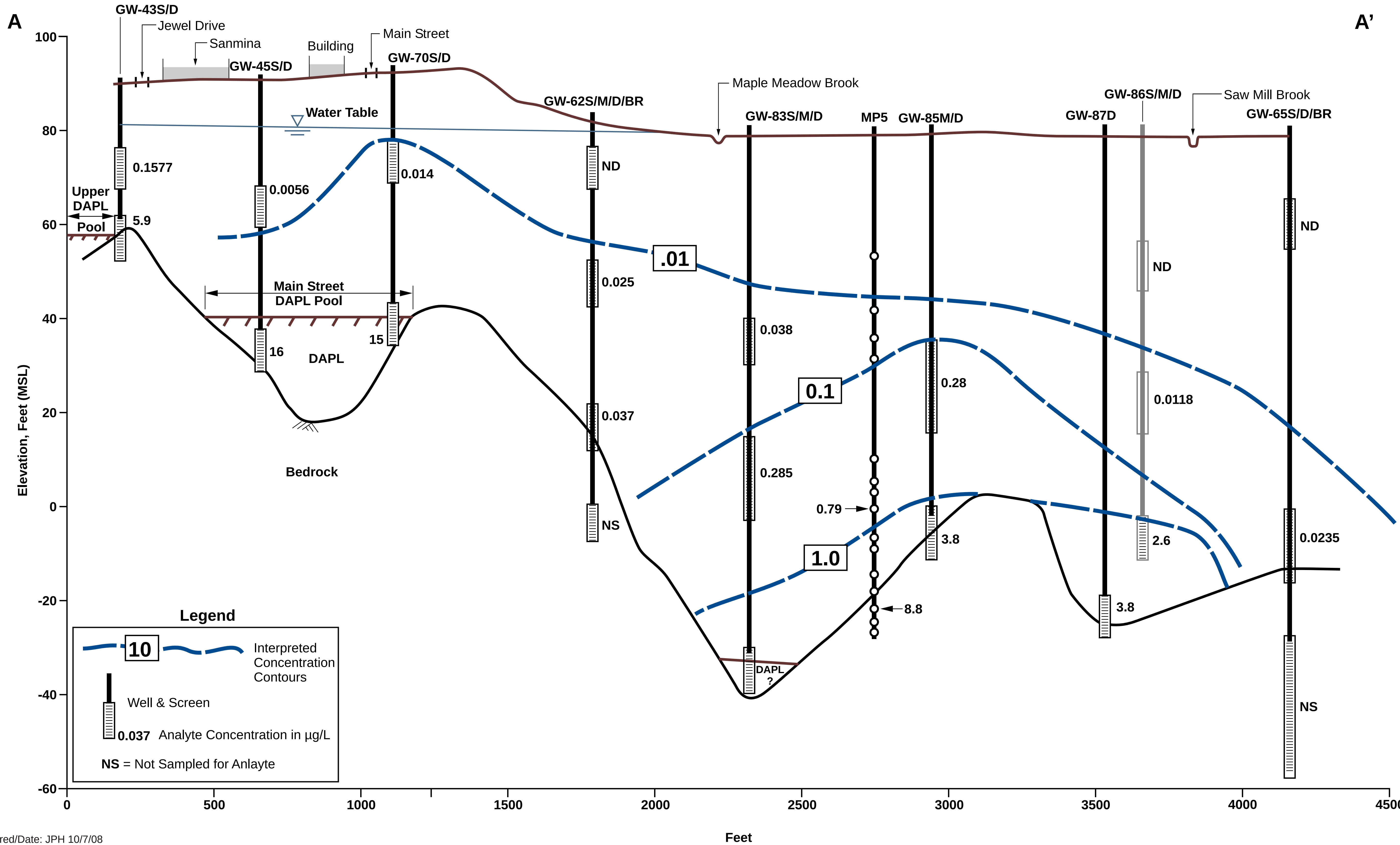
Sulfate Cross Section A - A’
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Figure 6.2-27

PORT2008017g.cdr



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October 2008
6100080016 Task 3

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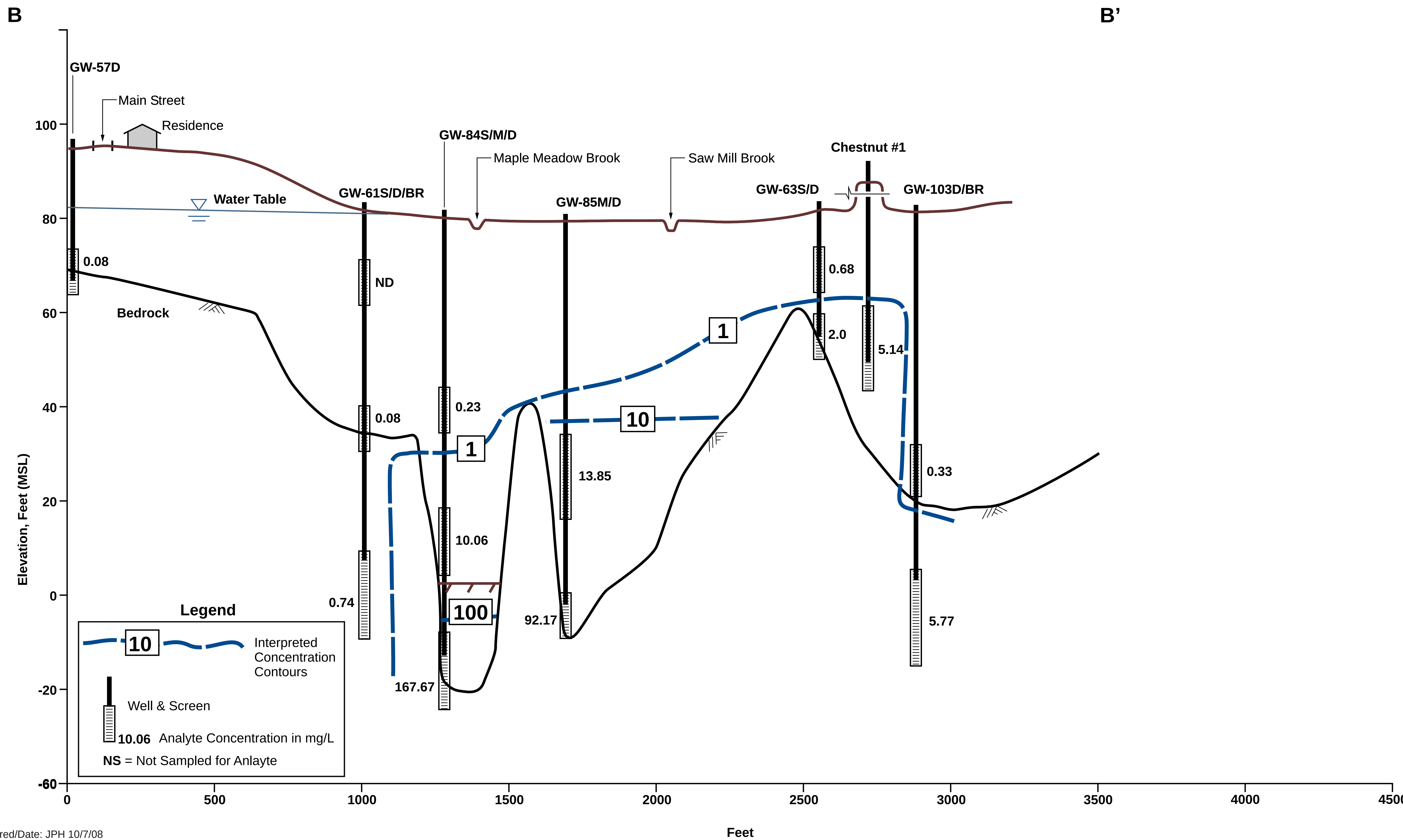
N-Nitrosodimethylamine Cross Section A - A'
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Figure 6.2-28

PORT2008017b.cdr



Prepared/Date: JPH 10/7/08
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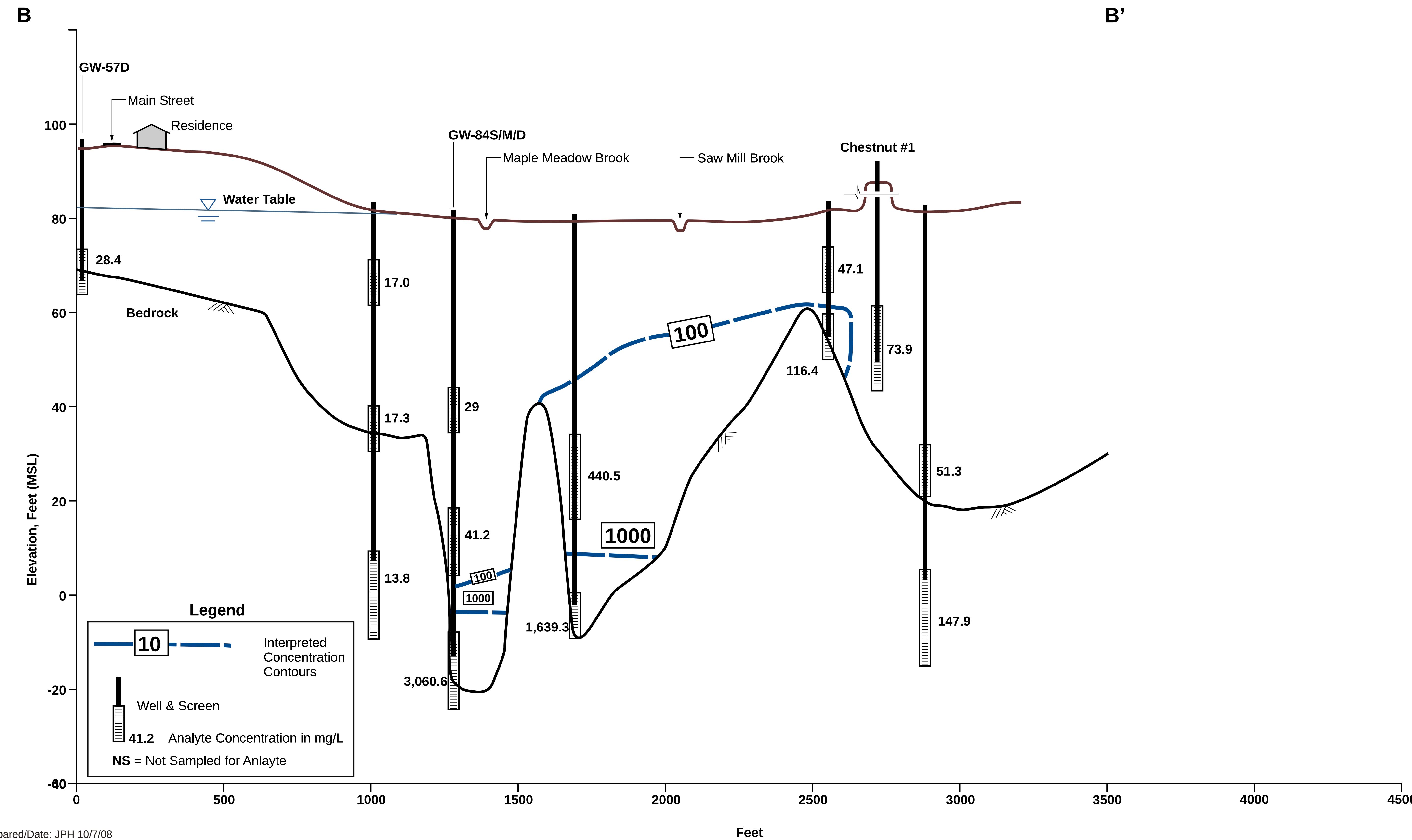
October 2008 6100080016 Task 3	MACTEC	Ammonia Cross Section B - B' Field Sampling Plan Olin Chemical Superfund Site Wilmington, Massachusetts Figure 6.2-29

PORT2008017d.cdr



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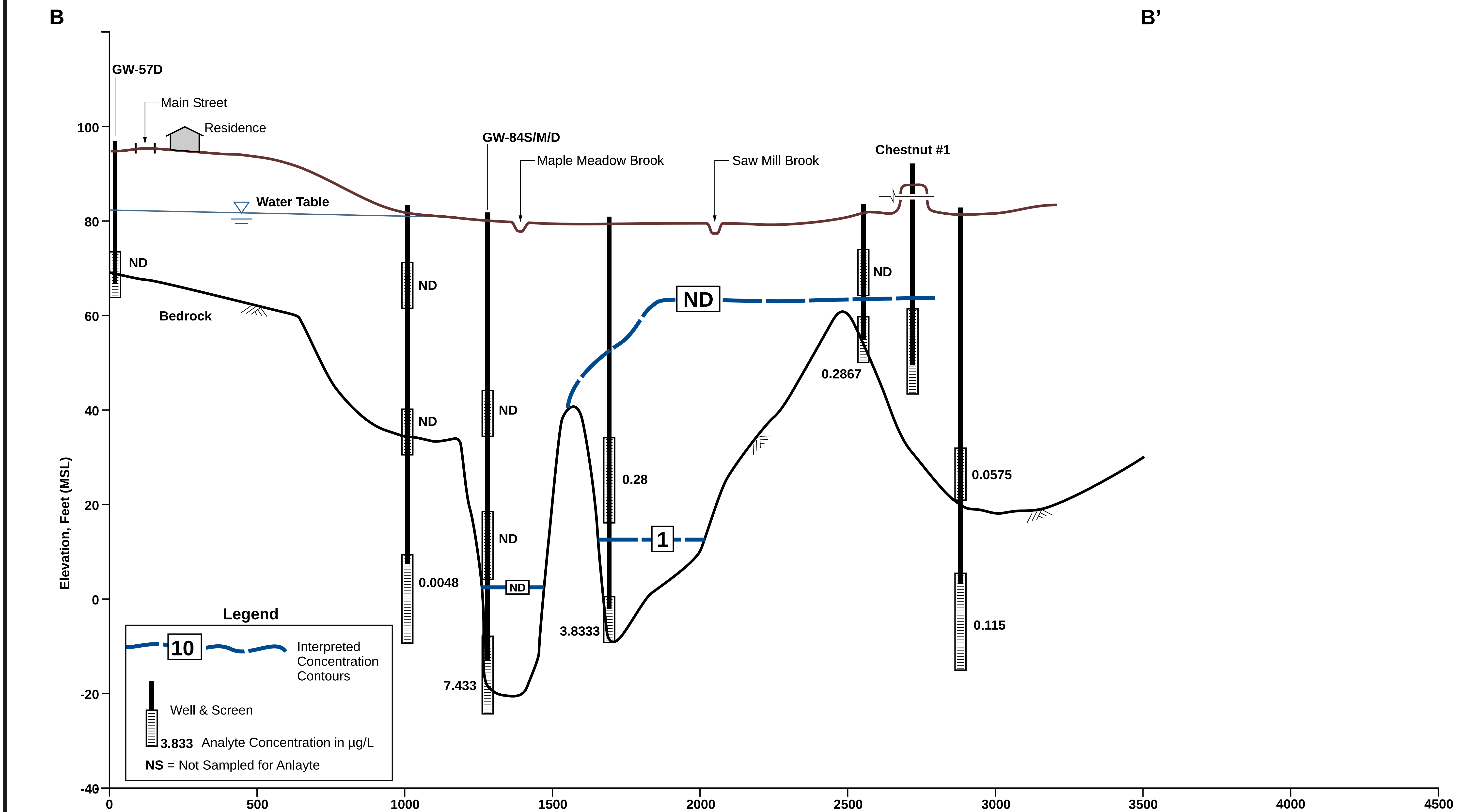
Sulfate Cross Section B - B'
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Figure 6.2-30

PORT2008017h.cdr



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October 2008 6100080016 Task 3	MACTEC	N-Nitrosodimethylamine Cross Section B - B' Field Sampling Plan Olin Chemical Superfund Site Wilmington, Massachusetts Figure 6.2-31

PORT2008017c.cdr

Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (µg/L)
- Analyte not detected (ND)
- Well is screened in DAPL
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Interpreted Chemical Concentration Contour
- Inferred Chemical Concentration Contour
- Interpreted Chemical Concentration Contour (0.01 ug/L)

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present. An arithmetic mean was calculated using half the detection limit for non detects. For those locations which have not been sampled after 1997, the latest sample result was used.

Massachusetts Drinking Water Guideline for NDMA = 0.01 ug/L.

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Figure 6.2-32
Interpreted Distribution of N-Nitrosodimethylamine in Deep Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08	Checked/Date: PHT 10/14/08

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Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

Massachusetts Drinking Water Guideline for NDMA = 0.01 ug/L.

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Figure 6.2-33
Interpreted Distribution of N-Nitrosodimethylamine in Shallow Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/14/08	Checked/Date: PHT 10/14/08

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND) or below 2006 USEPA Health Advisory (Life-time)
- Well is screened in DAPL
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Interpreted Chemical Concentration Contour

Notes:
Symbol size for wells not screened in DAPL is proportional based on chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects
For those locations which have not been sampled after 1997, the latest sample result was used.

Ammonia 2006 USEPA Health Advisory (Life-time) = 30 mg/L

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Figure 6.2-34
Interpreted Distribution of Ammonia in Deep Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/07/08	Checked/Date: PHT 10/07/08

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND) or below 2006 USEPA Health Advisory (Life-time)
- Well is screened in DAPL
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Interpreted Chemical Concentration Contour
- Inferred Chemical Concentration Contour

Notes:
Symbol size for wells not screened in DAPL is proportional based on chemical concentration.

Data used are from Jan 1997 to present. An arithmatic mean was calculated using half the detection limit for non detects For those locations which have not been sampled after 1997, the latest sample result was used.

Ammonia 2006 USEPA Health Advisory (Life-time) = 30 mg/L

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Figure 6.2-35
Interpreted Distribution of Ammonia in Shallow Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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Legend

- GW-201 Location ID
- 0.05 Analyte Concentration (mg/L)
- Analyte not detected (ND) or is consistent with background
- Well is screened in DAPL
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary
- Interpreted Chemical Concentration Contour

Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

Sulfate background = 48.76 mg/L

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Figure 6.2-36
Interpreted Distribution of Sulfate in Deep Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 10/07/08 | Checked/Date: PHT 10/07/08

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Notes:
Symbol size for wells not screened in DAPL is proportional based on log normal chemical concentration.

Data used are from Jan 1997 to present.
An arithmetic mean was calculated using half the detection limit for non detects.
For those locations which have not been sampled after 1997, the latest sample result was used.

Sulfate background = 48.76 mg/L

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Figure 6.2-37
Interpreted Distribution of Sulfate in Shallow Overburden Groundwater
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

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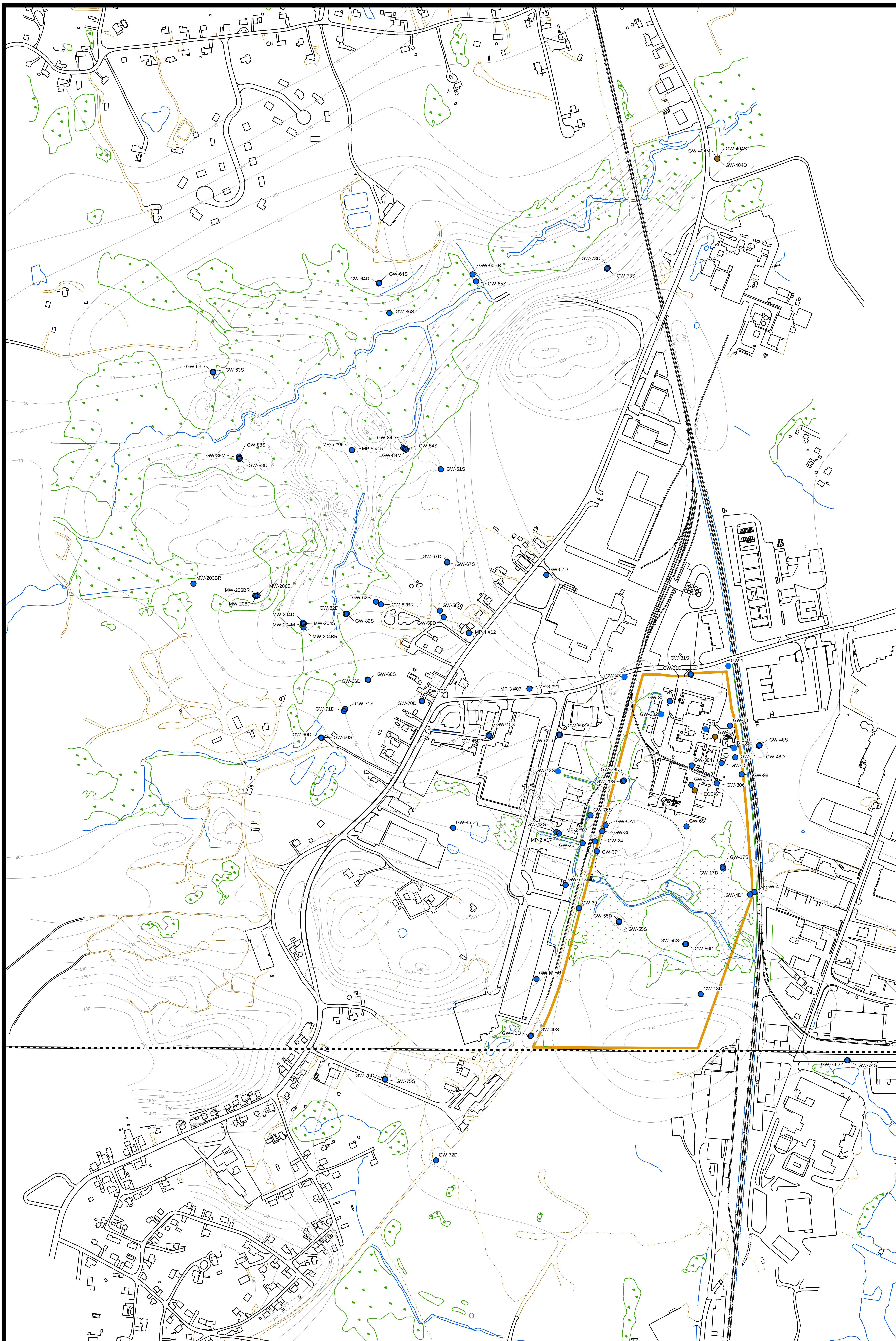

Legend

- Location with Standard Comprehensive Analysis and Low Level NDMA Analysis Proposed
- Other
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Bedrock Elevation Contour
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

Notes:
1. GW-16 has the following proposed analyses: Metals, NDMA, Inorganics,
2. ECS-2 will be sampled for PCBs only.
3. GW-404D, GW-404M, GW-404S will be installed if needed based on results from GW-400.

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Figure 6.2-38
Groundwater Locations with Standard Comprehensive Analysis and Low Level NDMA Proposed
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/23/09	Checked/Date: PHT 08/10/09

Legend

- Location with Standard Comprehensive Analysis and Additional Site-Specific Analysis Proposed
- Other
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Bedrock Elevation Contour
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

Notes:
1. GW-16 has the following proposed analyses: Metals, NDMA, Inorganics,
2. ECS-2 will be sampled for PCBs only.
3. GW-404D, GW-404M, GW-404S will be installed if needed based on results from GW-400.

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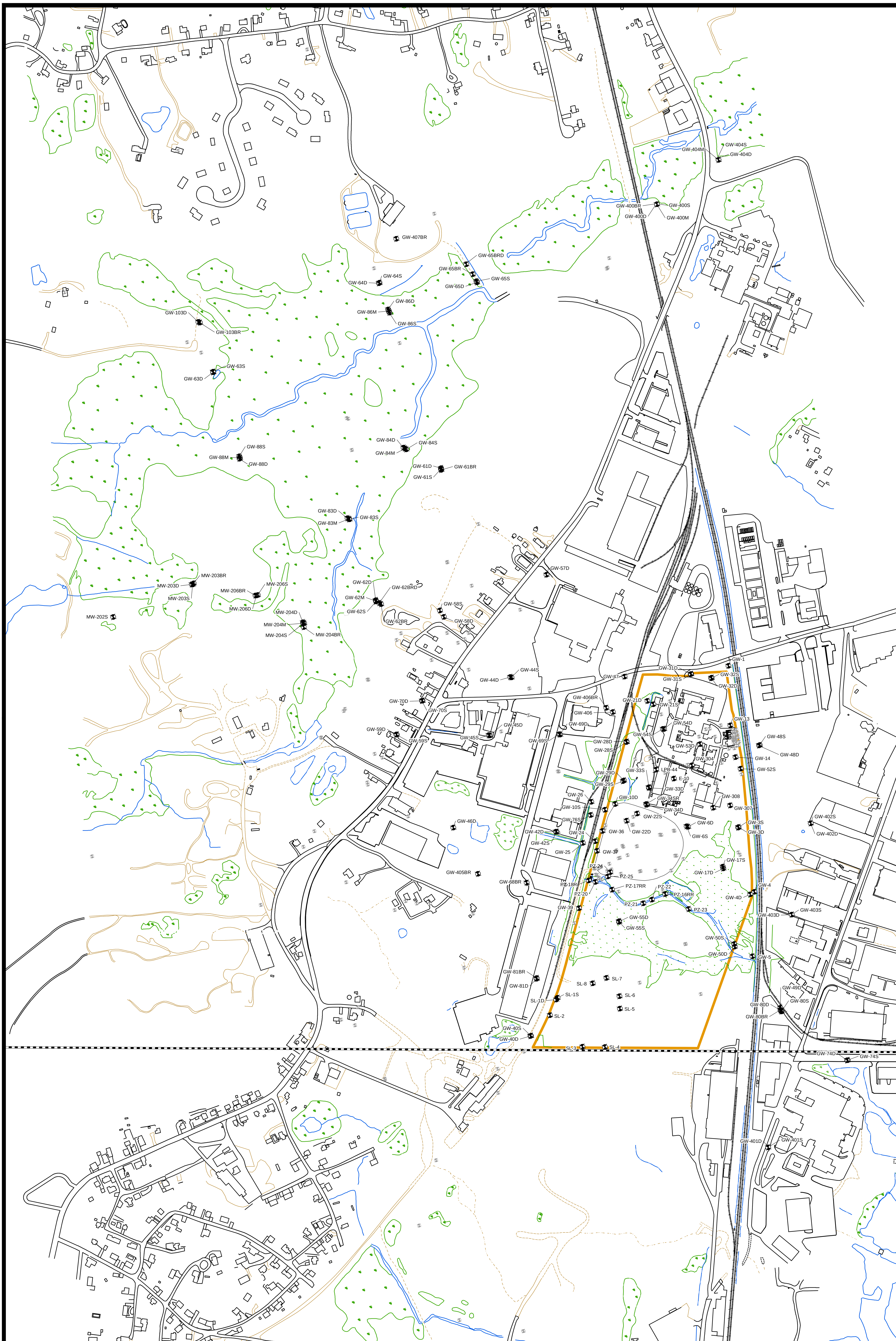
Figure 6.2-39
Groundwater Locations with Additional Site-Specific Analyses Proposed
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 07/23/09	Checked/Date: PHT 08/10/09



Legend

- Proposed Location for Synoptic Water Level Measurements
- Location Not Proposed for Synoptic Water Level Measurements
- Wilmington/Woburn Town Line
- 51 Eames St. Property Boundary
- Water
- Railroad
- Paved Road
- Unpaved Road
- Wetland Boundary

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Figure 6.3-1
Proposed Synoptic Water Level Measurements
Field Sampling Plan
Olin Chemical Superfund Site
Wilmington, Massachusetts

Prepared/Date: BJR 04/28/09	Checked/Date: PHT 04/28/09

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